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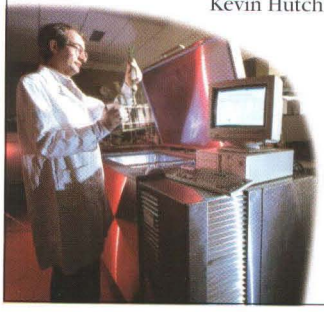

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The main activities of the Society include the organization of symposia, field meetings and study tours on forestry topics, and the publication of *Irish Forestry*, the Society's journal. The Society also organizes forestry shows and exhibitions and has published *The Forests of Ireland* and *Forest Images - Fr. Browne's Woodland Photographs.*

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Notification of Price Increase for Non-Membership Subscription. The non-membership subscription rate to *Irish Forestry* has remained unchanged since 1982. Commencing with Vol. 55, 1998, the annual subscription rate will increase to IR£25 per volume world-wide (incl. P&P). This increase is necessary due to the new colour format, increased costs of production and postage and our renewed objective to consistently produce two issues per year.

The Society of Irish Foresters is supported by the Forest Service, Department of the Marine and Natural Resources and the EU, under the Operational Programme for Agriculture, Rural Development and Forestry, 1994-1999.

Guidelines for Submissions

Authors are requested to observe the following guidelines when submitting material for publication in *Irish Forestry*.

- One complete copy must be submitted in typescript. Correct spelling, grammar and punctuation are expected. Nomenclature, symbols and abbreviations to follow established conventions, with the metric system used throughout.
- A computer disc containing text must be submitted. If applicable, a second disc containing computer generated tables, graphs and illustrations is also required. In both cases, clearly indicate the editing package used.
- Authors submitting scientific papers are requested to indicate whether they wish their material to be subjected to peer review. Papers submitted for peer review should include an abstract (max. 150 words) and a list of up to six key words before the main body of text. For general papers, a summary (max. 250 words) is required.
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  Gallagher, G. and Gillespie, J. 1984. The economics of peatland afforestation. *In:* Proc. 7th Int. Peat Conf. Dublin. Vol. 3:271-285.
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  Forestry Abstracts may be used as a guide in the abbreviation of journal titles.
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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

Since its first appearance in 1943, *Irish Forestry* has endeavoured to bring to the attention of foresters in Ireland information on the latest research findings, innovations and developments in all aspects of forestry and the wood chain. Throughout this time, each editor has in turn strived to ensure the quality and academic merit of material appearing in the journal, and this attention to detail quickly elevated *Irish Forestry* to its current status as the mouthpiece for forestry research in Ireland. Readers of this issue will notice the introduction of a section containing four peer reviewed papers. As the title suggests, these papers have been reviewed for scientific content and merit by leading authorities in the relevant fields, in addition to the normal editing and proofing undertaken by the editor, supporting Editorial Committee and original author. While referees for individual papers will remain confidential, a list of acting referees will appear in the journal over coming issues, as the number of peer reviewed papers increases. On behalf the Society, the current editor wishes to thank referees, both in Ireland and abroad, for their efforts in reviewing papers contained within this issue, and for their advice and assistance in setting down criteria and conventions for the future working of the peer review system. Establishing and maintaining such a system in *Irish Forestry* will add to the task of future editors and contributors. As originally intended, this system will, however, guarantee the relevance and consistent quality of original research material appearing in the journal, and represents a major development in the history of the publication. The introduction of a peer review system can only serve to reinforce the role of *Irish Forestry* as the leading research publication on forestry in Ireland, raising it to a level comparable with leading forestry journals elsewhere around the world.

From its early days, *Irish Forestry* has also acted as a permanent record of Society events and activities, publishing symposium papers, tour reports and annual lectures. The effectiveness, however, of the journal as a medium for communicating upcoming events and day-to-day issues relevant to members is hampered by the considerable time involved in preparing each issue. Members will be aware of a general review over recent months of the Society, its events, activities and future direction. As part of this review, and in line with the rapidly changing nature of our industry and requirements of the members, the Society has identified the need to supplement the role of *Irish Forestry* with a newsletter specifically aimed at communicating more 'news and people' type items. By now, members will have received the first issue of the Society's new quarterly newsletter, *The Irish Forester*, and will be familiar with its contents. Its particular function is to communicate the work of the Council, as well as to carry news about members, Society events and activities, new publications and general items of interest. The newsletter will strongly complement the role of *Irish Forestry*, providing a flexible medium which can react to developments occurring during the preparation period of each issue of the journal. The success of *The Irish Forester* is very dependent on Society members. To this end, the Council would strongly welcome any comments and feedback regarding the newsletter's first issue, and items for inclusion in future issues.

Both developments will provide the solid basis for effective communication and the dissemination of high quality research material, underlining the Society's commitment to serving the needs of its members as Irish forestry enters the 21st century.

Submissions to *Irish Forestry* are welcome and will be considered for publication. The attention of contributors is drawn to "Guidelines for Submissions". Submissions to be addressed to:

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Peer reviewed paper

Long term response of Sitka spruce (*Picea sitchensis* (Bong.) Carr.) to fertilisers on low level blanket peat in the west of Ireland

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Abstract

A nitrogen and phosphorus experiment on Sitka spruce (*Picea sitchensis* (Bong.) Carr.), which ran from 1967 to 1982, was reopened in 1992. Half of the original experimental plots were left untreated, and the other half received lime and further applications of nitrogen and phosphorus in factorial combination. Levels of foliar nitrogen and phosphorus have fallen since 1979, with nitrogen now deficient throughout. Despite this, the effect of applied nitrogen and phosphorus on their respective foliar concentrations is still in evidence. Foliar concentrations of other nutrients, except sulphur, are adequate. The decline in the foliar concentration of nitrogen and phosphorus, coupled with estimates of top height, suggests that the lime has failed to achieve its long term objective of stimulating growth.

Key words: peatland forests, Sitka spruce, fertilisers

Introduction

In the first decades of blanket peatland forestry, there was a great deal of uncertainty about the fertiliser requirements of the two species in general use, Sitka spruce (*Picea sitchensis* (Bong.) Carr.) and lodgepole pine (*Pinus contorta* Dougl.). Many experiments were established to investigate their response to various fertiliser materials, in particular, phosphorus and nitrogen (OCarroll, 1967, 1972; Dickson, 1965, 1969; O'Hare, 1967). The experiment reported here was installed in a 6-year old Sitka spruce stand at Glenamoy in 1967. It was continued until 1982 and involved, in addition to a straightforward fertiliser trial (Farrell and McAleese, 1972; Farrell, 1985a), a range of studies on water relations (Farrell and O'Hare, 1974; Farrell, 1985b), peat shrinkage (Farrell, 1985b) and nitrogen transformations (Farrell, 1985b). Following an inspection in Autumn 1992, it was decided to conduct some limited studies to determine whether the experiment, 25 years after its establishment, could yield useful information on long term effects. The results of these studies are reported here.

Experimental design

The experiment was located in a Sitka spruce crop on low level blanket peat at Glenamoy Forest, north-west Co. Mayo. The climate of the area is extreme maritime, with an annual rainfall averaging 1,400 mm and distributed over 270 days. Wind is very severe, with gales in almost every month (Farrell, 1985a). The natural flora is dominated by the

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Schoenus nigricans L. association (O'Hare, 1959). The top 50 cm of peat has an ash content of 2.5% and a humification of 5 to 6 on the Von Post scale (Walsh and Barry, 1958). Bulk density is approximately 0.09 g/cm^3 in the 0-5 cm layer, and 0.10 g/cm^3 at 5-10 cm. Saturated hydraulic conductivity is approximately 1 cm/day (Burke, 1967).

Establishment procedures described by Farrell and McAleese (1972) included a spot application of 85 g (3 oz) of ground rock phosphate.

The fertilisation experiment was established in 1967 (Farrell and McAleese, 1972), comprising 48 x 0.03 ha plots. A randomised block design was employed with three levels of sulphate of ammonia and four levels of ground rock phosphate in factorial combination replicated four times, i.e. four blocks of 12 plots each. All fertilisers were applied broadcast, without incorporation, in April 1967. Some plots received a further application of nitrogen in 1969 (Table 1). Measurements were initially made in the centre of each plot inside a buffer strip two rows in width. From 1972 onwards, assessment was confined to the 16 trees closest to the plot centres, due to concern regarding the spread of fertiliser effects between plots. In 1976, trenches were dug between plots to prevent the further spread of such effects.

The original experiment was divided in two in Spring 1977. Blocks 3 and 4 received no further treatments (Experiment 1). Blocks 1 and 2 (Experiment 2) received an application of 8 t/ha of ground limestone, in addition to further applications of nitrogen and phosphorus (Table 1).

Water table studies have also been carried out in the experiment. In August 1969, a 7.0 cm x 1.6 m slotted pipe was installed in the centre of each plot according to the method described by O'Hare (1972). Depth to water table was measured during two periods, at weekly intervals between October 1969 and October 1970, and at weekly intervals between May 1981 and June 1983.

Systematic thinning, involving the removal of one line in three, was carried out in early summer 1982. As a result, some of the 16 designated trees at the centre of each plot were removed.

Table 1. *Summary of treatments applied in Experiment 1 and Experiment 2 (kg nutrient/ha). All treatments were applied in springtime. From Farrell (1985a).*

Year	N_0	N_1	N_2	P_0	P_1	P_2	P_3
1967[1,2]	0	132	264	0	55	110	220
1969	0	132	0	0	0	0	0
			Experiment 1				
1977-79			No further treatments applied				
			Experiment 2				
1977[3,4]	0	75	75	0	35	70	105
1978	0	0	75	0	0	0	0
1979	0	0	75	0	0	0	0

[1]N applied as sulphate of ammonia; P as ground rock phosphate.
[2]Sulphate of potash (42% K) was applied to all plots at 125 kg/ha and copper sulphate (25% Cu) at 11 kg/ha.
[3]N applied as calcium ammonium nitrate; P as superphosphate.
[4]All plots limed at 8 t ground limestone/ha.

Methods

Foliar analysis

In November 1992, foliar samples were collected from the lower live crowns of six trees at the centre of each plot in Block 1 (Experiment 2) and Block 3 (Experiment 1). In the laboratory, 1-year old needles were removed from the lateral branches of the samples. Each sample was then oven dried at 70°C for 48 hours. Following this, they were ground and placed in airtight plastic bags.

Nitrogen content was determined by digesting 0.2 g of oven dry material in H_2SO_4 (conc.) and selenium, followed by standard distillation and titration with 0.01N HCl. Phosphorus, K, Ca, Mg, S, Mn and Cu were calculated by Inductively Coupled Plasma Emission Spectrometry (Varian, Liberty 200) following $HNO_3/HClO_3$ digestion of 1.0 g of oven dry material.

Top height

Tree height measurements were made in April 1993, using a Blume-Leiss hypsometer. The average height of the two trees of largest diameter at breast height in a circular plot of 5.0 m radius at the centre of each plot was taken as an estimate of top height (Edwards and Christie, 1981).

Results

Growth response to treatment

Experiment 1

Local waterlogging and windthrow within Block 4 gave rise to anomalies in height values. Results for individual treatments were inconsistent with those in the other three blocks. Consequently, data from this block were excluded from further consideration.

In the early years of the experiment, phosphorus had a large effect on height growth, increasing it by 67% over the control in the 1967-72 period (Farrell, 1985a). It was not appropriate to apply statistical analysis to the most recent data and the results must therefore be treated with caution. They do, however, suggest a residual influence of nitrogen and phosphorus on top height (Table 2). They also suggest that the effect of nitrogen is now more pronounced than in the early years of the experiment, whereas the effect of phosphorus is less than on previous occasions.

Table 2. *Mean top height (TH) and general yield class (GYC) in Experiment 1. General yield class is taken from top height age curves in Edwards and Christie (1981). Figures for 1972, 1975 and 1979 taken from Farrell (1985a).*

Year	*1972*		*1975*		*1979*		*1993*	
Age	*11*		*14*		*18*		*32*	
Main Effect	*TH (m)*	*GYC*	*TH (m)*	*GYC*	*TH (m)*	*GYC*	*TH (m)*	*GYC*
N_0	4.6	18	5.7	16	7.6	14	14.4	14
N_1	5.1	20	6.3	16	8.3	16	16.5	16
N_2	4.9	18	6.6	18	8.9	16	17.5	16
P_0	3.7	14	5.1	14	6.8	12	15.2	14
P_1	5.5	18	6.5	18	8.5	16	15.9	16
P_2	5.3	18	6.7	18	9.8	18	16.7	16
P_3	5.0	18	6.7	18	8.8	16	16.8	16

General yield class, which declined progressively from 1972 to 1979, has apparently stabilised at 16 over all levels of applied nitrogen and phosphorus (Table 3).

Table 3. *Mean top height (TH) and general yield class (GYC) for Experiment 1 and Experiment 2 in 1993.*

	Experiment 1		*Experiment 2*	
Main Effect	*TH (m)*	*GYC*	*TH (m)*	*GYC*
N_0	14.4	14	15.2	14
N_1	16.5	16	16.7	16
N_2	17.5	16	16.2	16
P_0	15.2	14	16.0	16
P_1	15.9	16	16.3	16
P_2	16.7	16	16.5	16
P_3	16.8	16	15.6	14

Experiment 2

Farrell (1985a) observed the following responses to fertilisation in Experiment 2. Height increment in the 1976-79 period was significantly increased by phosphate in conjunction with lime. A significant effect of nitrogen on basal area was also recorded. Basal area increment in the 1976-81 period showed a 63% increase in the phosphate-treated plots over the P_0 treatment. The effect of nitrogen was smaller, with a 28% increase in basal area over the 1976-81 period. There is some evidence that the response to phosphate was beginning to fall off as it was less in the 1980-81 period than in 1976-79. This is probably true as examination of top height for each main effect mean (Table 3) shows that height increment may be increased by nitrogen and is no longer increased by phosphate.

Comparison of Experiment 1 and Experiment 2

Despite the stimulation produced by the fertiliser treatments in Experiment 2, top height increment over all the plots in this experiment was significantly less than that in Experiment 1 in the 1976-79 seasons (Farrell, 1985a). It was hoped that the lime would have the ultimate effect of stimulating microbial activity, with a consequent increase in the mineralisation of nitrogen and phosphorus (Farrell, 1985a). Instead, it has probably caused a decrease in mineralisation. Comparisons of the top height and general yield class data for Experiment 1 and Experiment 2 in 1993 (Table 3) show no major differences. This indicates that the crop is no bigger as a result of the treatments applied in 1977, and that the lime has failed to stimulate growth.

Nutrient status

In the early years of the experiment, it was found that maximum or near maximum growth responses can be obtained on this site at relatively low concentrations of foliar nitrogen, with both fertilisers producing increases in foliar nitrogen and phosphorus (Farrell and McAleese, 1972). This response of foliar phosphorus to the fertiliser application in 1967 gradually declined, but in 1979, the response of foliar phosphorus and magnesium to applied phosphate was still in evidence (Farrell, 1985a).

In Experiment 2, both fertilisers produced an increase in foliar nitrogen and phosphorus. In Experiment 1, however, where no treatments were applied in 1977, levels of foliar nitrogen also increased in the period 1976-79 (Farrell, 1985a). Liming produced an

Table 4. *Mean nutrient concentration (% DM) for Block 1 (Experiment 2) and Block 3 (Experiment 1).*

	Nutrient Concentration (% DM)															
	N		*P*		*K*		*Ca*		*Mg*		*S*		*Mn*		*Cu*	
Main Effect	*Block 1*	*Block 3*	*Block 1*	*Block 3*	*Block 1*	*Block 3*	*Block 1*	*Block 3*	*Block 1*	*Block 3*	*Block 1*	*Block 3*	*Block 1*	*Block 3*	*Block 1*	*Block 3*
N_0	0.874	0.706	0.173	0.110	0.983	0.755	0.819	0.279	0.128	0.108	0.108	0.086	0.006	0.004	0.0009	0.0009
N_1	0.935	0.962	0.189	0.155	0.995	0.878	0.340	0.337	0.099	0.138	0.095	0.075	0.004	0.021	0.0004	0.0003
N_2	0.934	0.956	0.148	0.150	0.608	0.857	0.362	0.351	0.114	0.131	0.085	0.093	0.007	0.006	0.0002	0.0003
P_0	1.010	0.944	0.105	0.103	0.806	0.793	0.942	0.353	0.104	0.122	0.100	0.087	0.009	0.010	0.0004	0.0003
P_1	0.812	0.858	0.189	0.145	0.893	0.904	0.391	0.260	0.120	0.138	0.085	0.101	0.005	0.007	0.0005	0.0009
P_2	0.898	0.795	0.200	0.149	0.999	0.828	0.300	0.303	0.115	0.129	0.091	0.081	0.004	0.005	0.0003	0.0004
P_3	0.936	0.902	0.187	0.155	0.750	0.795	0.395	0.373	0.116	0.114	0.107	0.069	0.006	0.020	0.0007	0.0005

increase in foliar calcium, with no other significant differences being recorded in foliar nutrients between experiments (Farrell, 1985a).

Foliar nitrogen levels have fallen considerably since 1979 (Farrell, 1985a) and are now below the level of 1.0% DM which is considered to be adequate for this site (Farrell and McAleese, 1972). Qualitative analysis of the main effect means shows that the effect of applied nitrogen on foliar nitrogen concentrations is still in evidence (Table 4).

Watts (1983) considered a foliar concentration 0.15% DM to be adequate for phosphorus in evergreen conifers. Following this, it can be seen that Experiment 2 has an adequate level of phosphorus and Experiment 1 a moderately deficient level (Table 5), although individual treatments may be deficient. Levels of phosphorus have not fallen as rapidly since 1979 as those of nitrogen (Farrell 1985a), but will probably continue to do so over time. Despite this, the effect of applied phosphorus on foliar phosphorus concentrations can still be seen (Table 5).

Further evidence of the failure of the lime to increase mineralisation is provided by the decline in the foliar concentration of nitrogen and phosphorus since 1979. Of the other nutrients (Table 5), potassium, calcium, magnesium, manganese and copper are adequate and sulphur is deficient when compared to the ranges given by Watts (1983).

Table 5. *Mean foliar nutrient concentrations for Block 1 (Experiment 2) and Block 3 (Experiment 1) (% DM).*

	N	*P*	*K*	*Ca*	*Mg*	*S*	*Mn*	*Cu*
Block 1	0.914	0.170	0.862	0.507	0.114	0.096	0.006	0.005
Block 3	0.875	0.138	0.830	0.322	0.126	0.084	0.011	0.005

Discussion and conclusions

Accelerated growth as a result of fertiliser application is usually explained in terms of nutrients accumulated in tree tissues immediately following fertilisation which are in excess of the requirements for growth. This improved growth generally continues in the years following treatment until the nutrient concentration in tissues fall to pre-treatment levels (Savill and Evans, 1986). This situation was illustrated in the early years of the experiment, where height growth responded vigorously to phosphorus and less so to nitrogen. These responses were reflected in the foliar concentrations of phosphorus and nitrogen. In keeping with the expectations of Savill and Evans (1986), latter years saw a fall in foliar concentrations with a consequent fall-off in growth rate. The declining general yield classes presented by Farrell (1985a) most readily illustrate this. By 1993, this decline had slowed considerably, although the decline in foliar nutrient concentrations has continued, with nitrogen deficient throughout and phosphorus moderately deficient to deficient. This ongoing decline in general yield class is probably due to continuing immobilisation of nitrogen in the forest floor, measurable levels of which were found by Farrell (1985a).

The failure of the lime to stimulate growth means that forest crops on peat will not benefit from the application of nitrogen and phosphorus in the presence of lime. Similar results have been found for nitrogen-poor soils in Sweden (Andersson and Persson, 1988), where the decreased growth was explained by a decrease in the net nitrogen mineralisation caused by liming.

It is useful to hypothesise whether fertilisers without lime would have improved the growth of the crop. At this stage, canopy closure was complete, with nutrient cycling within the ecosystem (as litterfall, crown leaching, root death and root exudation) and within the trees themselves becoming the dominant processes. Also, at this time, the capture and retention of nutrients from rainwater, aerosols, dust and gas is most efficient. Low immobilisation and enhanced inputs mean that for many elements, demands on the soil nutrient capital is low so that supplies are rarely inadequate and consequently responses to fertilisers unlikely (Miller, 1981).

At this stage, it is uncertain whether the crop will maintain the same general yield class until maturity. Levels of nitrogen are clearly inadequate and it has been hypothesised that on low nutrient capital sites, of which this is typical, litter which is low in nitrogen takes longer to decompose, resulting in the availability of nitrogen being reduced even further (Heilmann, 1966; Tamm *et al.*, 1960). Consequently, progressive nutrient deficiency can develop on marginal sites. Forest crops are capable of supplementing their nitrogen requirements by scavenging nitrogen from the atmosphere. In a study carried out in a Sitka spruce crop in Cloosh Valley, Connemara, Boyle *et al.* (1997) found evidence of nitrogen uptake by the canopy. It is unlikely, however, that these amounts would be sufficient to complete the nitrogen requirements of the crop.

It is pertinent to ask, given the limitations of the results, what are the lessons in this work for forest managers and the afforestation of peatlands. It is clear that, in order to achieve satisfactory levels of growth, the application of fertilisers is necessary. This would involve application at establishment and probably more following canopy closure. It is also clear that the magnitude of the growth response to these inputs decreases with time. Whether the decline in yield class will continue is uncertain.

This presents the question of the sustainability of peatland forestry. In recent years, interest has been focused at both policy and research level on the long term sustainability of the forest resource (Farrell, 1995, 1997; Anon., 1996; Mulloy, 1997). The principle of sustained yield is a cornerstone in the management of a forest resource. Over 40% of our plantations are on peatland and the processes which govern their sustainability are complex. The soil material in a peatland forest is organic, and drainage and forest establishment begin a process of subsidence and decomposition which threatens the sustainability of the peat soil. These losses may be offset by litter inputs from the forest crop. Whether such sites can continue to support forest crops beyond the first rotation, without artificial inputs, is unclear. Should yield class continue to decline with time, investigation of the measures necessary to arrest this decline would be warranted, as would the economics of such measures.

ACKNOWLEDGEMENTS

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Peer reviewed paper

Trends and spatial patterns in private afforestation in the Republic of Ireland

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Abstract

Against a background of minimal activity, the huge growth in private afforestation in the Republic of Ireland has been dramatic. This trend is defined and set in the context of European Union policy and related national forestry incentives, but other influences are also involved. There are distinct spatial patterns in the amount and characteristics of private planting. These are mapped on a county basis and discussed with reference to: the extent of afforestation and its role in land use change; comparisons with the public sector; the ownership of private afforestation; and the type and size of tracts being planted. Differences between east and west are evident. These include a greater volume of private planting activity in the west, together with the greater use of enclosed land and the development of larger tracts of forestry. The patterns are the outcome of many complex influences, but land type is of primary importance. In the major expansion of private afforestation which is projected, greater attention should be given to the spatial dimension.

Key words: Private afforestation, Republic of Ireland, Irish forestry

Introduction

Reference has often been made to Ireland as being the least forested country in Europe, apart from Iceland. Less frequently realised internationally is the fact that in the afforestation which has taken place to address this situation, private planting has traditionally played a miniscule role, so that the level of private ownership of Irish forests has been uniquely low among European countries. The extent to which this has been reversed in the Republic of Ireland since the 1980s has been dramatic, not only in forestry terms, but also in the context of national land use. The upsurge in private afforestation must rank among the most abrupt changes to have occurred in the history of the use of Irish land and it is notable even on an international comparative basis. It is the purpose of this paper to illustrate this remarkable development through graphic representation of trends and cartographic portrayal of spatial patterns, together with comment on the features concerned. The data used are based principally on those compiled by the Forest Service, Department of the Marine and Natural Resources.

The changed environment for private afforestation

The abruptness and magnitude of the escalation in private planting in the Republic of Ireland are demonstrated clearly in Figure 1. Private activity accounted for only 3% of all planting between independence and 1980, but contributed 79% of the expanded afforestation in 1996. The area planted annually increased from 134 ha in 1979 to 617 ha in 1985, and then sharply to 9,147 ha in 1990 and a peak of 17,343 ha in 1995. The area afforested in 1995 was 90 times the mean annual planting of 193 ha over the period 1930-79. The pri-

vate afforestation of 101,528 ha over the decade 1987-96 was more than 10 times the total area planted over the five decades 1930-79. This decade of private afforestation accounted for 17.2% of the total forest in the state at the end of 1996. It constitutes the most abrupt change in Irish forest history and represents a change in the use and cover on 1.5% of the country's total land.

The extremely low level of private afforestation prior to the 1980s suggests the existence of strong barriers inimical to private planting. These may be summarised as including: the lack of forest consciousness and knowledge; the tendency to associate forestry solely with the former landlord class and later, with the state; the small size of farm holdings and the competition with agriculture for the scarce land resource; the state subsidies and other incentives offered to agriculture; the costs and risks involved in planting combined with the long time scales of returns on investment; the long term commitment inherent in the conversion of land from agriculture to the very different use of forestry; the fear of detraction from entitlements to social welfare and other benefits; and uncertainty with regard to future marketing prospects for timber (Gillmor, 1992). As Neeson (1991) has emphasised, however, explanation for the predominance of state over

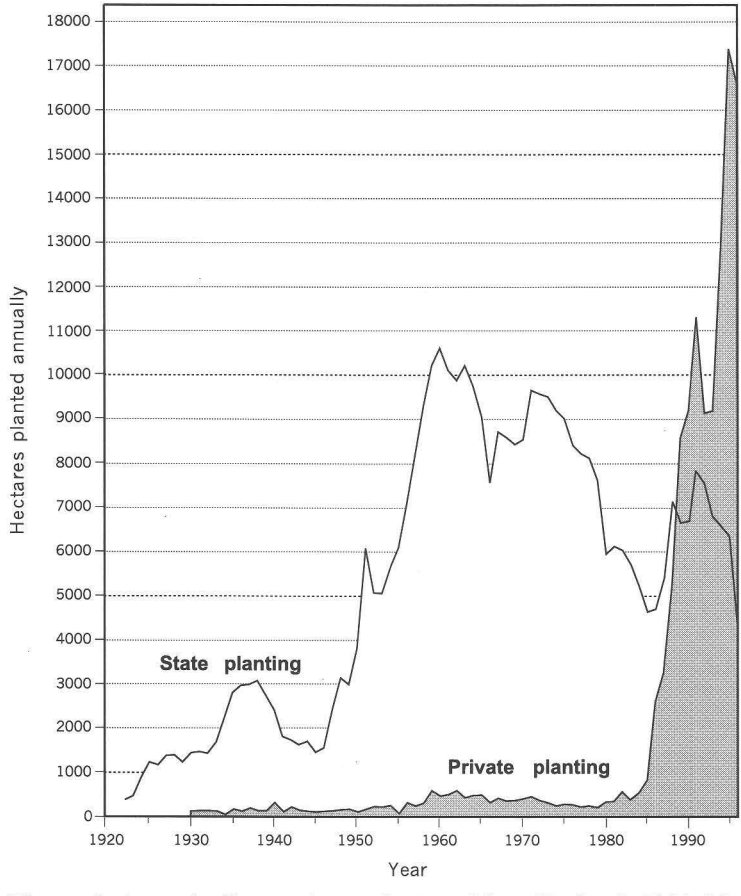

Figure 1. *Annual afforestation in the Republic of Ireland, 1920-96.*

private afforestation must be sought not only in the attitudes of land owners, but also in official policy. While the principle of providing state grants towards private planting costs was adopted as early as 1928, such afforestation was seen in practice as being very much secondary to direct state involvement and potentially a competitor with it for land. While some individual foresters and politicians were keen to promote private afforestation, there was little evidence of a general strong commitment and no clear policy was formulated.

While these influences seem to account for most of the lack of interest in planting trees among Irish landowners during much of the twentieth century, surveys of farmers shed some light on this reluctance in recent times. The perceptions of a sample of farmers who had planted in northern counties as to the main reasons why farmers in general were slow to avail of government financial incentives for forestry were: the long term nature of return on forestry combined with the absence of an annual income (42%); the lack of a forestry tradition (36%); and the prohibitively high initial costs involved (15%) (Kelleher, 1986). The reasons why they themselves had not planted given by farmers in 12 western counties were: the lack of suitable land (35%); a limited land resource (15%); a combination of the long time period associated with the returns from forestry and other financial reasons (15%); a dislike of trees (4%); and other reasons for not planting (12%), while 19% of respondents stated that they had never considered planting trees (Ní Dhubháin and Gardiner, 1994). With regard to the lack of suitable land, farmers felt that their land would be better used for agriculture, and that it was 'too good' for forestry. Some attitudes among farmers which are inimical towards forestry persist and hinder the promotion of planting (Ní Dhubháin *et al.*, 1994).

As the barriers to private planting were so effective, it is evident that a major change in the environment for private afforestation must have occurred in order for there to be such a sudden and huge growth in activity. This transformation related essentially to the incentives resulting from the change in the context for forestry relative to agriculture within the European Union, and the concurrence of Irish policy with this shift. It was facilitated by the increasing realisation of the suitability of the Irish biophysical environment for tree growth, the establishment of advisory, demonstration and training services, the greater media and public profile of forestry and the promotion of private enterprise.

The first measure in addition to the pre-existing state grants was the EU Agricultural Development Programme for the West of Ireland, known as the 'Western Package', which included forestry among several measures to promote development in the 12 western counties for a 10-year period from 1981. One-half of the generous grant funding for planting was provided by the EU, rising later to 70%. With take-up falling very far behind the target of 2,500 ha/year, a vigorous campaign to increase awareness of the Western Package forestry measures was undertaken in 1985. As emphasised by Bulfin (1993, 1994), what was to prove of greatest importance, however, was the fact that the disincentive to farmer afforestation resulting from the lack of short term income was tackled first in 1986/87. From then, farmers entitled to livestock headage grants in disadvantaged areas who converted to forestry continued to receive compensatory payments for 15 years, though they had to reduce stock levels to qualify. This vital incentive of annual payments was greatly extended 3 years later through the broader and much more beneficial Forest Premium Scheme. The National Farm Forestry Forum (1996) concluded that the most significant factor influencing the rate of farm afforestation is the level of premium payment, but that this is set within the context of the alternative returns in agriculture.

The shift in EU policy towards the promotion of afforestation was heralded in 1986 by the Community Strategy and Action Programme for the Forestry Sector. It favoured the

expansion of forestry as a means of reducing agricultural surpluses by affording an alternative use for land, lessening the EU's heavy reliance on timber imports, providing employment and economic development in rural areas, affording environmental and recreational benefits, and compensating for the destruction of the European forest resource by atmospheric pollution and fire (CEC, 1986). This emphasis was based especially on the striking contrast which developed between the market prospects for agricultural produce and for timber. Forestry was identified in *The Future of Rural Society* as having a potentially important role in integrated rural development (CEC, 1988). With this European commitment and the consequent prospect of financial assistance towards its achievement, Irish policy was to concur wholeheartedly. In 1987, the government identified forestry as one of the main areas for development in its Programme for National Recovery. This included a firm action programme to realise the potential of forestry for job creation, import substitution, export revenue, and regional and social development. Record total planting targets were set and particular encouragement was to be given to farmers to avail of the incentives and to expand into forestry.

The outcome of the concordance between Irish government and EU interests was the approval in July 1990 by the Community of the Forestry Operational Programme 1989-93 (Government of Ireland, 1991; Gillespie, 1994). The high level of financial support was made possible by the availability of Structural Funds under Ireland's Priority 1 status to compensate for the move towards the Single Market. The effect of the Operational Programme and other forestry measures was to increase and extend from the west to all of the state, the capital grant support for private planting and the annual payments. These incentives were additional to the favourable taxation regime for forestry (Grayson, 1993). Continuation and extension of EU financial support for Irish forestry since 1994 has been provided for by a Common Agricultural Policy (CAP) Reform Accompanying Measure. Afforestation of agricultural land was one of three accompanying aid measures agreed by the EU in 1992 as part of CAP reform, the others concerning agri-environmental policy and the early retirement of farmers. These measures are financed 75% from the EU FEOGA Guarantee Budget and 25% from national exchequers. The forestry incentives were increased in value, scope and duration. The influence of incentive levels was reflected in the decline in private planting in 1992-93 (Figure 1). During this period, uncertainty existed regarding the process of CAP reform, and some landholders delayed planting in expectation of enhanced forestry benefits under the new measure. Depressed timber prices may also have played a role in this decline. Similar expectations of even greater incentives seem to have affected planting in 1996-97. The relative attractiveness of agricultural incentives and prospects must also be considered but the impact of these under CAP reform has not to date had the depressant effect on forest planting projected by Kearney (1994). Nonetheless, the recent downturn must to some extent reflect the success of the Rural Environment Protection Scheme (REPS), which has been adopted by over 30,000 farmers and under which, afforestation is barred on environmental grounds.

The very close correspondence between the trends in private planting and the EU and state measures to promote afforestation suggests the extent to which the development is incentive-led. It must be acknowledged, however, that simple questioning of farmers concerning their motives for planting illicits responses which do not prove the total dominance of grant aid alone. In Kelleher's (1986) study, the predominant reason given for respondents' planting intention (84%) was to use land that was waste or of no good for anything else, with only 6% specifying investment reasons. Ní Dhubháin and Gardiner (1994) found that the reasons given by farmers were shelter provision (45%), financial rea-

sons (23%), use of wasteland (15%) and aesthetic reasons (8%), but only 38% of these respondents had received grant aid. The ranking of motives for future planting was rather different. This was: to use up poor ground (58%); financial reasons (16%); landscape and conservation reasons (12%); and shelter provision (8%). Although the main reason given overall was to use land of little value for other purposes, obviously the land of poor quality was there and remained unplanted until the introduction of the afforestation incentives. In answering such questions, many farmers tend to take the availability of grant assistance as given and not requiring mention, so that they concentrate on other influences (Cawley *et al.*, 1995). Additionally, there may be some deliberate downplaying of the role of grant dependence by farmers.

Distribution of private forestry

The distribution by county of private planting over the decade 1987-96 is shown in Figure 2, in terms of total planting (represented by the proportionate circles) and also in the context of total land use (represented by the choropleth shading). Both dimensions reflect a western emphasis. The counties with the largest areas afforested were Mayo, Kerry, Donegal, Clare and Cork, each with about 9,000 ha or more. In terms of the proportion of the land involved, this exceeded 2% over the decade in Clare, Leitrim, Kerry and Sligo. This western orientation reflects the extent of hill and bog land and the poorer quality of western farmland. Related in part to this is the fact that the intensity of agricultural use there, as indicated by stocking densities, is lower, as are farm incomes and land prices. Also, more land becomes available through retirement, due to the older age structure of the western farm population. The activities of forestry contracting companies and cooperative effort have influenced the pattern of afforestation locally, as has South Western Forestry Services in Kerry and the Western Forestry Cooperative in the northwest. The highest levels of planting in the eastern half of the country were in Laois-Offaly, where the Slieve Bloom Mountains and substantial tracts of peatland are situated, and in Wicklow, with its large area of upland and longer tradition of forestry. The lowest levels were in the northeast, where the proportion of non-agricultural land is least.

There has been some spatial shift in the pattern of private afforestation. Prior to 1988, grant aid was given only to the 12 western counties (Cavan, Clare, Cork, Donegal, Galway, Kerry, Leitrim, Longford, Mayo, Monaghan, Roscommon and Sligo), and to Limerick from 1986. While the response to the availability of grant aid was at first slow in other counties, extension of incentives to all of the state was followed by a decline in the western region's share of planting. This had lessened to 77% by 1990, and was 68% in 1992 and 1996. Within the west, there has been some change, with afforestation being highest in Donegal and Kerry in the period 1992-96. Most notable was the expansion of planting in Donegal, where it had been slow to develop in the 1980s. The share of planting in Leinster increased to 15% in 1990, 24% in 1992 and 27% by 1996. This eastward shift in recent years seems to be partly a response to coming under the CAP Accompanying Measure, whereby higher premiums are being paid in the non-disadvantaged areas to encourage afforestation of agricultural land. Also, the introduction of higher grants followed by a greater differential for broadleaf planting have encouraged the planting of better land. This is reinforced by the setting of a minimum yield class of the equivalent of 14 for Sitka spruce and, to a lesser extent, environmental concern regarding the afforestation of blanket bog. The encouragement of planting better land and broadleaf species seems likely to promote further shift in the distribution of afforestation. Another influence

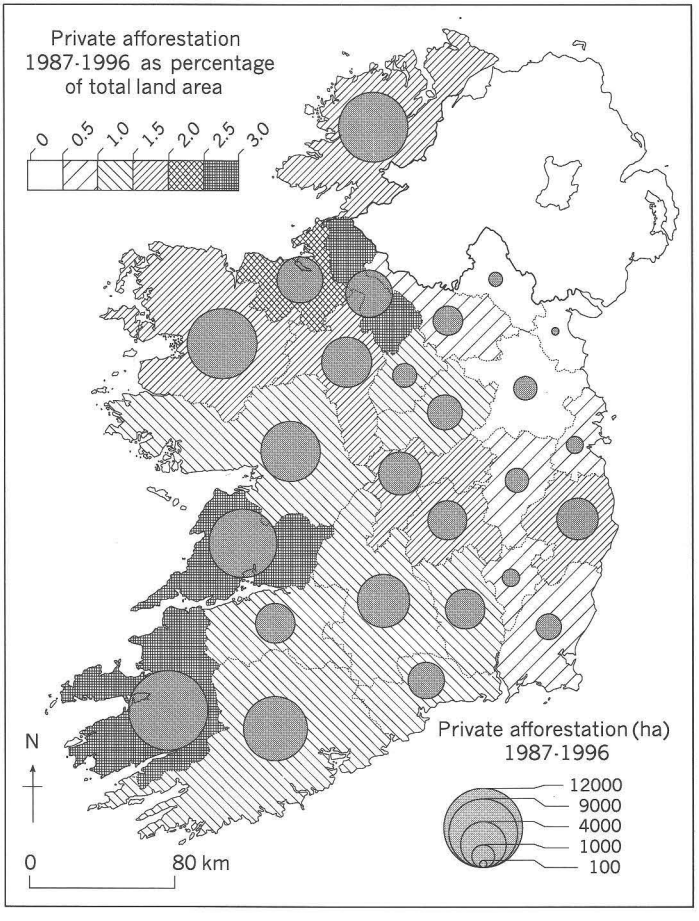

Figure 2. *Distribution of private afforestation, 1987-96, and its role in land use.*

which may become of significance is the pattern of REPS adoption by farmers, which is now higher in the west and northwest of the country.

The spatial pattern of private afforestation shown in this paper differs markedly from that portrayed in the map by Hannan and Commins (1993), and their finding that forestry grant applications were most common in the larger farm areas of good land and intensive agriculture. They acknowledged that these findings were contrary to their hypothesis. The difference may be explained at least in part by the fact that the pattern shown here is based on the area and proportion of land afforested, whereas Hannan and Commins used the proportion of holdings with applications for forestry grants. Thus, it may be that in the areas of large farms and good farming, a higher proportion of farmers apply for forestry grants, but go on to plant only very small parts of their holdings.

The spatial patterns portrayed at the county level are the outcome of the decisions made by a multiplicity of individual landowners. As has been conceptualised for farm diversification as a whole (Cawley *et al.*, 1995), these decisions may be seen as the result of

interaction between the internal environment of the farm itself and the external environment of institutional and other macro influences. While the latter are the factors which are most likely to be evident in the consideration of general trends and patterns, this is not to deny the importance of socio-economic, personal and other influences at the level of the individual landowner and holding. Among the complex range of such variables are: the individual's age, marital status and life cycle situation; the extent and nature of social welfare, health benefits and other income support receipts; the farm layout and farming system; the individual's involvement in various agricultural and other schemes; and his or her familiarity with and attitudes towards planting incentives. The process of adoption and diffusion of innovations affects the pattern of afforestation at the local level. As concern about the environmental impacts of forestry has increased, this and the designation of conservation areas affect local distributions (Hickey, 1990; RDS, 1991). Research concerning the many influences affecting decisions to plant or not to plant is needed urgently in order to provide a better understanding of the afforestation process.

The public and private sectors

There are interrelationships between trends in public and private afforestation. With the huge expansion of state planting in the period after the second world war, afforestation reached a peak of 10,500 ha in 1960 (Gillmor, 1993). As may be seen in Figure 1, annual planting subsequently declined, particularly over the period 1972-85 during which it fell from 9,600 ha to 4,600 ha. This resulted primarily from the increasing cost and difficulty of procuring land, particularly in the 1970s after accession to the EC had led to greater prosperity in agriculture. Another restriction in the 1980s was the curtailment of state expenditure due to national budgetary difficulties. A further consideration has been the need to allocate an increasing share of state resources towards reforestation with the maturing of the national forest. Reforestation has increased from 691 ha and 10% of total state planting in 1980, to 6,003 ha and 57% of planting in 1996.

The shortfall in reaching even reduced state national planting targets prompted government to turn more towards the private sector, reinforced by the tendency to lessen direct state participation in the economy as a whole. Thus, the decline in state involvement was a contributory factor in the expansion of private afforestation. Greater encouragement had begun in 1978, even before European funding for forestry became available, with a substantial increase in the level of grants under the Private Forestry Scheme. The subsequent growth in private planting began to compensate for the decline in state afforestation. This inverse relationship ceased in the period 1986-91, however, when an upturn in state afforestation occurred at the same time as the huge expansion of private planting. This correspondence is accounted for by the provision of substantial EU funding for public as well as private afforestation under the Forestry Operational Programme. Nonetheless, as private activity and the related price of forestry land increased, it became progressively more difficult to acquire land for state afforestation, accounting for the downturn in planting in the 1990s. This difficulty contributed to the introduction in 1992 of the Coillte Partnership Scheme, whereby Coillte undertakes planting, management and marketing while the farmer retains ownership of the land and receives an annual income based on the value of the grants, premium payments and revenue from the sale of the timber. In 1996, 814 ha were planted under this scheme, contributing 18% of Coillte afforestation. The Coillte Partnership Scheme has resulted in a blurring of the boundary between public and private afforestation.

Over the decade 1987-96, 62% of the afforestation in the Republic of Ireland was by private planting, but the relative contributions of the private and public sectors varied by county (Figure 3). While private activity figured prominently in this recent afforestation in the west, some of the highest shares were in some eastern counties. This reflects some private planting in the context of a general lack of afforestation by either state or private interests on good agricultural land and in particular, the lack of acquisition by the state of this land, due to its high cost. The private contribution was greatest, at 96%, in Meath, but the total afforestation in this county over the decade was only 1,100 ha. It seems likely that this was accounted for by some large farmers planting small parts of their holdings combined with a few substantial plantings. Among the counties with major forestry activity, Kerry was exceptionally high with 82% private sector involvement, second only to Meath. The private contribution was also high in the northwest, exceeding 70% in Sligo, Leitrim and Roscommon. It was lowest in Waterford, by a significant margin at 40%, where there was substantial state planting in upland areas but limited private interest on good agricultural land.

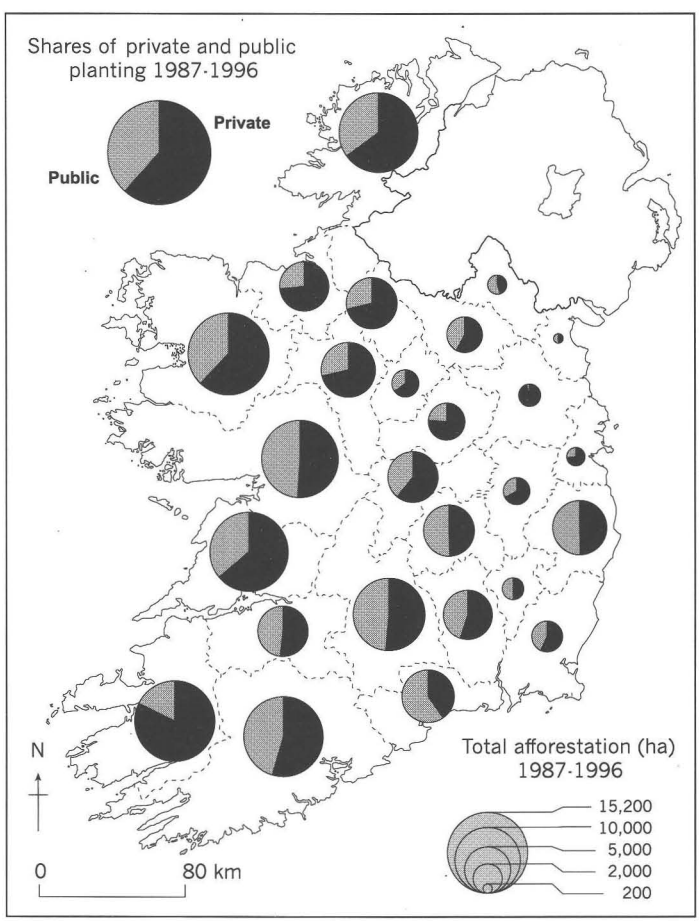

Figure 3. *Distribution of private and state afforestation, 1987-96.*

The contribution of private planting over the decade 1987-96 to the total forest landscape at the end of 1996 is shown by county in Figure 4. With the type of land used for private planting tending to be somewhat similar to that of the state sector which dominates the total forest area, general uniformity in the contribution might be expected. Spatial variation existed, however, and this reflected especially the temporal differences in the respective planting efforts and in particular, the recent nature of the major private contribution. This may be seen by comparing the older forested county of Wicklow, where the recent private contribution was only 9%, with western counties, where it generally exceeded 20%. The contribution was greatest, at 33%, in Kerry, with its high level of recent private planting activity having a major impact on the forest landscape of the county.

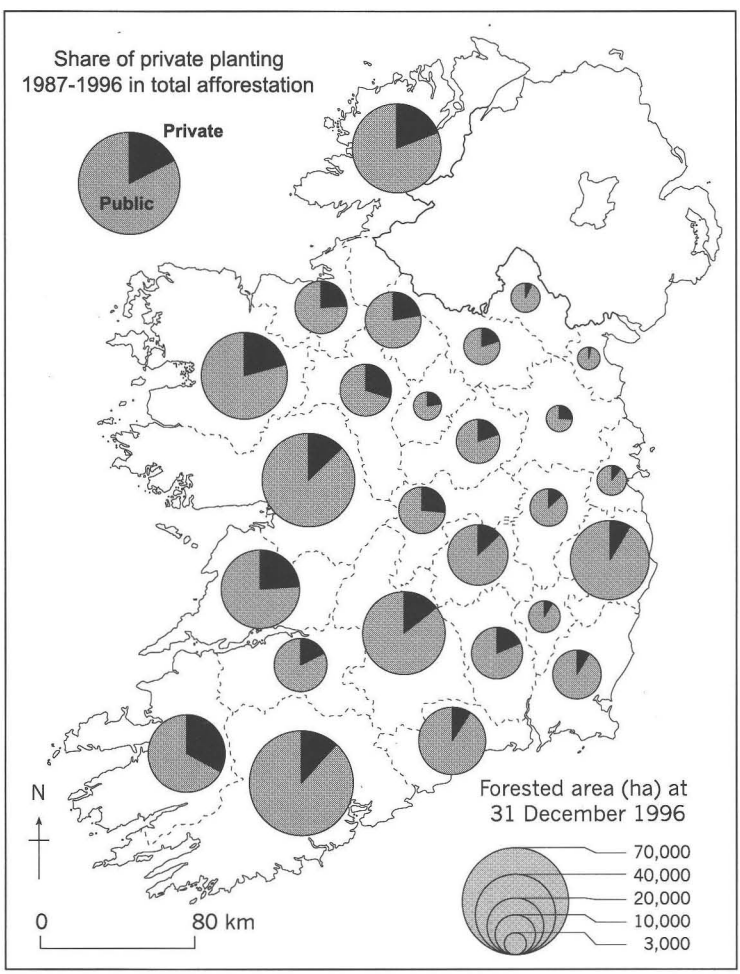

Figure 4. *The contribution of private planting, 1987-96, to total afforestation.*

The private planters

Financial institutions were quicker than farmers to avail of the opportunities to invest in the rapid expansion of forestry in the 1980s, to the extent that farmers accounted for only one-fifth of private planting in 1986. Corporate participation did in itself influence farmer interest in forestry, by contributing to confidence in the future of the industry, but it was the addition of annual payments to the pre-existing generous grants which provided the major stimulus to the huge expansion of planting by farmers. This was reinforced by the development of support from the farmers' organisations, advisory services and cooperative societies. The share of ownership by farmers in the greatly expanded private planting had increased to 45% by 1990.

Data on three categories of private planters (non-farmers, part-time farmers and farmers) are available from 1992, with non-farmers comprising both corporate forestry and planting by individuals in occupations other than farming (Figure 5). The share of non-farmers diminished over this 5-year period in both relative and absolute terms, from 4,017 ha and 44% of private planting in 1992, to 1,529 ha and 9% in 1996. This reflects in particular the progressive rise in the price of forestry land and the effect of this on projected rates of return on investment in forestry (O'Connor and Kearney, 1992/93; O'Connor and Conlon, 1993). Also, there is difficulty in acquiring the size of tracts which are of interest to companies, combined with the fact that pension funds devote only a small part of their portfolios to forestry, due to its illiquidity. The decline in the share of planting has occurred despite the feeling among farming interests that circumstances are weighted in favour of those who are not farmers (Divilly *et al.*, 1995). The increased participation by part-time farmers, from 922 ha and 10% of planting in 1992 to 3,614 ha and 22% in 1996, followed from the broadening of the income eligibility status for the forestry incentives and greater realisation of the benefits of forestry to people in that situation, with perhaps an increase in the extent of part-time farming.

There were variations by county in the ownership of private afforestation in 1992-96 which reflected differing participations over time but also spatial variation in any one year (Figure 6). Apart from the tiny area of planting in Louth, farmers and part-time farmers combined had a majority share everywhere. The role of

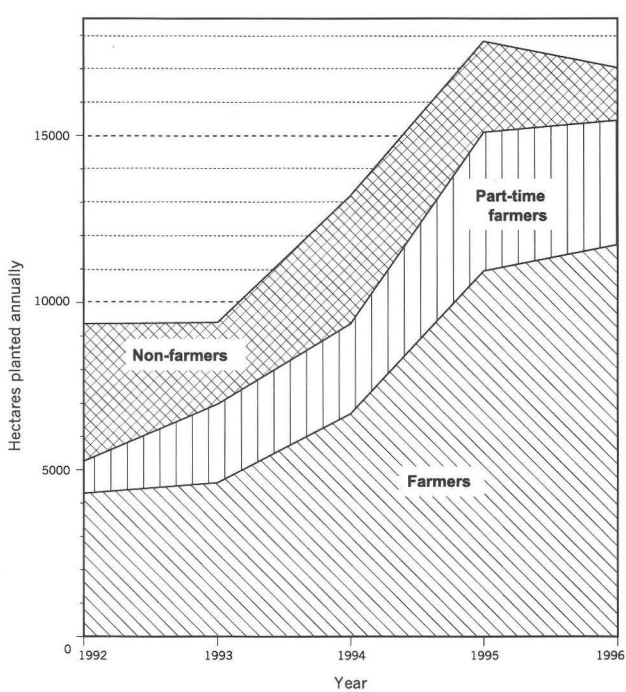

Figure 5. *The ownership of private afforestation, 1992-96.*

non-farmers was highest, at 49%, in Leitrim. It was there that the comparative advantage of forestry relative to agriculture was demonstrated first and to the greatest extent on its wet mineral soils (Foras Talúntais, 1973-78), attracting considerable corporate interest. Land acquisition in Leitrim has been facilitated by the fact that population decline has been greater than in any other county. Participation by non-farmers was next highest in the other adjacent and northwestern counties of Roscommon, Mayo, Cavan and Donegal. This conforms to some extent with the finding of Hannan and Commins (1993) that the small amount of land sold for forestry was more prevalent in the more remote and traditional areas of poorer farming conditions. In the east, participation by non-farmers was substantial in the established forestry county of Wicklow, and there was some planting near to Dublin by people in occupations other than farming. The share of planting by part-time farmers was as high as 28% in Donegal and Kerry, where it made a substantial contribution to the high level of very recent afforestation. It tended to be greater in general in the west, as small holdings are more likely to be operated on a part-time basis, but it was also relatively significant among the much lower forestry activity in north Leinster.

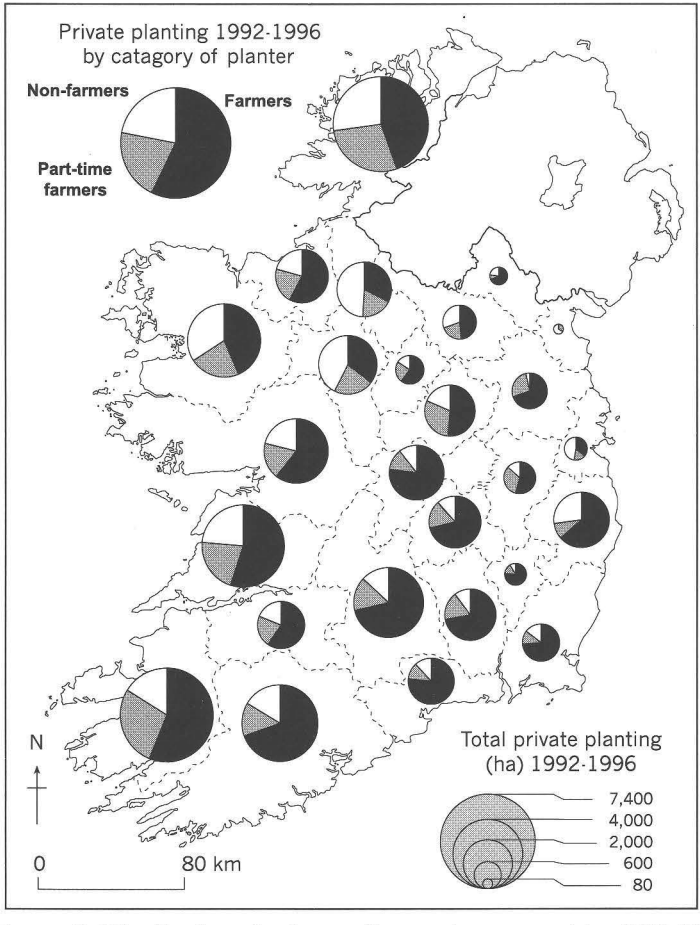

Figure 6. *Distribution of private afforestation ownership, 1992-96.*

Forested land: type and size of tracts

With regard to the nature of the land being afforested, the data enable a distinction to be made between enclosed and unenclosed land. There has been pronounced spatial variation in the relative proportions of these land types (Figure 7). Planting on unenclosed land correlated closely with the distribution of upland and bog, being markedly higher along the west coast and reaching its peak in Donegal and Kerry. This indicates the importance of private forestry on western hill land and peatland. Also, in areas where uplands exist, it is much more likely that adjacent lowland or enclosed land is of inferior quality for agriculture and therefore more likely to be planted. In the eastern half of the country, there is little unenclosed land available for planting and so values were very low. The exceptions were on the Wicklow and south Dublin uplands, on the Slieve Bloom Mountains and peatlands of Laois and Offaly, and in upland districts of Waterford and Tipperary. These considerations of unenclosed and adjacent land reinforce the primacy of land type as a factor in the spatial distribution of private afforestation.

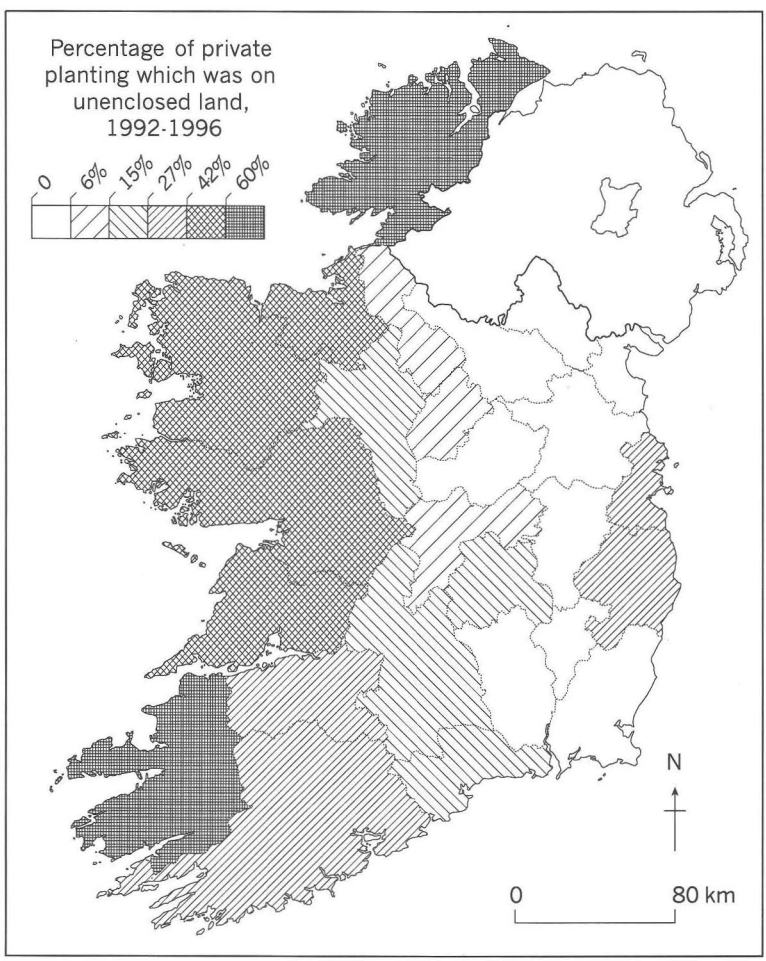

Figure 7. *Private afforestation on unenclosed land, 1992-96.*

The availability of the substantial tracts of unenclosed land contributed to the larger average size of plantings in some of the western counties (Figure 8). Also, some whole farms were afforested in these areas, although the general practice was to plant only part of the holding. While tracts were biggest in Donegal, at 13.7 ha over the period 1992-96, there were high mean values in Counties Westmeath, Dublin and Meath. This belt in north Leinster seems anomalous, especially when compared with the counties of lowest value to the north and south of it. Perhaps it may be explained by the distortion of average values by a small number of large plantings among the generally low level of afforestation activity there. The low mean size of plantings in the other counties of larger farms suggest that only small parts of these holdings have been afforested. These explanations are supported by the findings of Hannan and Commins (1993) concerning grant applications. The spatial pattern of planting size tends to be the reverse of that of farm size, with the largest afforested tracts being in the western counties of small holdings. Variability was greatest among the counties with small areas of afforestation, and elsewhere there was relative uniformity in the mean size of forested tracts.

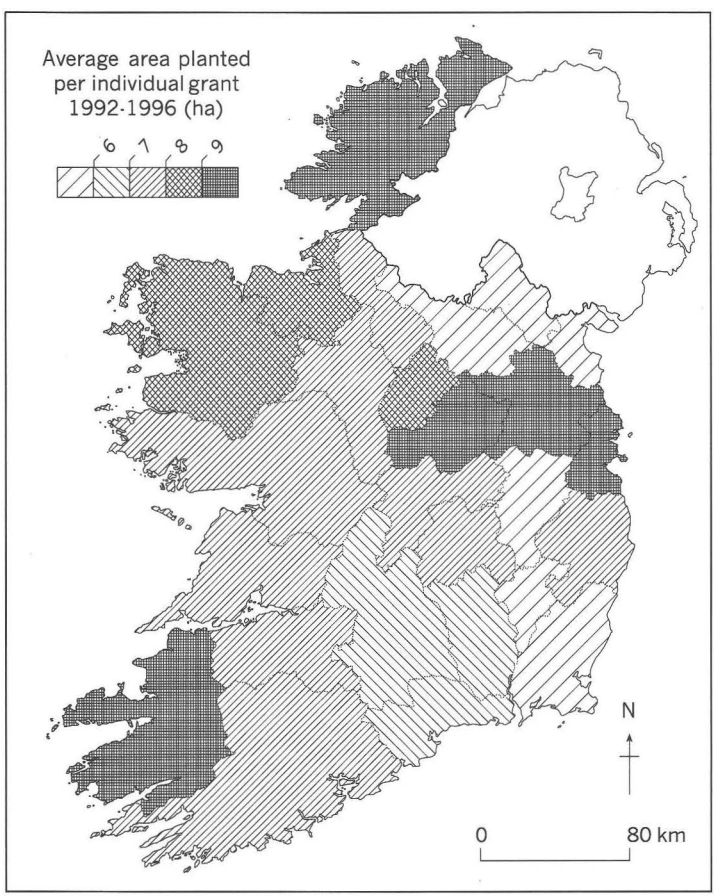

Figure 8. *Size of private plantings, 1992-96.*

The mean area to which grants over the period 1990-95 applied was 9.9 ha, but the size structure varied somewhat from year to year. The range was from 7.5 ha in 1993 to 11.2 ha in 1994, and this contrast may have resulted in part from some large plantings being delayed in order to avail of the increased incentives in 1994. The structure of plantings in the 1990s was skewed towards small size, with tracts of less than 10 ha representing 72% of the total in number but accounting for only 31% of the total area of land involved (Table 1). Obviously the small sizes and scattered distribution of private planting in the Republic of Ireland present difficulties for forest management and harvesting, though these can be lessened through cooperative effort on the part of farmers and through the development of management practices appropriate to small scale production.

Table 1. *Size structure of private planting, 1990-95.*

Size of planting (ha)	*Number (%)*	*Total area (%)*
100+	0.5	6.8
50.0-99.9	1.7	11.7
20.0-49.9	9.0	26.8
10.0-19.9	16.9	24.1
6.0-9.9	17.4	14.0
4.0-5.9	14.6	7.4
2.0-3.9	23.1	7.1
<2.0	16.8	2.1

An analysis of a random sample of 10% of grant-aided plantings in the year 1991/92 provided interesting information on the nature and size of private afforestation tracts (Convery and Clinch, 1994). The favourable environmental context was indicated by the fact that on almost 40% of sites, the yield class was 20 or higher for Sitka spruce, the species which accounted for 90% of planting. The facts that only 19% of sites were severely exposed, 82% of the total area was below 200 m and over half of the plantings were on mineral or mixed soils, were taken to indicate that forestry was 'coming down the hill'. The vegetation of the sites was: grass/rush (49%); heather/furze (41%); grass (5%); and scrub (5%). Of the land planted, 79% had been used for grazing and 65% enclosed and improved prior to afforestation. With regard to size, 33% of the lots and 9% of the area planted were below what was considered to be the commercial threshold of 4 ha. The average number of hectares planted per grant were: corporate sector (17.4 ha); full-time farmers (8.7 ha); part-time farmers (6.4 ha); and individuals in other occupations (5.9 ha). Thus, the pattern of ownership has an influence on the distribution of tract size (Figures 6 and 8).

Conclusion

The rapid growth of private afforestation in the Republic of Ireland has been a remarkable development. This is so within Irish forestry in that it represents both a shift from state to private afforestation and a major expansion in the level of total afforestation. In the broader terms of national land use, private afforestation is a major new element in the scene. As has been demonstrated in this paper, there are distinctive trends and spatial pat-

terns involved. Given the significance of this development, it is surprising that it has not attracted more general attention, debate and policy formulation.

Based on assumptions concerning a critical mass for the forest industry, official policy envisages a continuation of a high level of afforestation, with annual targets for total planting of 25,000 ha to the year 2000, and thereafter 20,000 ha to the year 2030 (Department of Agriculture, Food and Forestry, 1996). This would extend the forest area from 8% to 18% of the land in the Republic of Ireland. It is envisaged that private planting will predominate over public afforestation in the approximate ratio of 70:30, with an emphasis on farmer participation. This level of private planting would involve private afforestation of 490,000 ha or 7.1% of the total land of the state, in addition to that existing at the end of 1996.

There is no reference in the strategic plan to the spatial dimensions of this high level of private afforestation, though it does contain a proposal to establish a national Forest Inventory and Planning System. The Forest Service is also funding work on an indicative forestry strategy. The remote sensing and geographical information systems technologies currently available provide the basis for some of the information needed in spatial planning. The forestry adoption process and the role of forestry in rural development are essential inputs to the planning system, and more research into these factors is required. A useful start in relation to the rural development dimension has been made through the work of Kearney and O'Connor (1993) and Ní Dhubháin (1995). The National Economic and Social Forum (1997), expressing reservations about the continuation of forestry policy formulation within a top-down framework, recommended that future policy should be determined in consultation and cooperation with local communities. This should be done within the broader context of integrated sustainable rural development. In association with this, the planning of spatial trends and patterns would ideally be within the framework of an indicative strategy and national land use policy, something for which geographers have been calling for decades.

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Peer reviewed paper

Effect of grit grade and grit source on the germination, early morphology and health of Sitka spruce (*Picea sitchensis* (Bong.) Carr.)

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Abstract

The impact of grit grade and source on the seed germination, early morphology and health of Sitka spruce (*Picea sitchensis* (Bong.) Carr.) germinants and on soil pH was investigated in a greenhouse trial. Seed germination, germinant morphology and health were best in the coarse (2.0-6.0 mm) grits, and grit source had no effect. Germination percentage, germinant size and number of healthy germinants were lowest in the fine (0.2-2.0 mm) grits, and there was significant variation among grit sources. The pH of the soil was increased in three grit sources within this grade, and in one by nearly two pH units. Results for the mixed (0.2-6.0 mm) grits were closer to those obtained for the coarse grits for all variables except soil pH, but grit source effects were significant. The pH values for this grade were almost identical to those obtained for the fine grits.

Key words: Seed cover, grit, germination, pH, Sitka spruce

Introduction

It is generally accepted that seed of most tree species covered with fine grit or coarse sand germinate quicker and give higher yields than if nursery soil alone is used. Grit is the preferred seed cover material used in Irish nurseries. A grit having a particle size of 3.0-5.0 mm is recommended by the Forestry Commission (Mason, 1994). In addition, grits should be free from silt and lime. The silt portion may 'cake' and reduce germination, while the lime may increase the pH of the soil. Furthermore, the colour of the grit has an effect on germination and growth, with light coloured grits giving the best results. In one British study using Sitka spruce (*Picea sitchensis* (Bong.) Carr.), a very coarse (>6.0 mm), dark grey grit yielded 274 seedlings/m^2 of 2.5 cm height, compared with 821 seedlings/m^2 of 4.6 cm height for a coarse (or medium), white grit (2.0-6.0 mm) (*Ibid.*). The colour of the grit affects the temperature of the covering material, and severe damage to new germinants may occur during warm sunny days if black or dark grey coloured grits are used (Petrie and Mackay, 1948).

A wide variety of grit types are used in Irish nurseries, largely depending on local availability. It has long been suspected, however, that the quality and type of grits used contribute to the variable germination of seeds and early growth rates of seedlings in some Irish nurseries. There is little information (and none published) on the effects of grit quality and type on seed germination and early seedling growth in Ireland. It is worth noting

that although the overall pH of the soil may be influenced only slightly by the use of grit, the pH of the soil in the germination zone may be affected more. There is no information on the possible effects of grits used in Ireland on soil pH. To this end, the influence of grit grade (fine, coarse or mixed) of six different grit types or sources (used operationally in three nurseries in 1993) on the germination and early growth of Sitka spruce was investigated in a greenhouse trial. The effects of grit grade and source on the pH of the soil in the germination zone was also studied. The effect of grit colour on germination was, however, not investigated.

Materials and methods

Grit source and description

Six grits, used at three different Coillte nurseries in 1993, were used in this study (nurseries A, B and C[1]). The particle size distribution of the ungraded grits varied considerably (Table 1). Grits from nursery A (A1) and nursery B (B1) had higher proportions (60%) of large (>2.0 mm) material compared with those from other sources (40-50%). A physical description of the grits is given in Table 2.

Table 1. *Percentage particle size distribution in the six different grits. (The grits from the three nurseries are denoted by an arbitrary letter (A, B and C), followed by an arbitrary number for each of the two grits per nursery.)*

Class	*Particle size*	*Grit Source*					
	mm	*A1*	*A2*	*B1*	*B2*	*C1*	*C2*
Gravel	>2.0	59.95	39.56	61.00	41.33	49.88	49.12
Sand							
Coarse	0.5-2.0	39.46	55.31	37.61	53.08	47.61	46.86
Medium/fine	0.05-0.5	0.50	5.07	1.33	5.51	2.32	3.95
Silt/clay	<0.05	0.09	0.06	0.06	0.08	0.09	0.07
pH		7.80	8.20	7.30	7.30	8.50	7.80

Note: Particle size categories are those used by Teagasc (the Agriculture and Food Development Authority).

Table 2. *Physical description of the six different grits.*

Grit	*Description*
A1	White coloured granite schist
A2	Dark grey/black coloured granite
B1	Grey coloured granite
B2	Dark red/purple coloured sandstone
C1	Pink/light red coloured granite
C2	Cream coloured quartzite

[1] To preserve anonymity, the nurseries are referred to only by use of an arbitrary first letter followed by an arbitrary 1 or 2 for each of the two grits per nursery.

Grit treatments

To determine the effects of grit source and grade on various response variables, each of the six grits (sources) was separated into three particle size categories by passing the ungraded material through a series of sieves/screens of mesh sizes 0.2, 2.0 and 6.0 mm. Fine (0.2-2.0 mm), coarse (2.0-6.0 mm) and mixed grade (0.2-6.0 mm) grits were created from each grit type. Most of the silt/clay (<0.2 mm) fraction was removed from all grades. The mixed grade was almost identical to the ungraded grit except for this factor. This process yielded a total of 18 different grit treatments (6 grit sources x 3 grades).

A 5 g random sample was taken from each of the 18 different grit treatments for pH (H_2O) determinations, using standard procedures (Anon., 1974). Each grit sample was placed in a beaker containing 12.5 ml of deionised water, agitated for 10 minutes, and then allowed to stand for 48 hours. Five pH readings were taken of each sample solution using a standard pH meter (Radiometer PHM 84). The solution was agitated before each reading. The pH readings for each grit sample and among sample grades from the same grit source varied little. The mean pH of the mixed grades were 7.3 (B1, B2), 7.8 (A1, C2), 8.2 (A2) and 8.5 (C1) (Table 1).

Experiments

Germination and early growth

In early June 1993, stratified Sitka spruce seed (registration code 94R91) of Washington provenance were sown in plant pots containing soil from the Coillte nursery at Ballintemple, Co. Carlow. The soil was a sandy loam of pH 5.5, having an organic matter content of 8-12% and sand, silt and clay fractions of 66%, 19% and 15% respectively. The pots were sown with 25 seeds and placed in a glasshouse unit at Thornfield, UCD, receiving water at 2-day intervals. The seeds were covered with 0.5 cm of grit from one of the 18 grit treatments, while the controls were covered with 0.5 cm of soil. Each grit treatment was represented by five single pot replications. The germination test was laid out as a randomised block (five) design, each block containing one replication of each of the 18 grit treatments and 6 controls (equivalent to the number of grit sources).

The number of germinating seeds per pot was recorded at 2-day intervals over 21 days. Germination was defined by plumule emergence as it was difficult to judge when radicle emergence took place without disturbing the grit surface and seeds.

As the soil would dry quickly in the pots at this time of the year in a greenhouse and in order to improve relative humidity levels, small polytunnels covered with shade cloth (50% reduction over ambient) were placed over the pots. The temperature in the tunnels was within 20-30°C and relative humidity was >90% at all times.

At the end of the germination period, the shoot and root lengths of five healthy germinants from each pot were measured. For this purpose, every fifth germinant was systematically removed, beginning at one point in each pot (sometimes requiring more than one sweep). Following measurement, each germinant was carefully washed to remove grit, soil and other residue and oven dried at 65°C for 24 hours, after which dry weights were determined.

The stage of development and disease status of each of the remaining germinants per pot were assessed a few days later. The stage of development of each germinant was scored as follows: (i) emerged from seed but seed cap present; (ii) cotyledons fully developed; (iii) primary needle initiation beginning; and (iv) visible new shoot elongation

underway. The presence of damping off fungi (*Pytium* spp.) or *Rhizoctonia solani* was noted, and the actual level of damage per plant was subjectively scored (healthy, unhealthy or very unhealthy).

Soil pH

A parallel experiment, identical in design to the germination experiment, was initiated to investigate the effect of grit on soil pH. In this experiment, however, no seeds were sown in the pots and the soil within each pot was separated into three layers. The layers were introduced to facilitate sampling and to prevent the intimate mixing of grit and soil. Furthermore, it was felt that the germinating seeds might disturb the upper layer. The layers were demarcated using six pieces of a permeable inert nylon gauze per pot. The top layer was located near the grit surface (2 cm depth), the middle layer approximately 7 cm from the grit surface and the third near the bottom of the pot. The pots were watered in the same way as those in the germination experiment. After 21 days (as in the germination test), the layers were removed from the pots, sieved and oven dried. The pH (H_2O) of each soil sample was determined. Five 5 g samples were arbitrarily taken from each layer, mixed in 10 ml of deionised water, agitated for 1 minute and then allowed to stand for 10 minutes. Each pH reading was taken after the suspension had been agitated again for another 1 minute.

Data analysis and presentation

Most data were analysed following an ANOVA for a balanced randomised block design, followed by a least significance difference test to determine which means were significantly different. For each variable, the following analyses were carried out: (i) effects of replication and grit source across all grades; (ii) the effects of replication, grit source and grit grade; and (iii) the effects of replication and grit grades within each grit source. The pH data were similarly analysed, except that the effect of layer was considered an additional factor (repeated measures design). The data were also analysed separately for each layer. The pH data were transformed to antilogarithms for analysis. The stage of development and condition data were analysed using chi-squared tests.

Results

Germination

Grit source and grit grade had a highly significant effect on final seed germination ($p \leq 0.001$). The effect of grit grade was largest, with the fine grits having the lowest germination (Figure 1). There was no significant difference in germination rates among grit sources within the coarse grade, with close to 80% of the seeds germinating. In contrast, there were substantial differences among sources within the fine grits. Seed germination was highest in grit A1 and lowest in grit C1 within the fine grits. Germination values for the mixed grits were closer to those of the coarse grits, but the values were more variable. This trend mainly reflected the proportion of fine grit in the mixed grit (Table 1), with grits having the highest proportions tending to have the lowest germination.

Morphology and condition

Grit grade had a highly significant effect on height, root length and dry weight (all $p \leq 0.01$) after 21 days in the glasshouse (Figure 2). Germinants from the fine grits had a smaller shoot length and a lower mass than those from other grades. Root length, however,

was longer in germinants from the fine grits. Grit source had no significant effect on germinant morphology.

A high proportion of germinants from the mixed (90%) and coarse (87%) grits were undergoing shoot growth after 21 days, significantly greater ($p \leq 0.001$) than the proportion of those from the fine grit (76%) (Figure 3). Grit source had no significant effect on these values.

Diseased (mostly due to damping off fungi) and/or unhealthy germinants were significantly more frequent in the fine (14%) than in the mixed (8%) or coarse (4%) grits (Figure 3). Grit source had no significant effect.

Soil pH

The effect of grits on soil pH was most pronounced for the layer nearest the seeds. Data are presented for this layer only (Figure 4), although the trend was generally consistent across each layer.

The pH of the pots containing soil only (control) was increased by approximately 0.5 pH units, presumably as a result of the influence of the near neutral tap water. The pH of the control pots is indicated as a horizontal line in Figure 4.

The pH of the soil just beneath the seeds was increased in some mixed and fine grits of some sources, but not in the coarse grits of any source, compared with the control (soil only) (Figure 4). There was an increase of nearly 2 pH units in the mixed and fine grits of C1, but the effect was smaller in A2 (approximately 0.5 pH units). The fine grit of B1 increased pH by a similar amount to that of A2, but the effect was not reflected in the mixed grit of this source. This is presumably due to the fact that the proportion of fine grit was only 40% in B1, compared with 60% in A2.

Discussion

The results of this study clearly show that grit grade had a large impact on seed germination and the early growth and health of Sitka spruce germinants. The results also show that some of the grit types or sources (all used in Coillte nurseries in 1993) may not be suitable for covering Sitka spruce seeds.

Seed germination, stage of development and germinant morphology were best when the coarse (2.0-6.0 mm) grits were used. Grit source had no significant effect on this outcome. Soil pH also was not significantly influenced by this grit type. These results underline the value of using relatively large diameter grits to cover Sitka spruce seeds in Irish nurseries. It is likely that other species would equally benefit from using these grits (cf. Faulkner, 1953; Mason, 1994). Very large diameter grits (>6.0 mm) are not recommended for covering seeds (Mason, 1994), but the effects of using such grits were not investigated here.

In contrast, the fine grits had the most negative effect on germination, morphology, stage of development and health. There were significant differences among grit sources for the fine grits, perhaps due in part to the highly significant effect on soil pH for this grade.

The results for all variables in using the mixed grits were closer to those obtained using the coarse than the fine grits. Unlike the coarse grits, however, there was considerable variation among sources in germination, ranging from approximately 62% in C2 to 89% in A1. Soil pH was increased significantly in two of these grits, perhaps contributing to the reduction in germination. Nevertheless, evidence from this trial suggests that the proportion of

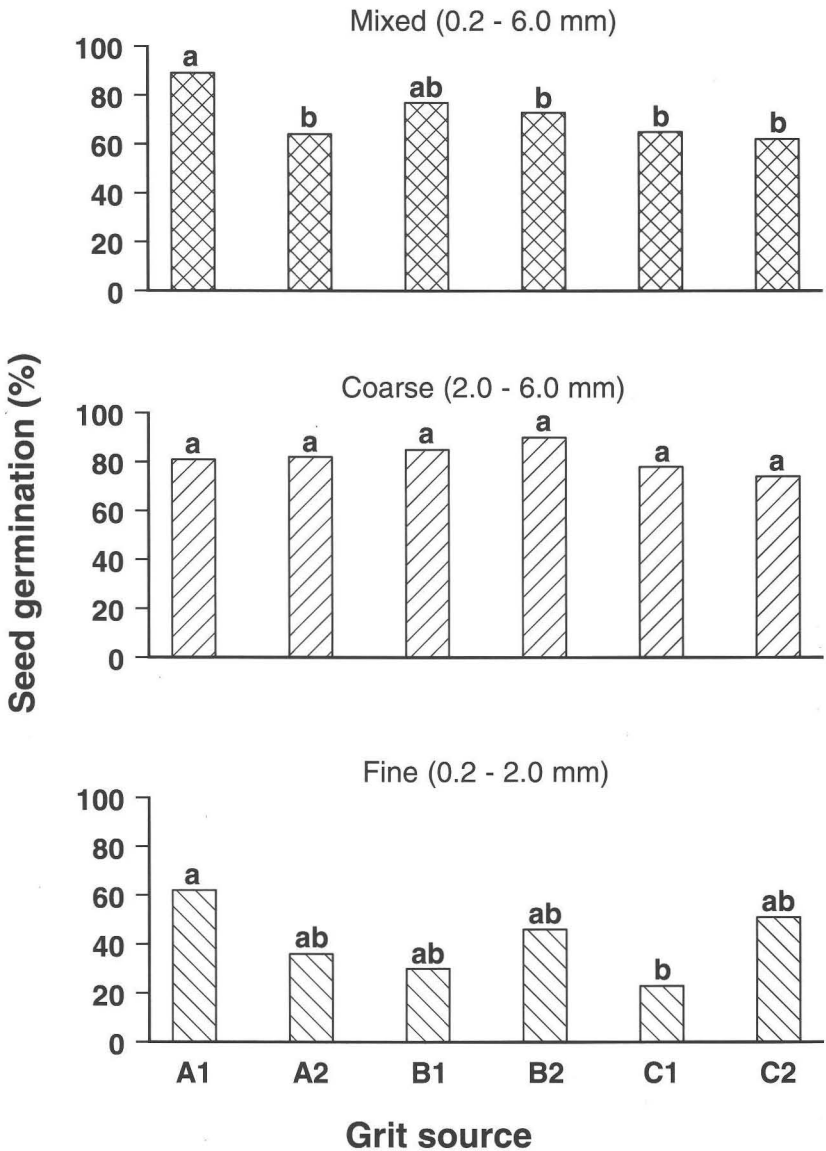

Figure 1. *The effect of grit grade within each of six different grit sources on the germination of Sitka spruce seeds in a greenhouse trial after 21 days. Values having the same letter within each grade are not significantly different at $p \leq 0.05$. The grits from the three nurseries are denoted by an arbitrary letter (A, B and C), followed by an arbitrary number for each of the two grits per nursery.*

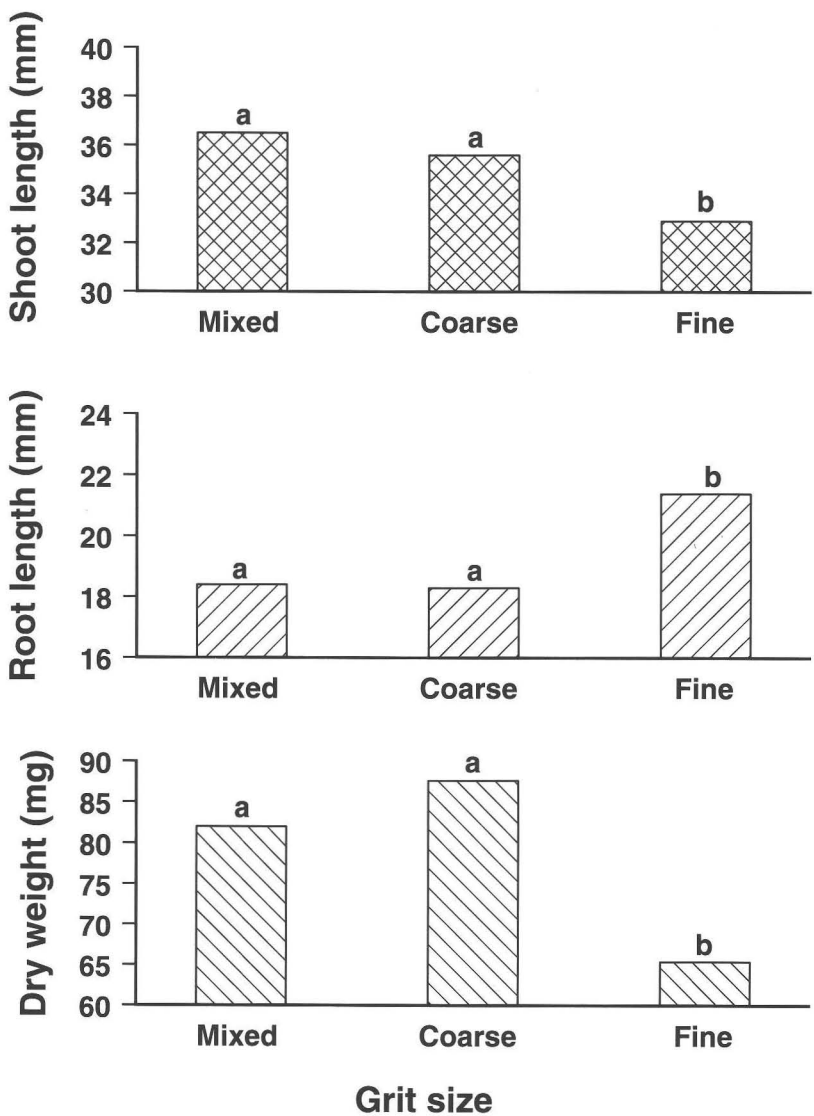

Figure 2. *The effect of grit grade averaged across all grit sources on the morphology of Sitka spruce seeds in a greenhouse trial after 21 days. Values having the same letter are not significantly different at $p \leq 0.05$. Grit source was not significant.*

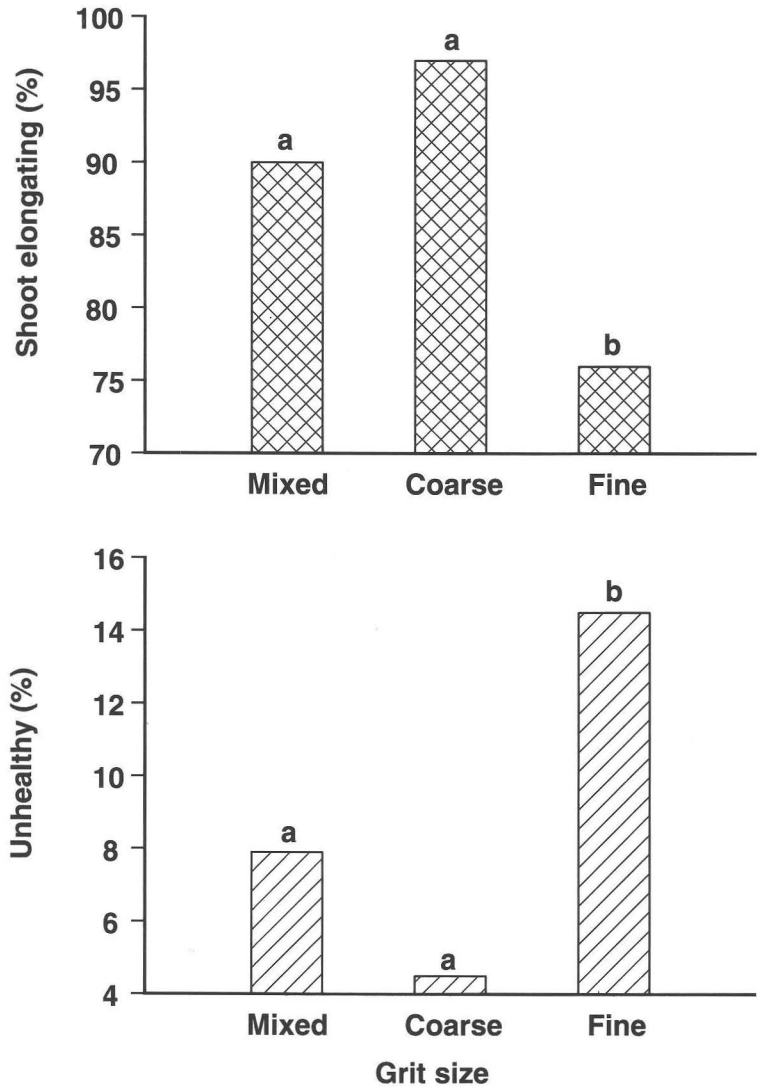

Figure 3. *The effect of grit grade averaged across all grit sources on the stage of development and health of Sitka spruce seeds in a greenhouse trial after 21 days. Values having the same letter are not significantly different at $p \leq 0.05$ for each variable. Grit source was not significant.*

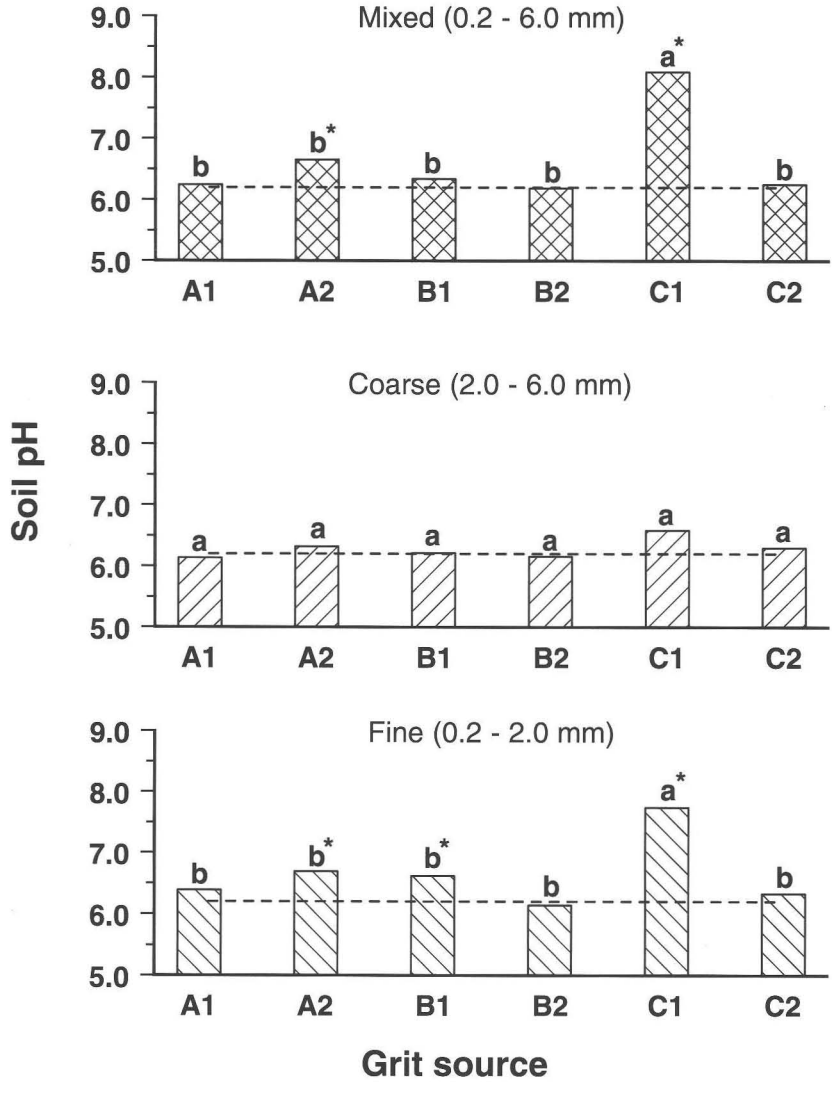

Figure 4. *The effect of grit grade within each of six different grit sources on the pH of the soil in a greenhouse trial after 21 days. Values having the same letter within each grade are not significantly different at $p \leq 0.05$. The dashed horizontal line refers to the pH of the control (soil only). Values indicated (*) are significantly different from the control. The grits from the three nurseries are denoted by an arbitrary letter (A, B and C), followed by an arbitrary number for each of the two grits per nursery.*

fine grits in the mixed grit also had a large impact on most variables. Grits having a low proportion of fine grits performed best, giving results similar to the coarse grit of that type. The mixed grits were almost identical to ungraded grits, except that the very small material was also removed (mostly very fine sand and silt comprising approximately 1-1.5% of the total).

Other workers have found that grits having a high proportion of particles in the 3.0-5.0 mm range gave the highest yield of Sitka spruce seedlings, compared with fine or coarse grade material (Mason, 1994). Hallet (1982), working in eastern Canada, suggests that grits predominantly in the 1.0-4.0 mm size category (60-80% in the 1.0-2.0 mm and 15-40% in the 2.0 mm range, with few fines) should be used for covering seeds of spruce or pine (*Pinus* spp.) when grown in containers. Other conifer species may have similar requirements to Sitka spruce, although there is evidence that some small-seeded species (e.g. *Thuja plicata* D. Don and *Chamaecyparis lawsoniana* (Murr.) Parlatore) may germinate better using coarse sand rather than grit (Gordon and Wakeman, 1979). There is little other information on the effects of grit grade on the germination and growth of conifers.

This study also provided evidence that some grits being used in Irish nurseries increase soil pH. In addition to the possible direct effect on germination, an increase in pH will have a detrimental effect on the nursery soil in the long term, perhaps contributing to the development of nutrition problems (Mason, 1994). The presence of free lime is undesirable and can be detected using vinegar or dilute hydrochloric acid, with the grit fizzing if it contains too much lime (*Ibid.*). The actual level of free lime in the grits studied was, however, not determined analytically. Three of the six grits used in this study increased soil pH, and the effect for one grit was dramatic, increasing it by nearly 2 units. However, as this experiment was carried out in a controlled greenhouse environment using local tap water (near neutral pH), it is difficult to extrapolate from these results to the nursery. In addition, the results presented here were for pH effects in the germination zone only, and the effect was less pronounced in deeper layers. Nevertheless, two points are worth noting. First, it is likely that soil pH is perhaps affected more in the nursery as the grits remain in the soil for a much longer period than was examined in this study. Second, even if average soil pH is only slightly influenced by the grit, it is likely that the impact on soil pH in the germination layer (Figure 4) is much more marked, perhaps contributing to a reduction in seed germination (Figure 1).

Recommendations

1. Only grits containing a high proportion ($\geq$60%) of coarse (2.0-6.0 mm) material should be used to cover Sitka spruce seeds.
2. The content of free lime in the grits should be low. The grit should pass the test described above (after Mason, 1994).

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Peer reviewed paper

The development of urban forestry in Northern Ireland[1]

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Abstract

Urban forestry in Northern Ireland has made excellent progress since the concept was given government recognition in 1990. This progress has been achieved against a background of severe economic difficulties exacerbated by political instability and widespread civil unrest. Despite an erratic and low level of funding, the Forest of Belfast project has developed as a model for a planned, systematic and integrated approach to urban tree management which could be replicated by other public and voluntary sector organisations outside the Greater Belfast area. With the prospect of an end to 'the Troubles', there could soon be an opportunity for urban forestry to make a major contribution to the regeneration of Northern Ireland's towns and cities.

Key words: urban forestry, Northern Ireland, urban tree projects, central and local government, voluntary sector

Introduction

This paper charts the development of urban forestry in Northern Ireland, from its origins through to June 1998. It draws on published material in relevant journals, periodicals, conference proceedings and in the press. Unpublished material has also been used, mainly in the form of internal reports. These secondary sources have been supplemented by a considerable amount of original research. A questionnaire seeking information and opinion on the development of urban forestry in Northern Ireland was sent to 19 individuals known to be involved in the field. Eleven replies were received, containing valuable information for further research. A series of nine tape-recorded interviews were subsequently conducted with eight individuals identified as having played a prominent role in urban forestry in Northern Ireland. Some material was also taken from three tape-recorded interviews with individuals based in Britain and the Republic of Ireland.

Although geographically part of the island of Ireland, Northern Ireland is governed as part of the United Kingdom. It was created in 1921, following the partition of Ireland, out of six of the nine counties of the Province of Ulster (Kee, 1980). It is often popularly referred to as 'the Province' or 'Ulster', although three of Ulster's counties are under the jurisdiction of the Republic of Ireland. The only major city in Northern Ireland is Belfast, whose urban area contains approximately one-third of the total population of 1.6 million people.

[1] This paper forms the basis of part of a thesis 'The Development of Urban Forestry in Britain and Ireland' to be submitted under the regulations of the University of Ulster for the degree of Doctor of Philosophy.

From the late 1940s, Belfast experienced a steady decline in its traditional heavy industries, leaving a legacy of extensive dereliction and wasteland. The government's early attempts at economic regeneration were having little impact when the situation deteriorated further in the late 1960s. Widespread civil disturbances and armed conflict, known as 'the Troubles', broke out across much of Northern Ireland (Bew and Gillespie, 1993).

As a result of the deteriorating political situation, the Northern Ireland Parliament was suspended in 1972 and many of the executive powers normally vested in local government were replaced by 'direct rule' from central government agencies (Bew and Gillespie, 1993). These changes in statutory responsibility have had a significant impact on many aspects of the planning and management of urban trees and landscapes, which are now largely under the control of various sections of the Department of the Environment (Northern Ireland) (DoE(NI)) (Hunter Blair, 1996; Parkinson, interview, 1997). The Northern Ireland Housing Executive, another government agency, has responsibility for trees and landscapes on publicly owned housing estates. Local authorities in Northern Ireland, however, continue to manage their own parks and open spaces and are responsible for the daily management of highway trees under agency agreements with the DoE Roads Service (1993).

Local authorities in Northern Ireland, like those in the Republic of Ireland, have not developed specialist Tree Officer posts. At a time when the creation of these posts was becoming common in Britain, local authorities in Northern Ireland were losing many of their statutory responsibilities for urban trees under the direct rule policy. While the Northern Ireland Forest Service has been at the forefront of the development of urban forestry, foresters are not directly involved to any significant extent in the management of urban trees. There are also very few arboriculturists in Northern Ireland, the professional background most associated with Tree Officers in Britain. The planning and management of urban trees is invariably undertaken by a wide range of other professionals, particularly horticulturists and landscape architects, who usually have additional responsibilities for other aspects of landscape management. Belfast City Council is still the only local authority in Northern Ireland with a specialist Tree Section. There are no arboriculturists working in any of the central government agencies.

Initial recognition of the concept

Interest in urban forestry in Northern Ireland emerged initially in the early 1980s among a small groups of civil servants at the DoE(NI) (Boyd, interview, 1996). Against a background of continuing economic and environmental decline, the DoE(NI) was constantly looking for new ways to help regenerate the many depressed areas of Northern Ireland, particularly in Belfast. At that time, the DoE(NI) had an imaginative Landscape Section which was particularly receptive to some of the innovative approaches to urban landscape management then emanating from Britain. The Landscape Section worked closely in a support role with other sections of the DoE(NI), such as the Belfast Development Office (BDO), the Planning Service and the Works Division. It was through these regular contacts with the Landscape Section that David Boyd, a Senior Principal Officer in the BDO, first heard the term 'urban forestry'. Through his work in the BDO, Boyd was to play a crucial part in gaining official recognition for the concept of urban forestry in Northern Ireland (McClean, interview, 1996).

The role of the BDO, as a branch of the Urban Affairs Division of the DoE(NI), focused

on promoting economic and environmental improvements throughout the Greater Belfast area (Cadden, interview, 1996). Boyd recognised immediately the potential of urban forestry as a new and radical approach to 'greening' derelict and vacant land. His interest was fostered by Ross Anderson of the ASH Partnership in Glasgow, a pioneer of urban forestry in Britain, who was then engaged as a consultant to the Urban Affairs Division on urban regeneration initiatives (Boyd, interview, 1996).

To promote urban forestry within the relevant public and voluntary organisations, Boyd decided to organise a 1-day seminar on the subject. Andy Lipkis of the TreePeople organisation in Los Angeles, an early pioneer of urban forestry in the United States, was visiting Dublin at this time and accepted an invitation to give a presentation at the event. Roy Stirrat (interview, 1995) of Northern Planners in Glasgow, another pioneer of urban forestry in Britain, also agreed to give a presentation.

The BDO's seminar was held in Belfast in September 1984, marking the beginning of the development of urban forestry in Northern Ireland. It was successful in promoting the concept, not only to senior officials within the DoE(NI), but also to officials from Belfast City Council, the Forest Service and a number of other relevant organisations and agencies (Boyd, interview, 1996). Most importantly, the seminar achieved Boyd's major aim of convincing his own Under-Secretary within the DoE(NI) that urban forestry was a concept with sufficient relevance to Belfast to justify substantial funding. Consequently, urban forestry became a part of the programme of the Urban Affairs Division of the DoE(NI) in 1985, and Boyd was able to allocate initial funding of some Stg£100,000 from his own budget at the BDO.

Boyd's deputy at the BDO was Eddie Cadden (interview, 1996), who became responsible for translating Boyd's initial interest in urban forestry into practical action. It was Cadden's commitment to the concept, perhaps more than any other factor, that was to lead to the development of a series of practical initiatives in the Belfast area which rapidly established urban forestry in Northern Ireland.

Early practical projects in Belfast

Following the DoE(NI) seminar in 1984, the relevance of urban forestry became apparent in some practical urban regeneration initiatives already involving the BDO (Cadden, interview, 1996). The Colin Glen Forest Park was being developed as an area of public open space in West Belfast which would provide a 'green finger' for recreation and conservation, in contrast to the dense residential developments of the vast new housing estates in Poleglass and Twinbrook. The idea for the project had initially come from Peter Deahl of the DoE(NI)'s Landscape Section and its practical implementation had begun under an Action for Community Employment (ACE) scheme, a government funded training and employment scheme that engaged long term unemployed people. The BDO was requested to provide some funding for the project. It did this by employing consultants and contractors to undertake landscape and engineering works which were beyond the expertise of the workers on the ACE scheme. This initial funding came out of the BDO's allocation for urban forestry.

In 1989, the Colin Glen Trust was formed as a registered charity with responsibility for the management of the Forest Park which comprised 80 ha of scenic woodland, river, open grassland and wildflower meadows. This exciting initiative has become a major environmental education resource for school children as well as a popular recreation area for the people of West Belfast. While it generates some income through its golf course and other

leisure facilities, it receives the vast majority of its funding from various central government agencies (Colin Glen Trust, 1993). In 1996, it won an award in the Highly Commended category of the ILAM Open Space Management Award (Anon., 1996a).

The development of the Colin Glen had a significant impact on many professionals involved with trees and the urban environment (Bankhead, pers. comm., 1996; Hunter Blair, 1996). The transformation of this previously neglected landscape into a 'green oasis' in West Belfast has been widely praised as an example of what is possible in both 'urban greening' and employment creation. While the project has evolved more as a leisure and environmental facility rather than as an urban forestry initiative, it is still an excellent example of multi-purpose woodland management on the urban fringe.

At the same time as funding Colin Glen Forest Park, the BDO was also looking at positive uses for the extensive area of reclaimed land in the Harbour area adjacent to the M2 motorway (Cadden, interview, 1996). Known as the North Foreshore, this was being used as a waste disposal site with the intention that it be eventually developed as part of the Harbour Industrial Estate. Due to problems of land settlement and landfill gases, however, it would not be possible to build on the site for many years. Urban forestry seemed an ideal solution and Cadden commissioned the ASH Partnership to design and implement a forest-type planting scheme over much of the site (Anon., 1989). The trees would provide an intermediate productive land use and create an attractive landscape framework whenever the site was eventually developed for industrial use. The trees are now 10 years old and have already dramatically improved the quality of the landscape for people approaching the city on the M2 motorway.

Belfast has very few street trees (ASH Partnership, 1989), in comparison with Dublin or cities of a similar size in Britain. Although a programme of systematic planting had taken place immediately before and after the first world war, many of these trees had disappeared or were in poor condition by the late 1970s. A survey by Belfast City Council in the early 1980s found that out of a total of 5,500 mature street trees, some 3,900 required tree surgery. The data from this survey were then incorporated into a computerised inventory which continues to be used by Belfast City Council in the management of the trees, acting as agents for the DoE Roads Service. In 1984, a street tree planting programme commenced in some of the previously treeless streets in the city centre. By May 1989, 1,700 trees had been planted, with funding from the BDO out of its allocation for urban forestry. From June 1985 to February 1987, some 3,000 of the existing 3,900 trees in poor condition were pruned by Belfast City Council staff or by contractors engaged by them. Funding of Stg£70,000 for this maintenance work was again obtained from the BDO out of its allocation for urban forestry.

The Belfast urban forestry initiative

The growing interest in urban forestry in Belfast was given official government recognition when the establishment of an extensive urban forest was included as an objective in the *Belfast Urban Area Plan 2001* (DoE(NI), 1990). The draft document was issued by the DoE(NI) in November 1987 and the final document was published in 1990. This was probably the first time that the establishment of an urban forest had been included as an objective in a regional planning document for any urban area in either Ireland or Britain. In developing the draft plan, sections of the DoE(NI) had been invited to submit papers highlighting themes and initiatives which they regarded as relevant (Cadden, interview,

1996). As many of these had mentioned the importance of urban forestry, this was formalised as one of the objectives.

In March 1988, Boyd (interview, 1996) and three other senior officials from the DoE(NI) attended the 1st UK Urban Forestry Conference, held in the West Midlands. John McClean, Director of Conservation Volunteers Northern Ireland (CVNI), also attended. They were greatly impressed by the event and particularly interested to learn that there were already some established projects in Britain (Boyd, interview, 1996). Although Cadden (interview, 1996) was unable to attend the conference, the enthusiasm of his colleagues and the exciting literature they brought back encouraged him to begin exploring the possibility of a major urban forestry project covering the whole of Belfast.

In July 1988, the BDO commissioned the ASH Partnership to undertake an extensive study of the potential for a city-wide urban forestry initiative in Belfast (ASH Partnership, 1989). The first part of the study comprised an evaluation of the street tree programme in the city, with recommendations for future planting and maintenance. The second part of the study examined the relevance of urban forestry to Belfast, referring to examples of existing projects in Britain. It concluded with a series of recommendations for the establishment and implementation of an extensive urban forestry programme over a 10-year period. These included the formation of a Steering Committee of relevant public and voluntary sector organisations to direct the initiative, and an Urban Forestry Task Force to coordinate the planting and maintenance programmes. The Task Force, comprising a Director and other specialist staff, would cost nearly Stg£2 million over the period. The planting and maintenance programmes called for an expenditure of some Stg£20 million. The results of the study and its recommendations were contained in a consultative document, which has become known as the ASH Report, submitted to the BDO in May 1989.

In the summer of 1989, when the ASH Report was circulated among the relevant public and voluntary organisations in Belfast, it was given a mixed reception (Cadden, interview, 1996). While most supported the idea of a major urban forestry project, concerns were expressed regarding the total cost of the proposed programme. While the BDO had been aware that the report's recommendations would call for significant levels of expenditure, a cost of Stg£22 million was not anticipated. Although surprised by the amount, the BDO had never intended this to be met by 'new' monies added to the BDO's existing budget or by any other single source. In its view, the cost of the programme could be met through a mixture of private and public funds from a range of agencies and organisations. The ASH Report had not described how the funding would be raised and when this was explained to the various organisations and agencies by the BDO, their initial shock began to subside.

Although the BDO's proposals were now generating a more favourable reaction, other public agencies were hesitant to offer any financial contribution to the initiative (Cadden, interview, 1996). As discussions on a possible funding package were making little progress, the early enthusiasm for the initiative began to dissipate. In an effort to maintain interest, Cadden organised several study trips for small groups of central and local government officials in Belfast to look at what was being achieved through urban forestry in Britain.

At the same time as trying to develop a city-wide urban forestry project, Cadden (interview, 1996) was also pursuing a nature conservation strategy for Belfast. This was also linked to clearly defined objectives in the *Belfast Urban Area Plan 2001*. On behalf of the BDO, he commissioned a team of consultants to conduct a survey and to produce a detailed nature conservation strategy document. The strategy, entitled *Nature in the City*

(DoE(NI), 1992), was published in March 1992. The information gathered in the survey was placed on a computerised database at the Ulster Museum. The concept of urban forestry was specifically mentioned, with the strategy recommending that the database be used to help determine species and site selection in future tree planting programmes for the city.

The Forest of Belfast

In the summer of 1991, Cadden decided to make another attempt to promote a city-wide urban forestry initiative for Belfast (Johnston, 1995). As a first step, he decided to form the Urban Forest Technical Group. This would be an advisory body to the BDO comprising representatives from the major relevant public and voluntary organisations. Its aim would be to generate discussion on how best to proceed with any project. In July 1991, the BDO commissioned the ASH Partnership to form the Technical Group and to progress the initiative. ASH then recruited Mark Johnston, formerly of the Forest of London Trust, to undertake the work.

The early development of the Forest of Belfast

The first stage of the initiative involved gaining official support for it from the relevant public and voluntary organisations. Several organisations were invited to nominate representatives to serve on the Technical Group. Maurice Parkinson, Head of Belfast City Council's Parks and Amenities Section, agreed to act as Chairperson.

The Technical Group's first meeting was held in August 1991, attended by representatives of the BDO, DoE Landscape and Planning Sections, the Forest Service and two voluntary organisations (Johnston, 1995). After this initial meeting, other public sector bodies were included, such as Belfast City Council, Castlereagh Borough Council, DoE Roads Service, DoE Countryside and Wildlife Branch, and the NI Housing Executive. Separate Community Action and Public Relations Subcommittees were formed, to include small voluntary organisations and to develop a promotional strategy for the initiative. To encourage an interest in urban forestry among individual professionals, the Technical Group organised a 1-day seminar at Malone House in March 1992. This successful event attracted almost 100 individuals and included speakers from Northern Ireland and Britain. The keynote address was given by Dick Abbott of ACRT, a leading urban forestry consultancy practice in the United States.

To assist in developing a promotional strategy, the Technical Group obtained the part-time services of a public relations consultant (Johnston, 1995). The time the consultant would spend working on the project was donated free by his company as a form of sponsorship. His first task was to produce a name for the project. The 'Forest of Belfast' was chosen as a title as projects with a similar name had already proved to have popular appeal in London and Cardiff, conveying something of the aims and vision of an urban forestry initiative. An attractive logo was designed and a range of promotional material produced.

To attract private sector interest in the Forest of Belfast, representatives from local companies were invited to a business lunch at Belfast Castle in June 1992 (Johnston, 1995). They were given a short presentation on the proposed project which highlighted its potential for sponsorship. Much of the success of the event was due to a television feature on the initiative broadcast by BBC Northern Ireland the previous week. In the year following the lunch, most companies present made some contribution to the project.

After much discussion by the Technical Group, the basic outline of the project was agreed. The Forest of Belfast would act as a partnership project, not as a separate tree planting and management agency (Johnston, 1995). Its role would be to promote and coordinate urban forestry events and activities by its partner organisations, to help raise funds for these, and to organise public relations and community involvement at events, when required (Anon., 1992a).

The Forest of Belfast was launched at an open-air event at Shaws Bridge on 18 June 1992. This featured the unveiling of a huge commemorative stone symbolising the commitment to the project by many different organisations and their determination to make it succeed. The launch was attended by the Permanent Secretary to the DoE(NI), the Lord Mayor of Belfast and over 100 invited guests and school children. It gained wide media coverage, including a feature on local television (Anon., 1992b). Shortly after the launch, further events involving school children were held. A children's 'Teddy Bears Picnic' was held in the Botanic Gardens, with 120 young people from all over Belfast taking part in an afternoon of environmental games (Anon., 1992c). Painting and creative writing competitions on the theme of trees were also organised through local schools, sponsored by *Irish News*, a local newspaper (Anon., 1992d, 1993a).

Before the launch of the Forest of Belfast, the Technical Group had agreed that the appointment of a full-time Urban Forester for Belfast was a priority (Johnston, 1995). The BDO had expressed a willingness to fund the post but hoped other public bodies would contribute. After discussions lasting several months, a funding package was agreed which still left the BDO effectively funding the post. In January 1993, Johnston of ASH was appointed as the Urban Forester. This appointment marked a significant development in urban forestry in both Ireland and Britain (Forest of Belfast, 1993). The post was unique in being supported by a partnership of public bodies with a brief to coordinate a comprehensive urban forestry initiative throughout a major city embracing several local authority districts.

The Urban Forester immediately began to concentrate on the more technical aspects of the project. The underlying aim of the Forest of Belfast was still to produce an urban forestry strategy for the city. Any meaningful strategy, however, would have to be based on a comprehensive survey of the existing urban forest and its potential for expansion. Due to the high cost of employing consultants to undertake a tree survey, the Technical Group enlisted the help of Enterprise Ulster, a government funded training and employment agency. From March 1993 through to the summer of 1995, several unemployed graduates were engaged to collect data. The survey methodology was based on two recently completed surveys in Britain (Cobham Resource Consultants, 1993; DoE, 1993).

Some members of the Technical Group wanted to produce an urban forestry strategy as soon as possible, rather than wait for the results of the survey. They hoped this might prompt the BDO into immediately increasing its funding for the Forest of Belfast. A discussion paper on the strategy was produced by the Urban Forester in March 1993. Several written comments were received from the Technical Group and these were included in a further discussion paper in August 1993. A draft public relations strategy for the project was produced by the public relations consultant in November 1993.

While work was progressing on the tree survey and strategy, community events and activities continued. The Forest of Belfast's Tree Warden Scheme was launched in April 1993, the first such scheme to be established anywhere in Ireland (Johnston, 1995). The scheme was organised on behalf of the Forest of Belfast by CVNI, with funding of Stg£5,000 from the BDO released to engage the part-time services of one of its Urban

Field Officers to coordinate the scheme and to organise training courses for the tree wardens. By the end of 1993, 20 tree wardens had been recruited and most were busy organising events and activities in their area in support of the project.

In June 1993, the Forest of Belfast organised a 2-day 'Tree Fair' festival held in Belvoir Park Forest on the outskirts of Belfast (Anon., 1993b). This entertaining and educational event on the theme of trees, forests and wood involved over 150 exhibitions and displays, including several from Britain and the Republic of Ireland, and attracted approximately 15,000 people (Johnston, 1995). The visual and performing arts formed a major part of the event, the centre-piece being a large wood sculpture entitled 'The Tree of Life' which remains on the site as a permanent memorial to the event. Much of the funding for the Tree Fair was provided by the Forest Service, although commercial sponsorship also played a significant role (Anon., 1993c).

In the autumn of 1993, the Forest of Belfast commissioned four community murals on the theme of people and trees, funded by the Arts Council of Northern Ireland and a local paint retailer (Anon., 1993d). Over 200 people of all ages helped local artists paint the murals which promoted a powerful and colourful message about the importance of trees. In December 1993, the Forest of Belfast organised a 'Tree Dressing Day' competition for schools and community groups, sponsored by the *News Letter*, a local newspaper (Anon., 1993e). This was the first event of its kind to be held in Northern Ireland, and with over 50 trees 'dressed' throughout Belfast, it was probably the largest environmental art event ever held in Ireland.

During the Forest of Belfast's first year, Stg£40,000 of sponsorship was raised to fund the project's community events and activities (Johnston, 1995). This amount was equal to the level of the BDO's core funding for the initiative. As the working relationship between the Urban Forester and the project's public relations consultant was proving so productive, the BDO agreed to employ the latter on a 1-year contract once the corporate sponsorship had ended.

During the Forest of Belfast's first planting season in 1992/93, its partner organisations planted a total of 160,000 trees (Johnston, 1995). Although there were no data to compare this total with previous years, most organisations reported an increase in planting as additional resources were committed to the project. In March 1993, the Forest of Belfast received Stg£20,000 from the BDO for community tree planting schemes coordinated by two of the project's voluntary organisations (Anon., 1993f). To give a boost to street tree planting in Belfast, a sponsorship scheme was launched by the DoE Roads Service, aimed at private companies and individuals (DoE Roads Service, 1993).

By the end of 1993, just as the project was becoming established as a major initiative in Belfast, its progress was disrupted by some unexpected events. Following an internal reorganisation of the BDO prompted by a financial crisis within the whole of the DoE(NI), Cadden (interview, 1996) was relieved of his responsibilities for urban forestry and assigned to other duties. He was replaced by officials who did not regard the Forest of Belfast as having a high priority in the current financial climate. The loss of Cadden as an enthusiastic advocate for urban forestry within the BDO at a time when it was experiencing financial difficulties was to have serious consequences for the Forest of Belfast. Although the project's Urban Forester and public relations consultant had been informed by the BDO that their contracts would be renewed, this decision was reversed (Johnston, 1995). The sudden departure of the Urban Forester in January 1994 was to have a damaging effect on the Forest of Belfast (Cadden, interview, 1996). For over a year, the project was without a full-time officer to coordinate and develop it. During this period, much of

the project was 'in limbo' and its public profile was significantly lowered. Valuable work, however, continued with the Tree Warden Scheme and technical aspects of the Forest of Belfast. The reduction in activity also allowed for a period of reflection on the future direction of the project (Hunter Blair, interview, 1997).

The Forest of Belfast since 1994

When renewed funding for the Forest of Belfast was eventually obtained from the BDO, the Technical Group, now referred to as the 'Steering Group', was able to advertise for another full-time officer. In February 1995, the Forest of Belfast began a new chapter in its development with the appointment of Dr Ben Simon as Forest Officer, a post with similar responsibilities to the Urban Forester. Simon (interview, 1997) had several years of experience in tree planting and conservation management with the Ulster Wildlife Trust.

During the Forest Officer's first year in 1995, the Forest of Belfast was able to make two significant advances towards its long term aim of becoming a comprehensive urban forestry initiative (Forest of Belfast, 1996). The first was the publication, in June 1995, of the results of the tree survey (Segoviano, 1995). This recorded, for the first time, the nature of the tree cover in different parts of the city, by each of the five local authority districts. The Belfast City Council area, by far the largest, was further divided into seven distinct zones. Most importantly, the survey provided sufficient information about the species, age, location, condition and ownership of Belfast's trees to develop a comprehensive and appropriate long term strategy for planting and management.

The second significant development was the production of the urban forestry strategy, issued at the same time as the survey results (Forest of Belfast, 1994). The document began by stating the aims and objectives of the Forest of Belfast. These included highlighting the need to conserve the city's existing trees and woodland, encouraging increased levels of new planting, and promoting community interest and involvement in the care and protection of the city's urban forest. While the strategy expressed the hope that the survey results would enable future resources to be targeted at areas of greatest need, its only quantified targets related to tree planting. These consisted of proposed increases in the percentage of tree cover in various zones over the next five or 10 years (Forest of Belfast, 1994). Achieving these targets would cost Stg£5,170,000 over the next 10 years, with a further Stg£750,000 required for maintenance. The calculations were based on the cost of planting whips at 2 m centres with an annual increase of 27 ha of new planting. While the strategy did not indicate how funding would be obtained, it did identify some priority sites for tree planting.

As well as these planting targets, the strategy also listed some broad recommendations aimed at enabling the Forest of Belfast to continue its valuable work in other aspects of urban forestry (Forest of Belfast, 1994). These included the continued employment of the Forest Officer, the further development of the Tree Warden Scheme, and a commitment to regularly update the tree survey. Core funding for the Forest of Belfast of Stg£32,000/year was recommended to enable it to undertake this work.

While the strategy did not include detailed management plans, there were good reasons for this. In view of the limited and unpredictable funding for the project, it would have been unwise to set too stringent targets in case these could not be achieved (McClean, interview, 1996). Although this would not allow precise monitoring and evaluation of the project, the Forest of Belfast did not have sufficient resources to conduct such an exercise (Parkinson, interview, 1997). Furthermore, as the Forest of Belfast was not an executive

organisation and could only encourage and facilitate the efforts of its partners, setting precise planting and management targets would not have been appropriate (Hunter Blair, interview, 1997). The publication of the strategy and the city-wide tree survey were landmark developments in urban forestry, as this was the first time that either had been achieved anywhere in Ireland.

The Steering Group was now keen to expand its membership to included relevant public and voluntary organisations not previously involved in the Forest of Belfast (1994). After repeated invitations over the previous few years, Newtownabbey Borough Council and Lisburn Borough Council finally joined the Steering Group, together with a small number of additional voluntary organisations (Forest of Belfast, 1996, 1997).

As well as gaining the participation of more organisations, the Forest of Belfast was keen to foster greater interest in urban forestry among individual professionals. A seminar was held at Belfast Castle in May 1997, including presentations on the progress of the Forest of Belfast, the importance of sustainable development and the role of trees in urban regeneration (Forest of Belfast, 1998). One of the speakers was Nerys Jones, Executive Director of the National Urban Forestry Unit in England. A further seminar was held in February 1998 at Malone House, addressing trees and development in the urban area. It included two speakers involved in urban forestry in Scotland, David Jamieson of the Edinburgh Urban Forest Project and Simon MacGillivray, Director of the Scottish Greenbelt Company. The seminar attracted over 100 delegates and did much to raise the profile of urban trees in relation to planning issues. This was a subject which the Forest of Belfast had been trying to highlight for some time, given the ineffectiveness of planning controls in Northern Ireland to protect existing trees and to ensure adequate and appropriate new planting.

While very limited resources were now available to the Forest of Belfast for promotional work, it began to again attract significant media coverage of its events and activities (Simon, interview, 1997). The continuing progress of the Tree Warden Scheme was particularly helpful in generating public interest in the project (Forest of Belfast, 1996, 1997). Although the impact of the scheme was still limited by the lack of a full-time coordinator, many excellent planting events and other activities were organised (McClean, interview, 1996). During the 1995/96 season, 8,000 trees were given away free by the Forest of Belfast to individual Tree Wardens and local groups for community tree planting schemes (Forest of Belfast, 1996). In the 1996/97 season, a further 10,200 trees were supplied for community planting at more than 50 sites (Forest of Belfast, 1997). Although these were planted throughout Belfast, efforts were made to ensure a high proportion were planted in areas identified as having low levels of tree cover.

In early 1997, the Steering Group was able to secure substantial funding for its community tree planting efforts. An application was approved under the European Union's Peace and Reconciliation Fund for Stg£120,000 over a 3-year period (Simon, interview, 1997). This grant aid was 75% funded by the Peace and Reconciliation Fund, 20% funded by Belfast City Council and 5% funded from the resources of the Forest of Belfast project. The funding, however, was only for the trees and did not include the provision of a post to coordinate the plantings (Parkinson, interview, 1997). This had to be done by the Forest Officer in addition to his existing commitments, with the post-planting maintenance undertaken by the groups carrying out the planting (Simon, interview, 1998). During the 1997/98 season, approximately 40,000 trees were planted at nearly 150 sites (Forest of Belfast, 1998), with the majority of the plantings undertaken to a high standard (Simon, interview, 1998). The Forest of Belfast continues to ensure its community tree planting

schemes are exciting and imaginative events. One of the most successful was its 1-day 'Plantathon' event, held in November 1997 (Forest of Belfast, 1998). During the day, approximately 200 adults and children planted 5,900 trees to create a hedge over 1 km long on the edge of Ormeau Park in South Belfast.

In another measure to promote the planting activities of the Forest of Belfast, some schemes undertaken by its partner organisations have included the erection of a sign-board to promote the scheme as part of the project (Simon, interview, 1997). Some publicity for the Forest of Belfast was also obtained through the sponsorship by Phoenix Natural Gas of tree planting in the city centre (Anon., 1997a). The DoE Road Service's street tree sponsorship scheme, however, has proved less successful, with very few trees being sponsored (Parkinson, interview, 1997). This is probably due to the high cost of each tree and a lack of promotion for the scheme.

In September 1996, the Forest of Belfast organised another 2-day Tree Fair event in Belvoir Park Forest (Forest of Belfast, 1996). This attracted nearly 4,000 visitors and included displays and demonstrations by a wide range of public, private and voluntary organisation. Once again, the event included a strong element of the arts and crafts. The Forest of Belfast also commissioned three sculptures on the theme of woodland, sited on the banks of the River Lagan opposite Belvoir Park Forest. In April 1998, a third fair was incorporated into Belfast City Council's Spring Flower Show, held at Malone House and Barnett Demesne (Simon, interview, 1998).

While the Forest of Belfast was now making excellent progress, it had still not managed to increase the level of its core funding which was limiting any substantial development of the project. In 1997, the vast majority of this, only Stg£25,000, was still being provided by the BDO, with an additional Stg£6,000 from the Housing Executive (Anderson, interview, 1997). None of the Forest of Belfast's other partners were making any significant financial contribution, although Belfast City Council was providing office accommodation for the Forest Officer and bearing some of the ancillary costs associated with the post. Following the departure of Cadden, the BDO itself had been playing a far less proactive role in the Forest of Belfast. Its involvement was now mainly concerned with providing a secretariat to the Steering Group and acting as the 'banker' for the project.

In March 1997, the future of the Forest of Belfast was again placed in doubt when the BDO was merged with Making Belfast Work, another section of the Urban Affairs Division of the DoE(NI) (Anderson, interview, 1997). The merger had followed a Public Expenditure Survey which had imposed severe cuts in the budget of the Urban Affairs Division. The BDO's existing funding for the Forest of Belfast was due to expire at the end of the 1997/98 financial year, and there was no indication that the Belfast Regeneration Office (BRO), which had assumed the BDO's role in the project, would be able to continue its funding after that time (Parkinson, interview, 1997). Following several months of uncertainty, the situation was temporarily resolved when the BRO announced that it would continue to support the Forest of Belfast in the short term (Lucas, pers. comm., 1997). Any extended period of funding would depend on an evaluation of the achievements of the Forest of Belfast and an assessment of its future direction. In the meantime, however, the BDO's annual funding of Stg£5,000 to CVNI for the Tree Warden Scheme had ceased (Simon, interview, 1998). In the 1997/98 financial year, this was provided out of the Forest of Belfast's own budget. In April 1998, a further Stg£2,500 was provided out of this budget to enable the scheme to continue for a further six months. Unless, however, an alternative source of funding for the scheme can be secured, its future looks bleak.

In the spring of 1998, the BRO commissioned a financial consultant to undertake an evaluation of the Forest of Belfast, partly with the aim of developing an 'exit strategy' should the BRO decide not to continue its funding (Simon, interview, 1998). The consultant's report, however, found that the BRO's funding represented excellent value for money and recommended that it should continue. It also recommended an additional member of staff to assist the Forest Officer and that the partner organisations make some regular and direct financial contribution to the project. The acceptance of the consultant's recommendations by the BRO and the Forest of Belfast's Steering Group would mean a far more secure future for the project after the periodic uncertainties of the past.

Since its launch in 1992, the Forest of Belfast has achieved a remarkable level of success with a limited and unpredictable level of resources (Hunter Blair, interview, 1997). This success was formally recognised when the Forest of Belfast received the Urban Forestry Award for 1997 from the Royal Dublin Society in its annual Irish Forestry Award (Forest of Belfast, 1997). The project has developed successfully into a wide ranging initiative embracing most aspects of the planning and management of trees and woodland in the Belfast area. The Steering Group has always been conscious of the need to develop a planned, systematic and integrated approach to the management of Belfast's urban forest and continues to make steady progress in this regard. While the Forest of Belfast may not yet have achieved the level of planting envisaged in the strategy, its partner organisations are planting significantly great numbers of trees, and tree cover in many areas of Belfast is undoubtedly increasing (Parkinson, interview, 1997).

The Forest Service and grant aid

The Forest Service of the Department of Agriculture (Northern Ireland) is the forestry authority for Northern Ireland and an entirely separate organisation from the British Forestry Commission. Although not directly involved in urban tree planting to any great extent, it has been keen to encourage it through the allocation of grant aid. A report on proposals for community woodlands was produced by the Forest Service in conjunction with the DoE(NI), culminating in the launch of the Community Woodlands Initiative in October 1992 (Forest Service, 1993). A major feature of the initiative was the expansion of the Forest Service's Woodland Grant Scheme to include a Community Woodland Supplement, an additional Stg£950/ha, to encourage the creation of new woodland close to towns and cities. Although there was little response to the Community Woodland Supplement in the first few years, there has been steady growth in the total amount of this grant paid out, as local authorities and other landowners have become more aware of the scheme (Forest Service, 1995, 1996, 1997). A successful seminar for local authorities on the potential for community woodlands was held at Pomeroy Forestry School in June 1993 (Forest Service, 1994).

In 1994, the Forest Service approved a Community Woodland Plan for Greater Belfast which had been prepared by the Forest of Belfast's Steering Group. The plan identified major areas of existing woodland and areas of opportunity for new planting (Forest Service, 1995; Chambers, interview, 1996). A similar plan for the Craigavon area has also been prepared by Craigavon Borough Council and approved by the Forest Service. The production of these plans has promoted a significant increase in planting in both areas. The Forest Service's grant schemes continue to encourage new urban and urban fringe tree planting projects (Hunter Blair, interview, 1997). The new Glenside Forest of 70 ha has been planted by RMC Quarries Ltd. adjacent to Hannahstown in Belfast, most of which received grant aid.

The Forest Service has also been keen to encourage applications for its tree management grants. In 1996, it paid this grant to Rathfern Residents Association to bring into management 10.5 ha of neglected woodland owned by the Housing Executive on the slopes of Carmoney Hill, on the northern outskirts of Belfast (Forest Service, 1997).

The Forest Service's Belvoir Park Forest has recently received much recognition as a model of multi-purpose woodland management in the urban fringe (Hodge, 1995). In 1996, it won the Urban Forestry Award in the Royal Dublin Society's annual Irish Forestry Award (Forest Service, 1997). Located in south Belfast just 4 km from the city centre, a significant section of this 75 ha forest has been under threat for several years from plans by the DoE Roads Service to build a new relief road. These plans have met with sustained and vigorous opposition from local conservation and community groups (Anon., 1992e). To many people, it is inconceivable that a public body should be involved in a major 'greening' initiative for Belfast, while at the same time proposing to destroy and degrade a large part of the city's most valuable woodland asset. While the matter is still unresolved, a major road through the forest seems increasingly unlikely (Simon, interview, 1998).

The Forest Service has consistently been very supportive of the concept of urban forestry and has made a major contribution to the development of the Forest of Belfast (Johnston, 1995). Much of this is due to the enthusiasm of its Planning Branch which has played an active role on the project's Steering Group since its formation. With the recent development of an urban forestry project in Derry, the Forest Service intends to play a similarly constructive role in that initiative.

Urban forestry in Derry

Following the launch of the Forest of Belfast in 1992, there was much discussion among the Steering Group about the possibility of similar projects in other towns and cities in Northern Ireland. Much of this discussion centred on the prospects for urban forestry in Derry, the second largest city in the region. Although Derry has a legacy of fine trees and parks from Victorian times, much of this is situated on the outskirts of the city (PRONI, 1984). Large areas of Derry, like Belfast, have been economically depressed for many years and the city has also suffered greatly from the Troubles.

The Londonderry Development Office (LDO) had been showing an interest in the Forest of Belfast from an early stage (McClean, interview, 1996). The LDO has very similar responsibilities in Derry to the BDO in Belfast, and is also part of the Urban Affairs Division of the DoE(NI). It saw a similar project in Derry as an opportunity to bring together the many different public and voluntary organisations and work with local community groups to 'green' some of the more depressed and desolate parts of the city. The LDO's interest was fostered by the Forest Service which had targeted Derry as one of the areas where it was keen to see a substantial uptake in its Community Woodland Supplement (Hunter Blair, interview, 1997). Some members of the Forest of Belfast's Steering Group also began visiting Derry to discuss urban forestry with professionals there.

Although interest in urban forestry was initially slow to develop in Derry (Simon, interview, 1997), the LDO became increasingly convinced that some form of project based on the Forest of Belfast model would be of benefit to the city (Magowan, interview, 1998). In March 1997, it commissioned CVNI to produce a Development Plan for the implementation of an urban forestry strategy in Derry. CVNI's plan recommended the

establishment of an urban forestry project including community tree planting programmes, educational activities with schools, and many other community-based activities (CVNI, 1997a). It was hoped that the major public and voluntary organisations in the city would join a Steering Group to help develop the project. Much of the emphasis of the Development Plan was on the contribution an urban forestry project could make to the aims of Local Agenda 21. Communities in Derry could be empowered to make a real and lasting improvement to their own neighbourhood (Magowan, interview, 1998).

The Development Plan was approved by the LDO which then invited a wide range of public and voluntary organisations to participate in a Steering Group (Magowan, interview, 1998). Public sector bodies agreeing to attend included the Housing Executive, Derry City Council, the Forest Service and the Industrial Development Board. Funding for the project over a 3-year period was approved by the LDO to enable CVNI to implement the Development Plan. CVNI then requested its Local Field Officer, John Magowan, to work full-time on the project as its coordinator.

The first stage in developing the practical aspects of the project involved an extensive series of meetings with local community groups to encourage their interest and involvement (Magowan, interview, 1998). Once interest had been secured, residents were invited to attend a programme of courses run by CVNI giving basic instruction on various aspects of tree planting and management. CVNI's approach to the project was to encourage local groups to do as much of the planning and planting as possible. CVNI's role was to act as a catalyst for community action and to provide groups with the expertise to carry out the work. Community groups would also be encouraged to seek grant aid and local sponsorship for their planting schemes.

The project, entitled 'Trees in the City', was officially launched in December 1997 at a tree planting ceremony attended by the Mayor of Derry and children from local schools (Anon., 1997b). At the launch, it was announced that the project intended to plant 200,000 trees throughout the city by the year 2000. Following the launch, CVNI organised a wide range of tree planting events and other activities throughout the planting season, to involve community groups and to help promote the project. Some publicity was generated by setting up small educational displays in shopping centres and libraries (Anon., 1997c). On a number of occasions, free trees were given away to shoppers and community groups.

Trees in the City is still at an early stage in its development (Magowan, interview, 1998). Some successful tree planting schemes have already been undertaken and a few of these have been funded by a small amount of commercial sponsorship. Much of the work in the first season has, however, been taken up with building support for the project among community groups and schools. By the end of the project's first year of funding, in March 1998, 53 community groups had registered a formal interest in participating. At the end of its first planting season, 55,000 trees had been planted (Anon., 1998). CVNI expects a considerable increase in the volume of tree planting when the project becomes fully operational by the 1998/99 planting season (Magowan, interview, 1998). By that time, the project aims to have in place a network of voluntary Tree Wardens who will be invaluable in providing direct assistance to community groups in their locality. Plans for a considerable number of planting schemes have recently been submitted to the Forest Service and are awaiting approval for grant aid.

Trees in the City is envisaged by the LDO and CVNI as more of a community-based tree planting project rather than a comprehensive urban forestry initiative. It does, however, have the potential to expand into the more strategic aspects of urban tree management, particularly if Derry City Council became more actively involved. The suc-

cess of the project in embracing some of the wider aspects of urban forestry will depend on the extent to which the members of the Steering Group can be encouraged to develop their existing tree planting and management operations through the initiative. A long term and comprehensive strategy and management plan embracing the city's entire urban forest could then be developed and implemented.

Two major tree planting projects for the Millennium

Apart from projects in Belfast and Derry, there are not yet any other urban forestry initiatives in Northern Ireland embracing entire urban areas (Hunter Blair, interview, 1997). Two major tree planting projects for the Millennium have, however, been recently launched, and these have the potential to make a major contribution to the 'greening' of urban and urban fringe areas.

On 30 September 1996, the Woodland Trust launched its 'Woods on your Doorstep' project to plant 92 new community woodlands close to where people live (Anon., 1996b). Although the Trust had been established for over 25 years in Britain, it had not previously been active in Northern Ireland. To create these woodlands, the Trust will work in partnership with the Housing Executive, local authorities, landowners and community groups (Cregg, 1996). Local community groups are being encouraged to help plant the woodlands as a way of marking the forthcoming Millennium with a lasting environmental improvement to their own areas. Funding of Stg£5 million has been obtained from the Millennium Commission, with a smaller contribution from the local Dufferin Foundation (Anon., 1996b). The total cost of the project is estimated at Stg£10 million. Most of Northern Ireland's local authorities have already pledged support for the project, while the Housing Executive has set aside land close to its estates and will be providing financial assistance towards the long term management of each site. Work began on planting the first woodland in March 1997 at a site in Kilcooley, near Bangor in Co. Down (Drake, 1997). Residents of a nearby housing estate helped plant the trees, assisted by local primary school children (Doherty, 1997). This was followed the next day by the planting of a second woodland near Enniskillen in Co. Fermanagh. Although still at a very early stage in its development, the Trust has already recruited several full-time specialist staff for the project. The scale of Woods on your Doorstep should ensure it has a major impact, not only on the landscape, but also on professionals concerned with the creation and management of urban woodland in Northern Ireland.

The second major project is CVNI's 'Millennium Tree Campaign', launched on 25 March 1997 (CVNI, 1997b). Although not a specifically urban initiative, much of the planting will also take place in and around towns and cities in Northern Ireland. CVNI had been encouraged by the success of its 'Million Tree Campaign' when, after 12 years of sustained effort, the millionth tree was eventually planted in March 1994 (McClean, interview, 1996). It is hoped that a further 1.5 million trees will be planted throughout Northern Ireland under the Millennium Tree Campaign by March 2000, representing approximately one tree for every person living there. It aims to encourage and support local community groups to undertake the planting themselves on suitable sites in their respective neighbourhoods. They will be assisted by a network of 'Tree Champions', a type of tree warden scheme where individuals with experience of trees and working with communities will aim to inspire local action and provide support for the practical work. While the focus of the project is on community tree planting, there is also considerable emphasis on environmental education. As part of the project, there will be a wide ranging programme of

courses, exhibitions and displays on topics such as the conservation value of trees and woodland, tree identification and surveys, and how to grow trees from seed. Financial support for the project of Stg£85,000 over a 3-year period has been obtained from the Esso Living Tree Campaign, with smaller amounts from the Paul Getty Trust and other sources. A further Stg£200,000 was recently obtained from the European Union's Peace and Reconciliation Fund, and smaller amounts are being secured through landfill tax applications (Humphreys, pers. comm., 1998).

By June 1998, the project already had 2,600 formal registrations of interest from individuals and groups (Humphreys, pers. comm., 1998), and there are hopes that this will rise to 5,000 at the height of the project (CVNI, 1998a, 1998b). A total of over 387,500 trees have also been planted. A telephone advice line has also been established to assist community groups and individuals wanting to plant trees or grow them from seed.

There will inevitably be a degree of overlap in having two major community tree planting projects throughout Northern Ireland to mark the Millennium. Although CVNI and the Woodland Trust see their projects as complementary (McClean, interview, 1996), there could be some confusion in the minds of the public unless each project is promoted with a distinct identity. The practical focus of the two projects, however, is slightly different. The Woodland Trust initiative is concerned with sites of approximately 2 ha, while CVNI's will concentrate on much smaller sites. It also remains to be seen what impact these projects will have on both the Forest of Belfast and the new initiative in Derry, and how successfully they can be integrated in a wider strategic approach to urban forestry.

Social, political and economic factors

Any account of urban forestry in Northern Ireland would be incomplete without some reference to the special social, political and economic difficulties which prevail there. The Troubles impinge on almost every aspect of life, not least the quality of the urban environment and attempts to 'green' its towns and cities.

While the origins of the conflict are complex, they are a reflection of the different political aspirations between the Unionist community, which seeks to remain part of the UK, and the Nationalist community, which seeks to end the partition of Ireland. The lack of an acceptable resolution to these deep-rooted divisions has led to widespread civil disturbances and armed conflict over the past 30 years, with many thousands of people killed or seriously injured (Bew and Gillespie, 1993). Enormous damage has also occurred to property and industry through a sustained bombing campaign. The level of violence subsided with the paramilitary cease-fires of 1994, enabling the British and Irish governments, together with the political parties, to engage in negotiations to find an acceptable political solution. The historic agreement achieved at the multi-party talks on 10 April 1998 offers hope that the Troubles may at last be coming to an end (Northern Ireland Office, 1998). The agreement paves the way for the establishment of a devolved elected Assembly for Northern Ireland which, together with new cross-border bodies, could assume many of the powers currently exercised by central government.

The struggling Northern Ireland economy receives enormous financial support from the British government (Bew and Gillespie, 1993). With the huge additional cost of the security operation, this has been estimated at Stg£8.5 billion/year (Coogan, 1998). This has been supplemented in recent years by increasing support from the European Union (Farrell, 1998). As a result of Northern Ireland's preoccupation with its difficulties, environmental issues have remained low on the political agenda (Cadden, interview, 1996).

With the prospect of an end to the Troubles, urban forestry could become a major force in helping to deliver the regeneration of its towns and cities that is so urgently needed (Johnston, 1994). There has been evidence recently that public concern for trees and the urban environment may be growing. Not only has the threat to Belvoir Park Forest galvanised some well coordinated opposition, so also have the activities of a number of utility companies that have been digging up almost every street in Northern Ireland. Guidelines for this work have sometimes been broken, resulting in dead and dying trees and considerable disquiet among nearby residents (McKeown, 1997).

The DoE(NI)'s recent discussion paper entitled *Shaping Our Future*, outlining a development strategy for Northern Ireland, does not give much indication that urban trees are about to be given any immediate priority by government (DoE(NI), 1997). The document contains a few lines about their benefits but no reference to any specify measures to improve the situation. A far more encouraging document entitled *Environmental Strategy for Northern Ireland* was produced the previous year by Northern Ireland Environment Link (1996). If its recommendations in regard to urban trees were widely adopted, this would have a dramatic impact on the quality of the urban environment. The strategy specifically stresses the contribution that urban forestry can make to the urban environment, and the valuable work carried out under the Forest of Belfast project.

As a consequence of the Troubles, Northern Ireland is unique in being the only region in Western Europe where security considerations play a significant role in urban forestry (Johnston, 1995). Trees and shrubs can provide cover for paramilitary attacks and opportunities for planting have often been very limited, particularly in the vicinity of security installations and near the 'peace lines' dividing the two communities in many urban areas. A complete demilitarisation could mean a lifting of many of these restrictions. Tree planting events and activities could also have a major role in helping to bring people together to heal the scars in their environment and the divisions in their community. Trees can be powerful symbols of peace and hope, and a healthy and vibrant urban forest in Northern Ireland's towns and cities would be to everyone's benefit.

Contacts with the Republic of Ireland and Britain

The initial development of urban forestry in Northern Ireland has been influenced more by developments in Britain than by those in the Republic of Ireland. This is evident from the replies given in the research questionnaire and interviews conducted for this study. This is understandable given the earlier development of urban forestry in Britain, Northern Ireland's history of institutional links with Britain, and the fact that many of its relevant professionals received their professional training there.

Contacts on urban forestry between professionals in Northern Ireland and the Republic of Ireland began to develop in the early 1990s. Although a few delegates from Northern Ireland attended the first Irish Urban Forestry Conference in Dublin in June 1991, it was only with the launch of the Forest of Belfast project that regular contacts were established (Johnston, 1997). The Forest of Belfast has continued to provide a focus for these cross-border contacts. It recently began cooperating with Conservation Volunteers Ireland, a major voluntary organisation in the Republic, to promote the planting of yew trees in graveyards and churchyards (Forest of Belfast, 1998). The rapid growth of urban forestry in the Republic since the early 1990s (Johnston, 1997) is also beginning to have an impact on professionals in Northern Ireland. Their interest has been stimulated by the increasing number of initiatives there and the dissemination of information about these through

organisations such as the Tree Council of Ireland (Collins, interview, 1997). It has also been fostered by their attendance at relevant conferences. Ten delegates from Northern Ireland attended the Second National Conference on Urban Forestry in Limerick, March 1996, and six delegates attended the Third National Conference in Galway, April 1998. The programme for both of these events included speakers from Northern Ireland, outlining the Forest of Belfast initiative (Hunter Blair, 1996; Simon, 1998), the work of Belfast City Council's Parks and Amenities Section (Holdsworth, 1998), and the value of partnership structures in urban forestry (Johnston, 1996). Further cooperation includes a recent joint survey carried out by the University of Ulster and the Tree Council of Ireland, studying local authority urban tree management practices in the Republic (Johnston *et al.*, 1998). With the growth of cross-border contacts, the development of urban forestry in Northern Ireland can be viewed increasingly in the context of a wider Irish urban forestry movement.

Conclusions

The initial interest in urban forestry in Northern Ireland came from a few civil servants who were able to engage existing British expertise to help develop a small number of major projects. With the success of these projects, urban forestry in Northern Ireland has grown to embrace an increasing number of organisations and individuals. While there is now significant interest, the contribution of a few influential and committed individuals will probably continue to be crucial in such a relatively small locality (Sneddon, pers. comm., 1996).

Funding for urban forestry from the DoE(NI) has been erratic, particularly following the end of Cadden's involvement at the BDO. At the same time as the BDO has been hesitant about urban forestry, some of its funding priorities have been questioned publicly as representing very poor 'value for money' (Anon., 1997d). Hopefully, the recent reorganisation within relevant section of the DoE(NI) will encourage the agency to promote urban forestry more vigorously. Of all the government agencies in Northern Ireland, the Forest Service has probably played the most consistent and constructive role, with the Housing Executive providing valuable support on some specific projects.

While the predominantly rural character of Northern Ireland may always limit the extent of government interest and support for urban forestry (Gordon, pers. comm., 1996), there is also a widespread belief among professionals that little progress can be expected until its political and economic difficulties are resolved (Parkinson, interview, 1997). Most also believe that, with the implementation of an agreed political settlement, the 'greening' of its towns and cities will receive a much greater priority and the opportunities for urban forestry will increase significantly. Its development so far in Northern Ireland has been restricted by the limited powers of local government. Although many relevant central government powers could soon be devolved to a new Assembly, it remains to be seen how this will effect the structure and function of local government. With much wider responsibilities for urban trees, and with the additional staff this would require, local authorities in Northern Ireland could play a far greater role in urban forestry, similar to that of their counterparts in the Republic of Ireland and Britain (McClean, interview, 1996; Parkinson, interview, 1997).

Despite the current limitations on local government, Belfast City Council and its involvement in the Forest of Belfast project remains a model for planned, systematic and integrated urban tree management, providing an example to local authorities throughout

Ireland. There is still a need, however, for authorities outside the Greater Belfast area to embrace the concept of urban forestry and to develop their own surveys and strategies (McClean, interview, 1996). The Forest of Belfast itself offers an excellent model for this, and is probably the most advanced city-wide project in the whole of Ireland.

To be taken seriously, urban forestry needs to be included in planning documents, and it needs real resources to be allocated to achieve planned objectives (Holdsworth, pers. comm., 1996; Lynch, pers. comm., 1996). It is hoped that the Forest of Belfast's recent highlighting of planning issues (Simon, interview, 1997) will soon begin to have a major impact on these aspects of government policy.

Support for urban forestry among the voluntary sector has been invaluable in developing its community aspects, with CVNI playing a leading role from the outset. There does, however, need to be greater recognition from all sectors that urban forestry is more than just an opportunity to promote community involvement with urban trees. Despite the weak economy, high levels of unemployment and the urgent need for urban regeneration in Northern Ireland, the potential for major urban forestry projects to provide training and employment through environmental improvement initiatives has yet to be explored to any great extent (Smyth, pers. comm., 1996).

After many years of focusing on social, political and economic issues, most people in Northern Ireland have little experience of having a creative input into their local landscape and environment (Magowan, interview, 1998). As environmental issues gain more attention, there is the potential to link these with urban forestry solutions. The vision of everyone working together to 'green' urban areas has to be linked with issues such as transport and pollution, creating a sustainable urban environment, and the obligations under Local Agenda 21 (Parkinson, interview, 1997).

The continuing development of urban forestry in Northern Ireland will depend on a strong and productive partnership between the public, private and voluntary sectors, as symbolised by the Forest of Belfast's commemorative stone. In view of what has already been achieved through some very difficult times, the prospects are encouraging.

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General paper

An overview of twentieth century Irish forestry and forest products literature

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Summary

The development of Coillte's bibliography of twentieth century Irish forestry and forest products literature is briefly outlined. An overview of Irish forestry literature, briefly describing its development during the time covered by the bibliography, is provided. A survey of the literature recorded notes the volume of work produced on each of the major subject areas, and compares the extent to which a number of topics are covered in this literature. The report concludes with a brief account of recent developments in the area of electronic publishing and forestry related literature.

Introduction

In March 1997, Coillte completed a bibliography of Irish forestry and forest products literature covering the period 1900-96. The bibliography was published in the form of a bibliographic database on CD-ROM under the title FIR CD. Material selected for inclusion in the database was obtained fr om journals, technical reports, theses, conference proceedings and number of other sources, published and unpublished, contained in various libraries and research centres throughout Ireland (Table 1). The variety of sources used enabled the compilers of the bibliography to assess a large amount of previously uncatalogued material, and to include much valuable unpublished work, so-called 'grey literature', and information contained in less well-known publications. There are approximately 1,500 records on the database, each containing an abstract, publishing details on the item referred to, the location of the document and, where possible, the address of the principal author. The database also has a key word index, containing several descriptors for each record.

Table 1. *List of locations of material selected for inclusion in the bibliography.*

Coillte library	Forestry Section, UCD
Forbairt library	Royal Dublin Society library
UCD library	Trinity College library
Forest Products Dept., Enterprise Ireland	RIA library
Dept. of Agriculture library, Dublin	Teagasc library
Forest Service, Dublin	Teagasc Research Centre, Kinsealy
N. Ireland Forest Service	Dept. of Botany, UCD
COFORD	Dept. of Botany, Trinity
ESB library	School of Pharmacy, Trinity College
ESB Information Centre	Dept. of Zoology, UCD
Dept. of Agriculture for N. Ireland library	School of the Built Environment, University of Ulster
Dept. of Agricultural and Food Engineering, UCD	Dept. of Environmental Resource Management, UCD
University of Limerick library	National Botanic Gardens library
College of Technology library, Bolton Street	

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Methodology

This survey examined the records in the bibliography in order to determine the extent to which various subjects have been covered in forestry related literature. The data for the survey were obtained by recording the frequency with which each of the subject areas examined are used as key words or key terms in the index of the database. The first part of the survey compares the following main subject areas covered by the literature: afforestation; silviculture; environment; forestry history; timber processing; forest policy; and forest protection. A comparison is also made of the volume of literature of each of these subject areas produced during four separate time periods, and this is represented by Figure 1. The second part of the survey uses the data to compare the amount of work produced on topics associated with the following general subject areas: (i) forest management and research; (ii) business and forestry; (iii) environment and ecology; (iv) timber processing; and (v) tree species. Finally, the output of a number of research institutes are compared.

Irish forestry literature

The earliest item recorded in the bibliography is a note in the journal of the Department of Agriculture and Technical Instruction for Ireland (March, 1902) on the appointment, by the Board of Agriculture, of a Departmental Committee to enquire into the state of woodlands and the prospects for forestry in Great Britain. The final report of the Committee, published in 1908, makes a number of recommendations regarding the preservation of existing woodlands and the correct approach to the establishment of a state forestry industry. The perilous state of Irish woodlands following the passing of the Land Purchase Acts, and the consequences of postponing the preparation of a coherent forest policy, are vividly described in a number of journal articles, pamphlets and books during the intervening period. Articles on woodland history and the economic benefits of afforestation were regularly published in the journals of the Royal Irish Academy, the Royal Dublin Society and the Statistical and Social Inquiry Society of Ireland during the first decade of the century. The early stages of the reforestation programme undertaken by the Department of Agriculture and Technical Instruction, beginning with the state's acquisition of the Avondale Estate in 1903, are described in articles in the Department's journal, along with advice and instructions on various aspects of silviculture and forest management. The progress of the programme, and the various administrative and legislative changes associated with it, can be traced in the pages of this journal, in the regular General Reports produced by the Department of Agriculture and Technical Instruction up to 1928, and also in the journal of the Department of Agriculture and Lands from 1923.

Several of these articles were contributed by Augustine Henry, Professor of Forestry in the Royal College of Science for Ireland from 1913 and co-author of *Trees of Great Britain and Ireland* (7 vols.), the first two volumes of which appeared in 1906. A consistent theme in Henry's writings was that a successful afforestation programme in Ireland would be heavily dependent on the planting of species from areas of the world with a mild and damp climate similar to that of Ireland. A.C. Forbes, who played a central role in the establishment of state forestry in Ireland, was another prolific author whose work on a range of silvicultural, economic and historical themes appeared regularly in the journals of the relevant Government Departments and scientific and agricultural societies. He was also one of the contributors to the first journal of the newly-formed Society of Irish Foresters. The first volume of *Irish Forestry* appeared in November 1943, giving Irish researchers, administrators and academics the opportunity to publish work in a journal

specifically devoted to the subject of forestry in Ireland. The hundreds of papers that have been published in *Irish Forestry* provide a comprehensive record of the growth and development of forestry, forest policy and forestry thought in Ireland over the past 55 years.

During its first 10 years, *Irish Forestry* carried extensive commentary on a number of important official statements on forestry policy during this period. The most significant of these documents were the Report of the Minister for Lands covering the period 1938-42, the 1946 Forestry Act, and the Report of the FAO Forestry Mission to Ireland which appeared in February 1951. This period of policy development resulted in the establishment of a stable and achievable annual planting target and the initiation of an integrated forest research programme. The results of much of the work undertaken as part of this programme are described in a series of internal reports produced by, successively, the Forestry Division of the Department of Lands, the Forest and Wildlife Service, and Coillte. The frequency with which these reports were published increased significantly with the establishment of the Forest and Wildlife Service in 1969. The number of postgraduate dissertations in forestry also increased significantly in the same period. The number of theses completed in the period 1970-73 far exceeded the number for the years preceding 1970, and more than 30 doctoral theses are recorded as having been completed since 1973. There has also been a steady increase in recent years in the amount of postgraduate research in other disciplines, such as economics, rural development and statistics, which deals with forestry related subjects.

With the establishment of a coherent forest policy and the consistent attainment of planting targets by the end of the 1950s, more attention began to be paid to issues related to timber processing and the replacement of imported timber by home-grown softwood. In 1966, a major study of the utilisation of Irish grown wood for pulp, paper and composite wood products was published by the Industrial Development Authority. Most of the research on forest products has been produced by staff at the Forest Products Department of the Institute for Industrial Research and Standards, and its successors, EOLAS, Forbairt and Enterprise Ireland. The Forest Products Department has also developed strong links with wood science faculties in a number of third level colleges, and an increasing amount of published work and postgraduate theses are being produced as a result of this collaboration.

The first significant official statement of forest policy in Northern Ireland, following the assumption of responsibility for forestry development by the Northern Ireland Ministry of Agriculture in April 1922, was the *Report on Afforestation in Northern Ireland*, undertaken by the Commission on the Natural and Industrial Resources of Northern Ireland and published in 1923. Following extensive afforestation during the period 1946-69, confined mainly to blanket bog and poor marginal hill land, a white paper was published setting out the future objectives of forest policy. Responsibility for the implementation of this policy has remained with the Department of Agriculture for Northern Ireland, and Northern Ireland Forest Service reports are published by the Department.

Survey of literature

A survey of the contents of the bibliography reveals the extent to which certain themes dominate forestry research and analytical comment on the Irish forestry industry. The large number of reports and publications which deal with silviculture, forest management and timber processing reflects the prolific output of research material from the state bodies responsible for research in forestry and wood science. The rapid development of

forestry in Ireland since the 1950s has had a significant impact on the Irish landscape and rural economy, and this is reflected in the volume of literature produced on political, social and economic consequences of the state's forestry programme. There are over 150 items which cover issues related to land use, in particular, the transfer of land from agricultural use to forestry and the afforestation of marginal lands. A similar number examine various issues associated with afforestation, including the social and economic effects of this process.

Table 2. *Comparison of major subject areas in the bibliography.*

Subject	*No. of records*	*% of total records*
Afforestation	149	10.0
Silviculture	291	19.6
Environment	149	10.0
Forestry history	90	6.0
Timber processing	294	19.8
Forest policy	214	14.4
Forest protection	150	10.1

Unlike the other major subject areas, work on forest policy appears regularly in each period covered by the bibliography. By contrast, there was very little work carried out on environmental issues before 1970, but it has been one of the most significant subject areas in the period since then. Similarly, although timber processing is the most frequently cited key term in the database, the volume of research in this area before 1970 was not significant. The promotion of home-grown timber has resulted in a significant increase in the

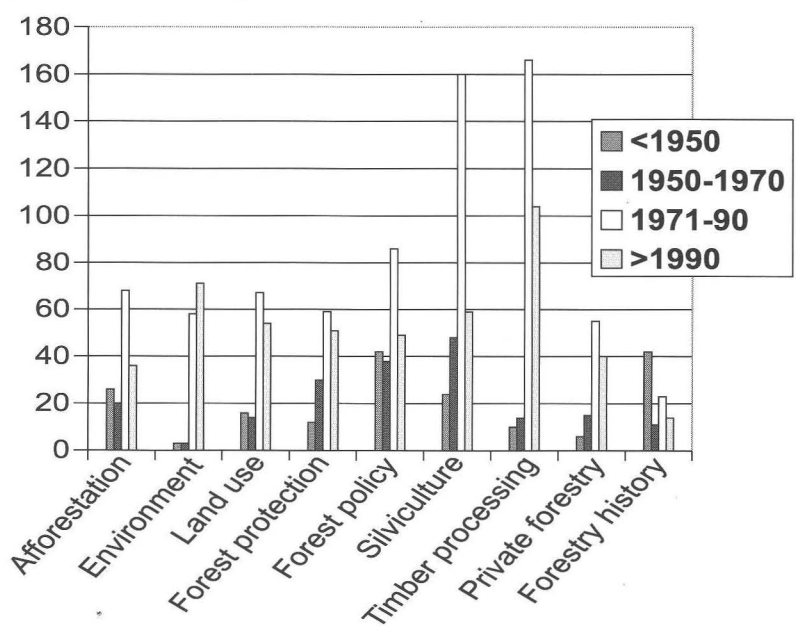

Figure 1. *Number of records referring to topics over certain time periods.*

amount of research on forest products and a corresponding increase in published material and limited circulation reports dealing with this area. While most of this increase is a result of the research carried out by the Forest Products Department of Enterprise Ireland, a considerable amount of work has been carried out by the wood technology and engineering departments of a number of third level institutions, either independently or in collaboration with Enterprise Ireland. Unlike the other major subject areas, a very high proportion of items in the bibliography which examine the history of forestry were completed in the first half of the period covered. Much of this work can be attributed to a small number of individuals, such as A.C. Forbes, who published a great deal of research findings and commentary during the early days of Ireland's afforestation programme.

Comparison of key words

Forest management and research

There is a fairly even distribution in the literature on the various practical aspects of afforestation and forest management. The volume of material concerned with matters related to the pre-establishment phases of forestry, such as site preparation and nursery work, is however, somewhat lower that that which looks at planting, establishment and maintenance. The production of articles and reports on harvesting has been fairly evenly spread throughout the period of the bibliography, but the work in this category which examines the development and performance of forest machinery has been carried out in the last 4 years. Although the earliest item recorded which examines the subject of genetics and breeding was written by Augustine Henry in 1914, most of the work on this subject has been completed since 1980. Since that time, it has become as significant a research area, in terms of the number of articles or reports published on the topic, as harvesting, cultivation, establishment or nurseries. A comparison of the frequency with which certain key words appear in this section shows how significant the issue of peatland forestry has been in Irish forestry literature. The extent to which the afforestation programme has been dependent on poor peat and gley soils is apparent from the volume which is concerned with the establishment and maintenance of forests on this land. More than 40% of the records which cite fertilisation as a key word refer to work dealing with low nutrient peat and gley soils.

Table 3. *Frequency of items related to forest management and research.*

Subject	*No. of records*	*% of total records*
Cultivation	40	2.7
Establishment	60	4.0
Fertilisation	80	5.4
Tree growth	68	4.6
Harvesting	77	5.2
Forest nurseries	48	3.2
Genetics/breeding	33	2.2
Peatlands	90	6.1

Business and forestry

In view of the importance of the subject of land use in Irish forestry, it is perhaps surprising that not a great deal of work has been carried out on the specific issue of land acquisition. Out of a total of 54 items dealing with the subject, almost 40 are annual reports produced by

the various state agencies responsible for forestry development. A recurrent theme in the research that has been completed on land acquisition is the pressure being placed on agricultural land in recent years due to changes in EU policy on price supports, and the attitude of farmers to the resultant increase in the afforestation of agricultural land. While the amount of research and commentary on the acquisition by the state of agricultural land for forestry purposes is limited, there is a significant amount of literature on farm forestry, i.e. the use of land owned by individual farmers for forestry purposes. Much of the work carried out in this area examines the question of incentives for farmers to become involved in forestry. More than half the items on farm forestry also cover the issue of grants and subsidies.

Table 4. *Frequency of items related to business and forestry.*

Subject	*No. of records*	*% of total records*
Investment	37	2.5
Land acquisition	54	3.6
Marketing	47	3.2
Grants	74	5.0
Private forestry	116	7.8
Farm forestry	60	4.0

Environment and ecology

Of all the topics covered in the bibliography, work on native or natural woodlands is the most evenly distributed throughout the period reviewed. Also, descriptions of existing or extinct woodlands are found in a great variety of sources, including archaeological, historical, ecological and natural history journals. Literature on forest ecosystems and ecology is contained in a similar range of sources, but nearly 80% of the work in this area has been completed since 1980. Almost all reports, articles and papers which examine pollution have been published since 1987, and nearly half of these relate to work carried out as part of EU sponsored research programmes such as the European Community Scheme for the Protection of the Community's Forests against Atmospheric Pollution. It is interesting to note that approximately one quarter of the records which have pollution as a descriptor in their key word fields refer to investigations on the pollutant effects of afforestation, with the main concern being the acidification of waterways. Afforestation has been described as the single most important agent of rural landscape change in Ireland in recent times, and much of the literature which examines environmental aspects of forestry, as well as economic and rural development issues, pays particular attention to this change. As public perception of the effects of forestry play an increasingly important part in the industry's decision-making process, landscape, and the related issue of urban forestry, will become an important area of research in the future.

Table 5. *Frequency of items related to environment and ecology.*

Subject	*No. of records*	*% of total records*
Forest ecosystems/ecology	45	3.0
Native/natural woodlands	38	2.6
Pollution	30	2.0
Landscape	37	2.5
Forest amenities	39	2.5

Timber processing

While issues associated with the processing and utilisation of home-grown timber have been covered in papers and official reports throughout the period reviewed, it was not until the late 1960s that a comprehensive forest products research programme was established. During the period 1966-70, the Forest Products Department of the Institute for Industrial Research and Standards published a series of reports on the timber properties of different species grown in Ireland. A report on the Irish home-grown softwood sawmilling industry in 1976 assessed the potential of this sector to compete with imported timber, and identified the need to develop a system of standards for timber quality. The establishment of new standards for Irish conditions, and the identification of the type of practice needed to attain these standards in the areas of drying, grading and preservation, were central to the research programme of the Forest Products Department in the following years. In recent years, a significant contribution to forest products research has been made by the School of the Built Environment at the University of Ulster. Staff at the department, and at the PROBE research group attached to it, are responsible for 14 of the articles, reports and conference papers recorded in the bibliography.

Table 6. *Frequency of items related to timber processing.*

Subject	*No. of records*	*% of total records*
Timber quality	49	3.3
Timber preservation	42	2.8
Timber drying	34	2.3
Timber grading	56	3.8
Sawmilling	47	3.2

Tree species

The importance of Sitka spruce to the Irish forest industry is immediately obvious from the frequency with which it occurs as a key term in studies on silviculture, botany and forest protection. It has also been by far the most important species in research on forest products. For example, more than one third of the literature produced by Enterprise Ireland's Forest Products Department recorded in the bibliography deals with issues arising specifically from the processing of Sitka spruce timber. Due to its high growth potential on poor soils and its usefulness as both a pioneer and nursing species, lodgepole pine has been widely planted in Ireland since the 1950s. As a result of the increasing availability of mature lodgepole pine during the 1980s, and the difficulties involved in processing a timber of lesser quality than that provided by other species, the amount of research into its potential end uses increased significantly. The amount of literature which deals specifically with the processing of other species, such as Norway spruce and Douglas fir, is considerably lower. There are over 100 separate items dealing with broadleaves in general or individual broadleaf species. A high proportion of these are botanical or ecological studies of woodlands, or assessments of the benefits from species diversification in Irish forests. While the amount of literature investigating the utilisation, marketing or processing of hardwood timber is quite small, research into the use of both broadleaf and conifer species as biomass for energy production has increased significantly in recent years.

Table 7. *Frequency of items on various tree species.*

Subject	*No. of records*	*% of total records*
Sitka spruce	245	16.5
Lodgepole pine	82	5.5
Norway spruce	33	2.2
Larch	33	2.2
Scots pine	31	2.1
Douglas fir	21	1.4
Ash	21	1.4

Research institutions

Not surprisingly, the institutions which have produced the largest amount of forestry related material have been those associated with the state forest sector, Coillte and the former Forest and Wildlife Service. Approximately 230 items recorded in the bibliography have been completed by one of these organisations or by members of their staff, just over 100 of which are reports by the Research Branch. Apart from annual reports and summaries of research work, the remainder, approximately 90 items, comprises articles, conference papers and contributions to published collections, including IUFRO reports and books on broad topics such as the environment or economic development. The staff of the Forest Products Department of Enterprise Ireland, and its predecessors Forbairt, EOLAS and the Institute for Industrial Research and Standards, account for 152 records, the majority of which are either internal reports or material produced by the Department under contract with the Forest Service or other organisations. Approximately 35% of the total have been included in publications, some of which are collections published by the Forest Products Department. The bulk of this organisation's output has been completed since 1979, with only 15 items recorded before that year. Literature produced by Coillte/Forest and Wildlife Service staff is more evenly distributed over the time period under review, with approximately 80% of the total dated 1979 or later.

The research work carried out by Coillte/Forest and Wildlife Service finds practical application in support of the organisation's primary task of tree production. Therefore, as most of the literature produced is intended for internal use, only a small proportion of research findings are published. University departments emphasise the importance of publishing research findings and it is therefore not surprising that a far higher proportion of their research results are presented in journals and other publications. For example, 85% of the literature attributed in the bibliography to the Forestry Section of the Department of Crop Science, Horticulture and Forestry, UCD, has been published. The corresponding figure for the Department of Environmental Resource Management is approximately 85%.

Electronic publishing and forestry research

Recent technological advances have enabled publishers to vastly increase the volume of information available in electronic format. An important part of this development is the use of the CD-ROM to carry information and the retrieval tools required to make it easily accessible. While the range of subject areas covered by published CD-ROMs is steadily increasing, there is a great deal of information contained in unpublished reports and less well-known publications which are unlikely to be documented by commercial publishers. Research institutions and similar information producing organisations therefore have an

Table 8. *Material produced by the main research institutions.*

Research institutions	*No. of records*	*% of total records*
An Foras Taluntais/Teagasc	51	3.4
Coillte/Forest and Wildlife Service	206	13.9
(Internal reports)	(121)	
(External publications)	(85)	
Enterprise Ireland	152	10.0
(Internal reports)	(116)	
(External publications)	(36)	
Forest Service	20	1.4
N. Ireland Forest Service	44	3.0
Dept. of Environmental Resource Management, UCD	36	2.4
Forestry Section, UCD	48	3.2

opportunity to become involved in the creation of innovative information products. The involvement of Coillte's research section and library in the compilation of a bibliographic database of Irish forestry and forest products literature is an example of this development in the field of forestry and timber technology. Other recent examples include the establishment of a comprehensive database of American wood products research by the Mississippi Forest Products Laboratory, and the compilation of a series of bibliographic databases by the University of Minnesota Forestry Library. These new products complement the information on forestry available on CD-ROMs compiled by commercial publishers such as the Commonwealth Agricultural Bureau and the National Agricultural Library (USA), and provide a valuable additional information resource in this field.

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Teagasc/TCD Symposium on Forest Genetics – Abstracts

The following is a selection of abstracts of presentations at the Teagasc/TCD Symposium on Forest Genetics: Strategies for the Improvement of Forest Tree Species, held on the 9th of March, 1998. Symposium proceedings, to be published by COFORD, will be available in early 1999.

Improving broadleaved species by genetic transformation and utilisation of molecular markers

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Unlike that of annual crops, tree breeding is a slow process. It is, however, of vital importance, given the ever-increasing demand for wood and wood products, and the growing concern regarding the destruction of natural forests. All methods enabling accelerated breeding and all knowledge necessary to optimise the production of tree growth are therefore invaluable. Molecular biology has only recently entered the field of tree breeding, but holds great promise to assist and complement classical tree breeding programmes.

Using DNA fingerprinting methods, DNA markers can be identified which co-segregate with important traits in a pedigree. These DNA markers can be used as diagnostic tools to predict the characteristics of new hybrids long before the traits are displayed, and as such, allow a faster and more intense selection of new hybrids from controlled crosses. The same methods enable the development of detailed genetic maps which enable the unraveling of the complexity of quantitative traits. This research group has identified molecular markers for resistance against *Melampsora larici-populina* (one of the most damaging fungal pathogens of poplar in Europe), for tolerance against *Xanthomonas populi* (which causes bacterial canker), for height growth and for wood specific gravity.

By genetic engineering, it is possible to obtain trees which are ideally suited for a particular purpose without going through the long term breeding programmes. In this field, the group has focused on the alteration of the structure of lignin in poplar by genetic engineering, in order to improve the chemical paper pulping process.

This research is funded by programmes of the European Union (ECLAIR AGRE-0021-C, FAIR-PL 95424, AIR2-CT93-1661, AIR1-CT92-0349, HCM 41AS8694) and the Flemish Government (BNO/BB/6/1994; 1995; 1996; 1997).

Range wide variation of genetic diversity and variability of adaptive traits in European oaks: evolutionary impacts identified by molecular markers

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Remarkable range wide trends of variation exist in European oaks for all traits investigated to date. An overall review of current results is presented for sessile oak (*Quercus petraea* (Mattuschka) Liebl.). Geographic trends can be depicted for the level of diversity within a population, and for differentiation between populations. All traits exhibit extremely high levels of within-population diversity. Nuclear markers (isozymes or DNA markers) show only slight allele frequency differences among populations, even among widely separated populations. On the contrary, adaptive traits, particularly bud burst, are highly differentiated among populations. Geographic patterns of variation show opposite trends: nuclear markers follow an east-west trend, while bud burst follows a north-south trend.

Range wide trends of variation are interpreted in terms of evolutionary causes. The comparison of the geographic distribution of quaternary pollen fossil records and chloroplast DNA (CpDNA) polymorphism indicated that Europe has most likely been re-colonised from three different glacial refugia: Iberian peninsula, Italy and the Balkans. Moreover, the patchy spatial structure of CpDNA diversity witnesses founder effects which accompanied post glacial colonisation. Foundation effects were, however, quite rapidly 'erased' by important pollen flow as new colonised areas coalesced into large compact oak forests. These colonisation dynamics are consistent with the contrasted current geographic pattern of diversity between nuclear and chloroplast markers. The potential 'persistence' of an historical effect on adaptive traits was investigated, by comparing genetic distances between populations originating from different glacial refugia with those between populations originating from the same glacial refugium. Results obtained from provenance tests indicate that there is no such persistence, and that current provenance differences for phenotypic traits result most probably from local selection pressures rather than from different historical origins.

Spatial genetic structure and inbreeding in a mixed oak stand based on experimental data and simulations

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Two complementary approaches (based on experimental data and simulations) were used to investigate the effects of natural regeneration on genetic diversity in a mixed oak stand (*Quercus petraea* (Mattuschka) Liebl. and *Q. robur* L.). Two genetic parameters were analysed: the spatial genetic structure in relation to gene flow (by pollen or seed); and the level of inbreeding.

Microsatellite markers were used to investigate the spatial genetic structure at the adult stage and the pollen gene flow with paternity analysis. It was first demonstrated that the

genetic diversity of the adult trees was spatially organised in 'clusters', suggesting restricted gene flow by seed or pollen. Pollen dispersion was characterised by a high amount of long distance dispersion (60% of the pollen coming from outside the 5 ha study area) and by a high variability of the mating success among the pollen donors caused by the distance and direction of pollination.

These results were used as input for a model predicting spatial genetic structure and inbreeding over generations. This enabled testing for the influence of restricted gene flow by pollen and seed on the spatial organisation of the diversity. Various ranges of dispersal parameters for pollen or seed were proposed, from highly restricted to near random. In particular, the influence of asymmetrical gene flow was examined, with a large amount of pollen flow associated with a restricted flow by seed. Results show the establishment of a genetic spatial structure for medium and high gene flow (by pollen or seed). The level of spatial genetic structure is clearly correlated to the level of restriction of gene flow for both pollen and seed. The respective effects of pollen dispersal, seed dispersal and asymmetry will be discussed.

This model also allowed the level of inbreeding in the population to be measured. From an experimental perspective, the estimation of inbreeding is generally indirect (through heterozygote deficiency). This estimation can be biased, but is the only available information on such long lived material where no more than two generations can be followed. An unbiased estimation of the inbreeding was introduced into the simulations, based on the true genealogy of individuals. The underlying assumption was that repeated matings among related individuals could increase inbreeding, especially under restricted gene flow by pollen and/or seed. This has practical implications as inbreeding depression has dramatic consequences in forest tree species for traits such as vigour and fertility. The inbreeding level and spatial genetic structure under various dispersion functions were then measured in parallel. The results indicate that even under strong asymmetry of gene flow, there is only a slight increase in the level of inbreeding.

Breeding strategies for hardwoods: oak, cherry and birch

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Silviculture includes more and more hardwood species all over Europe. This is partly due to ecological reasons and increasingly due to economical factors. Timber prices for indigenous hardwoods are steadily increasing, as the tropical hardwood resources for valuable timber become exhausted and as the appreciation for domestic hardwoods increases. Oak and cherry are traditionally species with valuable timber, and birch has recently reached top prices of more than DM 1,000/m^3 (IR£417/m^3).

Timber quality and growth rate are the key characteristics for a high economic return. Considerable variation exists for these traits between and within populations. Selection combined with appropriate propagation methods offers good opportunities to improve the economic return of hardwood silviculture. Breeding strategies must take into account the biology of the species, time scale and appropriate propagation methods. The approaches

are therefore quite different for the three species under consideration.

Oaks (*Quercus robur* L. and *Q. petraea* (Mattuschka) Liebl.) are long-lived species with late flowering and heavy seeding. While vegetative propagation by cuttings and *in vitro* methods is possible, clonal testing requires considerable time and experience with rejuvenation is still limited. Considerable variation in growth, stem form and other adaptive traits such as flushing, bud set and lammas shoot formation exists within and between populations. Extended populations exist all over Europe. Testing of provenances (stands) and concentration of the harvest of acorns to the most promising sources are the fastest possibilities. Tree selection and seed orchard establishment give an additional gain above the selected and tested stands, however, the seed production is limited. Methods of vegetative propagation can be used to increase the production of plants considerably. In addition, the selection and propagation of superior families and, at an advanced stage of the programme, of clones, are possible. Due to the higher cost per plant from cuttings or *in vitro* propagation, the silvicultural methods have to be adapted.

Cherry *(Prunus avium* L.) is scattered all over Europe in edges of forests, small groups in mixed hardwood forests and sometimes small stands. Cherry has a short life span, flowers early and its seed can be stored for some years. Vegetative propagation by root-sucker is frequent in nature and natural clonal stands exist. Vegetative propagation is comparatively easy and even old trees can be rejuvenated. Clonal testing needs limited time and the natural variability is high for quality, growth and phenology. Provenance testing will be an exception in cherry due to the lack of extended population. Testing of families and the conversion of progeny tests after genetic thinning into seedling seed orchards is an easy and efficient option, but plus tree selection and grafted seed orchards are also working well. The progeny tests offer the possibility to select superior trees from good families and to include those into clonal testing and propagation. Even selected older trees can be rejuvenated by tissue culture and included in clonal programmes.

Birches (*Betula pendula* Roth and *B. pubescens* Ehrh.) are pioneer species with a limited life-span, very early flowering and high intra- and inter-population variation. Vegetative propagation by cuttings and *in vitro* methods is easy and rejuvenation of old trees by tissue culture works well. Species hybridisation with non-indigenous birch species is possible. Some of these hybrids show outstanding growth. The optimal strategies are similar to cherry, however species hybridisation in combination with clonal selection and testing offers a rapid genetic gain. Flower induction by greenhouse seed orchards can speed up seed production in birch considerably.

Some experimental results for the three groups of species are presented, demonstrating the potential for genetic improvement.

Use of microsatellite markers in the management of conifer forest species

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The development of conifer microsatellite (SSR) markers is underway in several laboratories around the world. The Rhinelander Forestry Science Laboratory is developing SSR markers from eastern white pine (*Pinus strobus* L.) and loblolly pine (*P. taeda* L.). The white pine primers, as well as some hard pine primers developed in other laboratories, have been made available for wider distribution.

The white pine markers are being used to compare genetic diversity among native, managed and regenerated stands on the 95,000 ha Menominee Indian Reservation in Wisconsin, USA. Genotype data have been collected for 10 SSR loci in 450 trees, representing nine populations at six sites. Initial analyses indicate that current shelterwood management on the reservation preserves allelic diversity and that heterozygosity is not being lost through excessive inbreeding. Seed samples from two stands having different sawtimber densities are being collected and will be genotyped to determine differences of pollen flows and mating systems between the stands. The information will be used by tribal foresters in forest planning decisions.

As SSR markers are expensive and time-consuming to develop, it would be beneficial to use common primer pairs among related species so that development costs for individual species could be leveraged. SSR primers from *P. strobus*, *P. taeda* and *P. radiata* D. Don have been evaluated for marker amplification in other conifer species. In general, *P. strobus* dinucleotide SSR primers work well in related soft pines, *P. lambertiana* Dougl. and *P. cembra* L., but do not amplify informative loci in hard pine species or in other conifers. Similarly, *P. taeda* and *P. radiata* dinucleotide SSR primers work well in related hard pine species, but not in soft pines or other conifers.

In addition to nuclear DNA SSR markers, SSR markers for pine chloroplast DNA (cpSSRs) are also available. In collaboration with G. Vendramin of CNR, Italy, variation in paternally inherited cpSSRs was used to study population genetic structure in red pine (*P. resinosa* Ait.), a species characterised by morphological uniformity, no allozyme variation and limited RAPD variation. From nine cpSSR loci, a total of 23 chloroplast haplotypes and 25 cpSSR alleles were found among 159 individuals surveyed in seven widely separated populations. All populations could be distinguished from each other by their haplotype compositions. Frequency distributions of pairwise SSR differences among individuals within different populations indicated recovery from one or more population bottlenecks, and support a metapopulation concept for the species. In collaboration with B. Epperson of Michigan State University, more extensive sampling of red pine populations is proceeding, and cpSSR and nSSR data will be analysed to determine historical routes of gene dispersal and to quantify the range-wide geographic pattern of genetic diversity of natural red pine populations. This information will be used to preserve and utilise what little genetic diversity remains in red pine.

Chloroplast microsatellite approach for the study of diversity in conifers

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Chloroplast microsatellites (cp-SSRs) are highly polymorphic markers which can be used efficiently to study the history of populations in the most recent post-glacial period, for the analysis of the distribution of haplotypic diversity within and among populations, for the detection of natural hybridisation among different species, and for paternity analysis in conifers. The high degree of sequence conservation in the chloroplast genomes of conifers gives these markers the property of 'universality', whereby primers have been designed which allow for their cross-amplification among species and genera. By this means, the cost of developing markers has been reduced substantially. Here, results obtained using chloroplast microsatellite markers in *Pinus pinaster* Ait., *P. halepensis* Mill., *P. brutia* Ten., *P. resinosa* Ait., *Picea abies* (L.) Karst. and *Abies alba* Mill. are presented and discussed.

Occurrence and detection of triploids by microsatellite analysis

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Triploidy occurs frequently in nature but most of the time it does not result in viable organisms. Viable and fertile triploids do sometimes occur, and these may display advantageous characters compared to diploids.

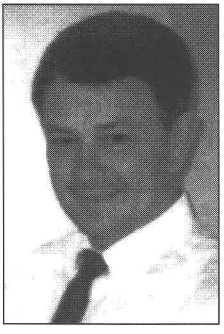
In trees, polyploids including triploids have been recognised for some time. Polyploids are rare in the gymnosperms and abundant in the angiosperms, where they represent a third of all the tree species. The development of cytological techniques allowed the detection of polyploidy in trees as early as 1927, and ploidy assessment in trees was extensively investigated during the period 1935-60. Forest scientists in that period expected to increase productivity by creating triploid or polyploid clonal lines which could be valuable in terms of productivity. The development of biochemical tools such as isoenzyme analysis in the 1960s and '70s also showed the effects of ploidy changes.

More recently, molecular markers such as AFLPs, RFLPs, RAPDs and specific gene markers have been applied to forest trees. These have also shown evidence for changes in ploidy level as a possible explanation for certain molecular patterns. Molecular methods can now be used to detect or confirm changes in ploidy, when used in conjunction with

cytological and other morphological traits such as stomata length. Reported here for the first time is the confirmation of triploidy in a confirmed triploid oak, as well as the occurrence of polyploidy (triploidy/aneuploidy) among elite Irish oaks. This research was carried out using microsatellite DNA profiling, which is the most recent method for analysing genetic polymorphisms at the DNA level.

This paper reviews the historical and recent literature on polyploidy in trees, and its use in programmes for tree improvement.

An appreciation
Padraig O'Halloron
1952-1995



The sudden death of Padraig shocked and saddened his many colleagues.

Padraig was born 5 miles from Ennistimon, Co. Clare. After National School, he attended Ennistimon CBS and later, the agricultural college at Mountbellew. He joined forestry in 1971 and was appointed Assistant Forester to Lough Gill Forest in 1974. He later served in both Kilkenny and Wicklow before returning to his native Clare in the mid-80s. Padraig spent the latter part of his career on research, in which he had a keen interest. Just shortly before his death, Padraig led a very successful field day on hardwood establishment and management at Ballygar Forest.

His calm and relaxed manner and good sense of humour enabled Padraig to form great friendships with those he worked with, all of whom will miss him greatly.

Padraig was very artistic, testimony of such is the interior decorations which he himself carried out in his beautiful house at Ennis, and the landscape and patios which he laid down with great taste. He also loved music and was a very talented singer, entertaining us on many occasions with his great collection of songs.

Since his marriage in 1988, Padraig's total devotion was to his wife and family.

Those of us who were so privileged to know Padraig will never forget his light-hearted sense of humour and that permanent smile which we will always miss. Of course, those who will miss him most are his wife Ann, his young children Anthony, Edel and Orla, and his mother, brothers and sisters, to all of whom we extend our deepest sympathy. May he rest in peace.

T.J. Greene

Trees, Woods and Literature – 22

The Birks[1] of Endermay

The smiling morn, the breathing spring,
Invite the tuneful birds to sing:
And while they warble from each spray,
Love melts the universal lay.
Let us, Amanda, timely wise,
Like them improve the hour that flies;
And in soft raptures waste the day,
Among the birks of Endermay.

For soon the winter of the year,
And age, life's winter, will appear:
At this, thy living bloom will fade,
As that will strip the verdant shade.
Our taste of pleasure then is o'er;
The featured songsters love no more:
And when they droop, and we decay,
Adieu the birks of Endermay.

[1]birches

David Mallet
(1705?-1765) 1733

Born in Scotland as David Malloch, he anglicised his name to Mallet, much to the disapproval of that other Scot, James Boswell, who, in his youthful *London Journal*, called him an "arrant puppy". Boswell later, though, admitted Mallet's *Life of Francis Bacon* to be "acute and elegant".

His change of *persona* was so thorough that Dr Johnson "never catched Mallet in a Scotch accent", even though he was over 25 years of age when he moved to London.

Johnson in his Dictionary defined 'alias' as "a Latin word signifying otherwise; as Mallet *alias* Malloch; that is, otherwise Malloch."

Mallet accepted a large sum of money from the Duchess of Marlborough to write a life of the Duke, but never got around to it.

Selection and note by Wood Kerne

(Editor's note: With the foregoing selection and note, Wood Kerne takes his final departure from 'Trees, Woods and Literature'. With him go all our thanks for his wonderful contributions under the series since its first appearance in 1969. Future contributions under 'Trees, Woods and Literature' are encouraged.)

Society of Irish Foresters Annual Study Tour – The Czech Republic, 20-27 September, 1997

Introduction

On Saturday, 20 September 1997, 34 members of the Society of Irish Foresters set off bright and early for the Czech Republic. This was the Society's second sojourn to eastern Europe, having visited Poland in 1995.

The group were the guests of the Czech Forest Service for the week, with internal arrangements by Dr John Cross. The leader/interpreter for the tour was Petra Ziegrosserová, who did an excellent job in explaining all forestry systems encountered. For one day, the Society were guests of the Mendel University of Agriculture and Forestry at Brno, the country's second largest city.

The Czech Republic was part of Czechoslovakia for a mere 74 years when it officially split with the Slovak Republic in January 1993. The country comprises the ancient territories of Bohemia and Moravia and had been for many years under the sway of its close neighbours, Austria and Germany.

The Czech Republic is approximately the size of the island of Ireland and has a population of 10.5 million people. Its largest city, Prague, has a population of 1.2 million. Forests covers 33% of the land area, the main species being Norway spruce (60%). In natural forest areas, species composition differs, with conifers accounting for 35% and the remainder comprising broadleaves. There is pressure on the Forest Service to reduce the area under spruce and to increase broadleaf planting. Throughout the tour, participants were greatly impressed with the quality of the stands and the excellent silviculture employed.

John Mc Loughlin
Tour Convenor

Saturday, 20 September

Leaving the damp overcast conditions of Dublin behind us, we flew *via* London into the Czech capital of Prague, to be greeted by fine sunshine. Unfortunately, there wasn't much sunshine for six members of the group, whose luggage failed to arrive. Thankfully, the missing items turned up a day or so later!

We were met at the airport by representatives of the Travel Agency Lesser, before being transported to Hotel Aron on the east side of Prague. Checking-in completed, the remainder of the afternoon was free to 'explore'.

Sunday, 21 September

The morning dawned bright and sunny with a glorious day to follow. In fact, we were to have magnificent weather all week. After breakfast, time was our own, during which this writer set off to sample the extensive transport system of which Prague boasts. What became known as the '10 penny ticket' gave great value on the bus, metro and tram. The latter was a most enjoyable method of getting around. One can only imagine the benefits to Dublin if the city still had its trams!

Following lunch, we left by bus to the city centre for an afternoon's guided sightseeing

tour. Known as 'The City of a Hundred Towers and Steeples', Prague has kept its extraordinarily rich heritage of historic buildings and townscape intact like no other European capital. Even the ravages of the second world war left the physical fabric of Prague largely untouched, as few bombs fell on the city. Our walking tour brought us by the Castle, across the Charles Bridge and into the Old City, with beautiful buildings at every turn. It was a fascinating tour. The few hours provided a real eye-opener, leaving many of us with a wish to return again at some future date.

Back at our hotel in the late afternoon, we were introduced to our guide and interpreter for the week, Petra Ziegrosserová of the Lesy Ceské Republiky (LCR) - the Czech Forest Service. Petra joined us at Stary vrch, a farm just outside Prague, for an evening spent sampling authentic Czech, Moravian and Slovak culture, including food, drink, music and dancing – a lively affair!

Monday, 22 September

Another grand bright morning, with a touch of frost in the air. After breakfast, we set off north-west from Prague for Jirkov in Northern Bohemia, bordering Germany. This is an area of rich agriculture, producing crops such as sunflower, corn, cereals and hops. The fields were extensive and without hedgerows. Nearer the German border, low grade coal is mined, large quantities of which are burnt to generate electricity. The resulting smoke emissions have given rise to serious air pollution. Petra pointed out the distinctive gray horizons in the sky which are typical of the atmospheric impurities. Over the years, the affects on forests have been startling, as would become apparent later in the day.

During our journey, Petra gave us some basic facts about forestry in the Czech Republic. Approximately 33% of the country is under forestry, amounting to about 2.6 million ha. Norway spruce represents 60% of the forest resource, with the remainder including Scots pine, fir, larch, beech and oak.

Some 2 hours after leaving Prague, we arrived at the sawmill at Jirkov to be welcomed by the Director and Executive Director of this shareholder company. The sawmill, which employs 90 workers, utilises approximately 70,000 m^3 of round timber annually, including spruce, fir and pine, with the raw material drawn by rail from an average transport distance of 250 km. The method of selling timber in the Czech Republic is that organisations buy standing trees from the Forest Service. After harvesting, these organisations in turn sell the logs to the mills. Yearly turnover is approximately 110 million Czech Crowns (IR£2.3 million), and roughly 70% of the sawn produce is exported to Germany as boards, flooring and pallets. Recovery rates at the mill average 56%, with the reminder made up of sawdust, chips and bark. The latter is used in compost and is also compressed into briquettes for the domestic market. The mill suffered a major fire in 1984, after which some reconstruction began, including the installation of some new machinery.

Logs arriving off rail wagons are sorted into 4, 5 and 6 m lengths. The supply of timber is scarce, due to a variety of reasons including poor growth and recent flooding in catchment areas. As a result, very little raw material is stock-piled in the yard. The whole complex had a very dreary and shabby look, and but for the sunshine, it would have been a rather dismal visit. Matters relating to safety seemed to take second place. Several of us watching the de-barker in action were horrified to witness a log being flung up and out of the machine, with its flight path intercepted by a pillar supporting the roof. But for this obstacle, the tour list could have been down a few participants!

Instruction in Czech forestry by tour guide and interpreter,
Petra Ziegrosserová, and other members of the Lesy Ceské Republiky
(Photo: J. Mc Loughlin).

Thus ended our tour of the Jirkov Sawmill. The Chairperson duly expressed a word of thanks to both mill representatives for showing the group around the facility. With that, it was back on the bus for the short distance to LS Janov. A picnic lunch was enjoyed in the warm sunshine before we sat down to a briefing in the local district forest office. Executive Director of LCR, Bretislav Jakubec, bid us a warm welcome to his district and wished the group a happy stay in the Czech Republic. Mr Jakubec and his assistants then proceeded to give us some background information on their area. Covering almost 10,000 ha, it is divided into eight working areas. The annual cut is 11,000 m^3, with reforestation on clearcut sites of between 170-190 ha/year. Much of the work is carried out on contract. For environmental reasons, the future trend will be towards natural regeneration. Since the 1960s, air pollution has caused problems in forest crops. Added to this, storm damage in 1976 and frequent outbreaks of bark beetle make for difficult management of the area. Hospitality was extended to the group by way of coffee - boy, was it strong! Mr Jakubec presented the Society with a print, for which our Chairperson thanked him most sincerely. The reminder of the afternoon was spent in the field at a number of stops.

Stop 1: Norway spruce blown in 1976. Cleared of all timber, the area was rapidly colonised by naturally regenerated birch. In 1988, 20 m strips were cut through this cover at regular intervals, and were subsequently ploughed and planted with beech (10,000 plants/ha), larch and Douglas fir (5,000 plants/ha). Birch timber was sold and exported to Sweden as firewood.

Stop 2: A brief halt to see where the remaining birch strips had been thinned out and underplanted with beech.

Stop 3: A strip cleared of birch and recently planted with larch, spruce and fir, thus ensur-

ing a good species diversity. Wonderful sunshine, no wind, a wonderful day to be out.
Stop 4: Dealing with air pollution. Extensive area of Norway spruce killed. Timber removed, limed and planted with larch and blue spruce, both species, along with broadleaves, being less prone to air pollution. In the distance, the group could see smoke rising from one of the power stations. Filters are now being installed to reduce emissions.
Stop 5: One of the few remaining original spruce stands to have survived atmospheric pollution. The severe winter of 1995-96, however, caused mortality. Dead trees were removed and the area was subsequently underplanted with beech, fir and Scots pine. Again, lime was added to the soil. Measures are required to minimise deer damage, with a deterrent paste applied to a number of stumps throughout the area.

All too soon, it was time for us to begin the journey back to Prague. Our Chairperson thanked all concerned for providing such an interesting afternoon, commenting on how we in Ireland are most fortunate to have some of the healthiest forests in Europe. We arrived back in Prague not long after sunset, thus ending a most enjoyable day.

Richard D. Jack

Tuesday, 23 September

We departed from Hotel Aron and headed south from Prague into southern Bohemia. Our programme for the day included a visit to a forest tree nursery at Olesná followed by a trip to Nové Hrady Forest in the District of Ceske Budejovice. We crossed the Vltava River at Prague and joined Route 4 heading south-west to Pribram, 50 km away. In the last century, Pribram was a mining town producing silver and lead. Passing Pribram, we veered south towards Pisek, which, we were informed, has the oldest standing stone bridge in central Europe. After a short stop, we continued eastward for about 10 km, crossing over the Vltava River once again before arriving at Olesná.

The forest tree nursery at Olesná is a shareholders' company. It is funded primarily by investors, none of whom are from the forestry sector, with some additional funding for specialised work provided by the Ministry of Agriculture. Four main areas of business are pursued at the nursery:-
Production of plants for commercial use: Plants are produced from both seed and cuttings. The nursery supplies 1.5 million transplants and approximately 500,000 plants from cuttings each year, the latter taking 2-4 years to produce before being ready for sale. This activity accounts for 40% of the enterprise's income. The use of vegetative propagation to produce conifers was well illustrated during a visit to the section of the nursery given over to transplant lines. We were shown 2+1 transplants produced from cuttings taken from trees in the Krusne Hory Forest which we had visited the previous day. Due to severe pollution in the forest, no seed has been produced for many years. Using vegetative propagation, however, it was possible to produce plants specifically for the site.
Production of bare-root and potted plants for the gardening, parks and landscape markets: The nursery produces around 65 different varieties of broadleaves and conifers, providing the overall enterprise with 30% of its revenue.
Landscape design and landscaping: The nursery provides landscaping services anywhere up to 300 km away. As well as providing its own plants, the nursery imports 'standards' from Holland. These activities account for 30% of the nursery's income.
*Micropropagation of woodland trees from shoot tips (*in-vitro *propagation) for commer-*

cial planting: The complex of buildings where *in-vitro* reproduction is carried out includes a laboratory completed in 1996, and a high-tech glasshouse completed in 1997 which is used to condition plants. To date, production of planting stock has concentrated on wild cherry, pedunculate oak and lime, although work has recently commenced with beech. Micropropagation is expensive and has to be subsidised by the other three businesses carried out at the nursery, with some funding from the Ministry of Agriculture. The manager is, however, optimistic that this system will eventually become profitable.

Modern equipment is evident throughout the nursery, from the *in-vitro* laboratories to the computerised irrigation systems in the glasshouses used for developing cuttings and cloned material. Herbicides are also used but there is still a considerable amount of manual weeding carried out. Overall plant quality was good, despite the wet and cold summers which adversely affect conifer seedlings.

From the nursery at Olesná, we continued on our journey heading south-east for approximately 100 km *via* Pisek and Ceske Budejovice to our next stop at Nové Hrady on the Czech/Austrian border. The district of Ceske Budejovice covers 162,000 ha, of which 52,000 ha (32%) is afforested. Conifer species account for approximately 85% of the forest cover.

Nové Hrady has a forest area of 1,500 ha comprising 60% broadleaves (70% beech, 25% oak and 5% lime and horse chestnut) and 40% conifers (spruce, pine and white fir). Also present are approximately 120 red deer, with some wild boar and roe deer.

In its simplest terms, the principle of forest management in this area is to grow beech on a 140-year rotation and Norway spruce on a 120-year rotation, using natural regeneration, while at the same time, managing the deer herd to provide hunting revenue. Throughout the afternoon, we were given a brief outline of the steps involved in the beech cycle. Gradual reduction of the beech commences at year 20. Every 12-15 years after that, selective thinnings are carried out to remove poorer quality stems. This process continues up to year 100, when the process of natural regeneration begins. The ground is lightly scarified prior to mast drop, with mast years occurring every 4 years. Seeds are left to germinate, and when the resulting seedlings reach a height of approximately 2 m, the felling of the mature trees commences. Trees are usually felled in groups 30 m wide (equivalent to the height of a mature tree). This process continues until a complete understorey is in place.

In tandem with that of the forest, the deer population is also managed. A variety of protective measures are used to reduce deer damage, including the retention of small stems for fraying, protective netting around selected trees, salt licks to provide mineral supplements, and various chemical applications. These efforts are not always successful, as demonstrated by some of the damage observed. It is also expensive and we were informed that the revenue from timber sales did not pay for the protection required.

Each year around nine stags are culled, along with 10 young deer and 18 1-year olds. The hunting is leased, usually to Germans, who pay IR£5,500-6,000 per stag for the privilege.

Following a pleasant walk to the hunting lodge to view a collection of trophy heads, we began our final leg of the day. We passed numerous small man-made ponds and lakes which contain many species of fish, most notably carp, which forms the basis of the traditional Christmas meal. We headed back through Ceske Budejovice, stopping briefly at the town square, and then west for 40 km to the town of Prachatice.

Richard Clear

Tour participants, Liam O'Flanagan and Pat O'Sullivan (Photo: J. Mc Loughlin).

Wednesday, 24 September

Departed Prachatice for the National Forestry Museum Ohrada near Hluboká nad Vltavou. The museum contains a wide range of exhibitions demonstrating the multi-faceted history of forestry in the Czech Republic, and its integration with non-wood enterprises such as game management and wildlife and other associated activities such as charcoal production, bee-keeping and musical instrument making. While the overall atmosphere of the museum was drab and dusty, the sheer quantity and diversity of exhibits (over 200,000, according to the equally drab catalogue) made it a worthwhile visit. Wildlife dominates the museum. In addition to numerous exhibits of animal life, the furniture in the museum's main hall is made entirely from deer antlers. The invalid gamekeeper Klenovic spent over 36 years designing and constructing the suite in the 18th century.

Although undated, the catalogue brings the story of the museum up to the height of the communist era in the mid-1970s. It makes interesting reading which reflects communist thinking at the time. For example, the collection of poachers' weapons is, according to the catalogue, a reminder "of the time when social conflicts existed in capitalist game management".

The next stop was Furniture Cooperatie Dobrá Voda – a furniture factory at Ledenice. The factory manufactures flat-pack furniture mainly for the export market. Over 80% of its output is purchased by the Swedish group, IKEA, with the remainder earmarked for UK's Habitat and the domestic market. The products include kitchen presses, living room furniture and computer desks made from a veneered chipboard. The factory occasionally produces furniture specifically for the domestic market, although this line was not in operation during our visit. The total turnover at the factory, which employs 90 workers, is in excess of IR£1.0 million. Most of the work, such as veneering, sanding and cutting, has a high manual input. The factory is run on a co-operative basis, with its average weekly wage of IR£40 being 30% higher than that for forest or sawmill workers.

After sampling their finished product in the company's local furniture store, the group drove west out of South Bohemia and on to the beautiful town of Telc in South Moravia. Telc was rebuilt in the 16th century after a major fire destroyed its wooden Gothic buildings. The group was treated to a guided tour of the Chateau, but the real beauty of Telc lies in its huge cobbled stone square surrounded by Renaissance arcades and lined with pastel

coloured houses, all over 300 years old. Some of the group joined an excellent guided tour of the square, while others simply sampled the unique architectural atmosphere and the excellent local beer before returning to the bus for the short journey to the Hotel Pod Kastany.

Donal Magner

Thursday, 25 September

We departed from Telc for Mor Budejovice, where we visited a private forest estate as the guests of Mrs Petrová and her daughter, the forest manager. Mrs Petrová informed us that her father had purchased the 280 ha estate in 1938, only to have had it taken away from the family in 1948. In 1991, ownership was returned to Mrs Petrová, who, with her husband, commenced management on 1 January 1992.

Government regulations specify that if a forest manager has no formal forestry training, a trained forest manager must oversee and guide the various forest operations undertaken. This function is carried out on the estate by Mr Dobesjri.

Mr Dobesjri explained that the forest estate was in poor condition upon its return to the Petrová family in 1991. Additional problems arose in 1993 in the form of storms which caused windbreak damage to 5,000 m^3 of a conifer plantation. Following this, the forest suffered an outbreak of bark beetle which resulted in the loss of a further 5,000 m^3. It is now planned to reforest 30 ha. As grants from the government are inadequate to compensate for these losses, the shortfall will be funded by the owner. This work will be carried out by two permanent staff and seasonal workers employed on the estate.

The area, with an elevation of 400 m above sea level, is located in the south of the Czech Republic. The rainfall is low at 400 mm/year. As rainfall fell to 350 mm/year during 1993 and 1994, it is thought that there is a connection between low rainfalls and bark beetle damage. Rainfall increased in 1995 and 1996 and no bark beetle damage was noticed in those years.

In the afternoon, we traveled to LS Zidlochovice where we were introduced to Mr Necas and Mr Policansky of the LCR. At this point we were treated to a traditional outdoor lunch, with beer, by the Forest Service. Hardened veterans of the Polish tour refused the sausages on sticks – bitter memories! LS Zidlochovice is a natural oak woodland area drained by the River Moravia. Thirty percent of the woodland of the Czech Republic is found in this region. It is 160 m above sea level, with rainfall of 500-550 mm/year falling mainly between April and September. The level of rainfall in the vegetative period has fallen in recent years, and the water level has dropped by 1.5 m over the last 30 years. The stocking rate is approximately 300 m^3/ha, with no natural regeneration.

As we travelled through the area, we saw the damage to crops and fodder caused by the severe floods which took place earlier in the summer, making world headlines. Floods are expected every 10 years, following long periods of rainfall in areas further north which cause rivers to overflow their banks. In the past, floods have been channeled into the forests to save villages.

The group observed oil wells in the forest which have been in production for 60 years, yielding a good quality oil for use in the pharmaceutical industry.

We were shown a stand of 103-year oak grown on a 140-year rotation, with a dbh of 48 cm, a top height of 33 m and a stocking rate of 447 m^3/ha. There was evidence of top dieback which was thought to be a consequence of the low water table.

We then moved to a 26-year stand of oak which had received its first thinning. Here,

we were introduced to Mr Vicha who informed us that the stand comprised 90% oak and 10% ash, with 400 stems/ha (8 m^3/ha) having been removed. At this stage, white bands had been placed on final crop trees. Dense undergrowth is encouraged to prevent the emergence of epicormic shoots. The area, originally planted at 10,000 plants/ha, will be thinned again in 5-7 years time.

At the next stop, we saw a 2.16 ha area of 14-year oak, with sugar beet and corn planted between the rows to help keep weeds at bay. The area was planted at the rate of 19,000 plants/ha. Approximately 9,700 stems/ha were left after the first thinning, with a further two thinnings due before the crop reaches 25 years.

Both this and the previous area had been under water for 2 months during the summer. None of the sites were showing any ill effects. Foliage was a deep green and showed no sign of colour change at this late September stage. The idea of flooding the areas periodically as a way of assisting growth is currently under consideration. It is planned to allow in the water in spring and then to release it slowly.

Finally, we saw an area where acorns were machine-sown 15 cm apart. It is an experimental planting site and as before, had been under water earlier in the year.

This stop concluded the tour for the day, during which we saw unique silvicultural practices matched with the unusual prevailing climatic and soil conditions.

Frank Nugent

Outdoor hospitality, Czech style (Photo: J. Mc Loughlin).

Friday, 26 September

We left the Hotel Moravia in the town of Boskovice, located approximately 43 km north of Brno. All was quiet on the bus, with fatigue beginning to beset our minds and bodies after 4 successive days on the road. Having travelled west for about 3 km, we made the connection with the E461 and thereafter headed directly south for Brno. The journey lasted a little over an hour, with much of the route lined with spectacular Norway spruce and Scots pine woodlands, terraced vineyards and rich farmland, all bordering the southern portion of the Draheny Highlands.

I was apprehensive about our impending visit to the Mendel University of Agriculture and Forestry, Brno, with visions of boredom looming. It was therefore a pleasant surprise to be greeted by the cheerful and upbeat Tomas Parik, our leader for the morning. This welcome was the beginning of a day which, for all of us, was destined to become the highlight of the tour.

Established in 1919, the university is the oldest University of Agriculture in the Czech Republic. It provides bachelor, graduate, postgraduate and continuous education in agricultural, biological, horticultural, economic and forest sciences. It comprises four faculties - agronomy, horticulture, economics and forestry and wood technology.

Within the Faculty of Forestry and Wood Technology, 16 separate departments provide a broad spectrum of forestry subjects and courses. Students have the option of a 5-year Graduate Engineering programme or a 3-year Bachelor Studies programme. Each programme operates on a semester system, no credits, all exams.

Within the Graduate Engineering programme, students can select either forest or wood engineering, depending on their desired choice of profession. The first specialises in forest management and administration, preparing students for managerial positions in forest administration, nursery companies, protected nature reserves and in commercial, state and private companies. The second specialises in wood technology and manufacturing, allowing students to qualify for work in the wood and forest industries such as commercial production companies in the wood, furniture and joinery sectors.

Students opting for the Bachelor Studies programmes can again specialise in forest or wood engineering. There is, however, less emphasis on the sciences and a greater emphasis on the economic, administration and business activities in forestry and the wood processing industries.

Both streams offer a solid grounding in core subjects such as game management, environmental management and protection. This reflects the historic and deep-rooted traditions in forestry training and education in the Czech Republic, with current silvicultural management practices based upon game management principles dating back to the early 17th century. The emphasis on environmentally-friendly practices reflects the extend of current problems associated with air and water pollution in Central Europe.

There are approximately 600 students attending the various programmes at the university, with an estimated 80-100 due to qualify in 1998. As in Ireland, career opportunities for forestry graduates in the Czech Republic are limited and are largely confined to private sector forestry and the wood processing industry.

We travelled north to the Masaryk Forest at Krtiny, managed by the Training Forest Enterprise (TFE) and utilised by the university for practical training in all forestry disciplines. Masaryk Forest forms a continuous complex of forests to the north of Brno covering 10,500 ha, including 840 ha declared as nature reserves. The forest, which comprises diverse site and stand conditions managed to unchanged principles for approximately 100 years, is ideally suited as a facility for education and research by students and faculty staff alike, and also provides for normal commercial forest production. During the afternoon, the group made a number of stops throughout the forest.

Forest Arboretum and Recreational Park at Ricimanice: Long-term analysis by the TFE indicate that its forests are visited annually by a large numbers of Brno inhabitants. Here at Ricimanice, various measures have been undertaken to enhance the multi-functional role of the forest. These measures include the creation of forest meadows and glades, and the construction of forest lakes, wells and view-points on higher elevations. An extensive range of exotic species have also been introduced for aesthetic purposes. The area includes

a collection of memorials celebrating various aspects of trees and forest culture. Entrance to the park is free, with its development and up-keep funded by TFE and the Mendel University.

Technological developments in logging operations: As part of their research into environmentally-friendly logging and reforestation technologies, TFE engineers are engaged in the development of machinery for sale to the state and private forest sectors. One such machine is the Larix 550 Cable System, a new type of middle line and middle loading cableway suitable for low harvesting volumes. The unit operates from a tractor PTO shaft and can be used as an endless or main line system. The group observed a demonstration of the unit in a beech stand located on a steep slope, which was being selectively thinned for seed regeneration. Haulage distance to the road was set at maximum capacity (550 m) and output rate achieved was stated to be approximately 70 m^3/day. Extraction cost was estimated at between IR£8-22/m^3 to roadside. Machine set-up time by a 3-person crew over the maximum yarding distance is normally 5-8 hours. Maximum loading capacity is 2 tonnes, with a maximum carriage speed of 2.2 m/sec. In addition to extraction from main haul lines, logs can also be pulled into the main line up to a distance of 70 m on either side, making the system ideal for selection felling of mature stems. In subsequent discussion with TFE personnel, it was highlighted that the extraction costs were considered to be excessive by Irish standards. It was, however, pointed that the remit of the TFE was to research, develop and demonstrate logging technologies allowing the management and harvesting of stands in an environmentally-friendly manner. The use of cable systems afforded the minimum of damage to ground surfaces and remaining trees. Furthermore, it is common practice in the Czech Republic to pay the contract logging companies a higher price to extract timber on difficult sites and in stands where the volume removed is low. The Larix 550 therefore enables forest owners to achieve higher prices for timber sold on roadside, as opposed to standing sale to a contract company.

Beech management – natural regeneration by shelterwood felling: Beech is one of the major commercial species in the Czech Republic, and its importance is set to increase with the growing emphasis on the gradual replacement of conifers with natural stand species. Beech stands account for over 27% of the total area of Masaryk Forest. The TFE has a long tradition in the finer methods of forest management, including shelterwood regeneration and the application of continuous selection management principles. Within the forest, beech stands are subjected to a 130-year rotation, with measures designed to facilitate natural seeding introduced at 100 years. These include group and border shelterwood felling against the prevailing wind, with the retention of a small number of good quality trees for seeding purposes. At year 60, individual sub-dominant trees are released *via* the selection of strong individuals displaying poor quality stems and/or poor crown structure, with the resulting increase in diameter growth compensating for losses associated with the removal of the larger diameter trees. After this treatment, the stand appears 'younger', with its canopy restored to a compact layer. This method of selection encourages an even, more open canopy from the middle age of the stand onward, providing the ideal basis for future natural regeneration. This method of management has been used with great success, with an average stem volume between years 116-126 in excess of 2 m^3, and a volume/ha of 333-368 m^3.

Regeneration of Norway spruce stands: Norway spruce is the second most important commercial species in the Masaryk Forest, occupying 25.7% of the total area. The species occurs both in mixed stands and in pure blocks. Our excursion itinerary included visits to stands which were regenerated on the shelterwood felling system and the continuous

selection (Wagner's 'Blendersaumshlag') system, the latter based on the harvesting of trees which have reached their MMAI and are of exploitable diameter.

Following a summary and discussions on the day's itinerary, our Chairperson thanked Mr Truhlar and his staff for extending their vast wealth of knowledge and experience in the finer methods of forest management. After making our farewells, we reluctantly boarded the bus and began the first stage of our journey back to Prague. We were indeed reluctant to leave, as we all felt that the day's proceedings represented a most fitting culmination to our tour. It enabled us not only to put into perspective all the traditions and management systems encountered during the week, but also created a desire to return to the TFE at some future date in order to learn more about the finer aspects of environmentally-friendly forestry practices.

Eamon Larkin

Tour Participants

Richard Clear
Tadgh Collins
Jim Crowley
Dermot Cunniffe
Gerry Dolan
Jack Durand
Charles Farmer
John Fennessy
Jerry Fleming
Brigid Flynn
Gerhardt Gallagher
Tony Gallinagh
John Gault
George Hipwell
Richard Jack
Eamon Larkin
Donal Magner
Tony Mannion
Kevin Mc Donald
Patrick McCloskey
Tom McDonald
James McHugh
John Mc Loughlin
Brian Monaghan
Frank Nugent
Michael O'Brien
Liam O'Flanagan
Mairtin O'Neachtain
Tim O'Regan
Pat O'Sullivan
Denis O'Sullivan
Thomas Purcell
Joe Treacy
Arie van der Wel

Knockboy – almost a start for state forestry

While visiting a forest office the other day, I noticed a printed sticker on the wall saying "100 isn't old if you're an oak". It reminded me of how short the story of state forestry really is, since it began with the establishment of a training school for foresters at Avondale in 1904. If we go back to 1892 we are, in fact, at the very first attempt by the state to plant trees.

Well, it really wasn't a carefully planned and prepared project, but suffered from the flaws of a rushed political decision. In attempting to help alleviate the distress caused by the failure, yet again, of the potato crop along the west coast, Arthur Balfour, Chief Secretary for Ireland, and his officials at Dublin Castle responded with an impressive alacrity. Balfour had said that the government would buy land for drainage and possible planting, provided that the title to the land was readily available. He knew of the seemingly endless difficulties in sorting out title to land in Ireland. But this time, an energetic Parish Priest, Father Thomas Flannery, at Carna right on the west coast in Co. Galway, immediately offered land which he held on good title from the vast Berridge Estate. The land was exposed mountain at Knockboy, within sight and sound of the rages of the Atlantic. But it was available and that was that!

The land was quickly acquired, use being made of the new-fangled telegraph system to speed the way. Although a bill was passing through Parliament at the time to create a new Irish Department – the Congested Districts Board – specifically to deal with the problems of the West, the urgency was so great that work started even before the new body saw the light of day. The Land Commission, itself established only a decade before, was given the task of getting it started. The Commission in turn had to use the Office of Public Works to take ownership, given that it was unable to do so itself. An experienced forester, a Scot named Robertson, was recruited and the initial drainage work began under the control of army sappers. They were part of a contingent which worked under an engineer officer, Major Peacocke, on a multitude of relief schemes up and down the West. In the Carna area alone, more that 900 men were registered for relief work of various sorts. Dublin Castle funded the work entirely and was determined to keep the relief scheme away from any local influence, apparently due to earlier misuse of funds.

By 1892, when the Congested Districts Board assumed control, up to 40 men were employed. Each was paid the equivalent of a stone (14 lbs.) of yellow meal a day, which was judged to be sufficient for one family. Payment was thus seven shillings a week. It sounds like very little money when expressed in today's terms as 35 new pence, but back then, it could buy more than 40 kg of meal.

Despite the skills and conscientious work of the forester to establish a plantation, only sheltered pockets provided even the slightest encouragement. More than 2.5 million plants were used on the 500 acres – approximately 200 hectares in today's terms – that were drained and planted in the decade or so the scheme lasted. Finally, having seen all the many species fail utterly, bar some stunted pines which managed to defy the welter of environmental enemies, the Congested Districts Board decided that enough was enough and walked away from the failure. The Board was embarrassed by the scheme, which had become in effect an experiment in state planting, rather than a simple and hastily-conceived relief project to provide much-needed employment quickly.

Several decades were to pass before a properly experienced state Forest Service was again to try planting at Knockboy. This time it used only a small portion of the area which

was least exposed, and trees of Western North America which experience had shown to be so superior to the European species used in the days of the Congested Districts Board.

To walk Knockboy today and to see the odd tree alive, however gnarled and windswept, and the traces of the many drains dug by hand a century ago in that wild landscape, can be an emotional journey into the past. Was it a failure or a useful experiment? As it was an attempt to grow the wrong trees in the totally wrong place, it is easy to scoff at it. In such failures, however, lay lessons for both foresters and political decision makers of the future.

Jack Durand

Book reviews

Diseases and Disorders of Forest Trees – A Guide to Identifying Causes of Ill-Health in Woods and Plantations

S.C. Gregory and D.B. Redfern. 1998. Forestry Commission Field Book 16. The Stationery Office, London. ISBN 0 11 710338 1. 136 pages. Stg£25.

Reviewed by David Seaby, Forest Pathologist, and Dick Schaible, Forest Research Officer, Department of Agriculture for Northern Ireland.

From the viewpoint of a forest pathologist, *Diseases and Disorders of Forest Trees* is to be thoroughly recommended, and would be useful in all forest and arboricultural offices. The key is very ambitious, particularly in light of the real difficulty in preparing one which is clear and yet covers all possibilities, but is nevertheless excellent. The writing – a pleasure to read – is clear, practical and down to earth. The pathology photographs are well-chosen, of excellent quality and are generously scattered throughout the text, bring it 'alive'. At the asking price, a slim volume like this might appear expensive. However, the glossy quality of the paper, the number of photographs and the relatively specialised nature of the text mean that the enormous amount of work gone into this book will not be particularly well rewarded in financial terms. The layout is logical and easy to use, and a little detail greatly appreciated is the publication's narrow width, which enables it to fit easily into a coat pocket.

From the perspective of a silvicultural research forester, the descriptions of genetic defects and climatic and herbicide injury symptoms are particularly enlightening. In these sections, however, and in the section pertaining to frost damage, a few more photographs showing a wider variety of symptoms and effects on different species might have been worthwhile. In contrast with the comprehensive nature of the sections dealing with climatic injury and pathogenic agents, which reflect the individual authors' contributions to research and long practical experience, the section on nutrient deficiencies is somewhat disappointing, both in terms of descriptive text and photographs. Only one passing reference is made to the relationships between nutrient deficiencies and site factors, which are vital to understanding and diagnosing nutritional problems, while no reference is made to the relationship between apparent nitrogen deficiencies and the availability of phosphorus. Consideration of trace mineral deficiencies is also omitted, except for the highly appropriate implication of manganese and iron deficiencies in the section on lime-induced chlorosis. To a large extent, these shortcomings could have been redressed if reference had been made to other publications illustrating and describing nutrient deficiencies, such as *Nutrient Deficiencies of Conifers in British Forests - An Illustrated Guide* (Forestry Commission Leaflet 76. HMSO, London. 1980). While this omission might possibly be perceived as encouraging complacency as regards the potential impact and extent of nutritional problems in plantation forests, it does not seriously detract from the essential purpose and value of this book. The publication of *Diseases and Disorders of Forest Trees* is timely and fills a hitherto significant gap in Irish and British forestry literature.

Celebrating Irish Forests

Coillte and An Taisce. 1998. ISBN 0 9518612 3 9. 56 pages. Paperback. IR£5 (available from all Coillte offices).

Reviewed by Niall OCarroll, former Chief Inspector, State Forest Service.

Coillte and An Taisce have come together to produce and publish this pamphlet, or brochure, celebrating that great, man-made national resource, the forests of Ireland, even now less than 100 years in the making.

The text is by Frank J. Convery, with acknowledgement for editorial advice going to Michael Carey, David Hickie, Tony Lowes and Alistair Pfeifer. This combination is our assurance of scientific accuracy. The photographs are by various hands and eyes.

The guarantee of an accurate text is fine as far as it goes. But that text covers considerable ground under the headings Introduction, Ecosystems, Landscape, Water, People, Spirituality, Farmers, Commerce and Sustainability, all in a total, by this reviewer's reckoning, of 4,000 words. A thin cover, it might be said.

The format is the standard glossy A4, profusely illustrated, with scattered blocks of text and lots of blank space, presumably dictated by 'design' considerations.

That a commercial forestry company and a national conservation organisation could co-operate in this project is highly creditable, even if at times one can almost hear the grinding of the wheels of compromise, as in "Where soils have a granite base...there may be a tendency towards some acidification of waters, which may affect fish life." But 'compromise' is a word much in the air in recent times. It is hoped that this co-operation will develop and flourish, and that its scientific base will be more firmly established by the necessary research.

The use of lodgepole pine of Lulu Island origin is given as an example of a past mistake. The background of that 'error' is not as straightforward as might be inferred. But that is a story for another day.

The picture of the cover and on page 17 is captioned "The Great Ride, Avondale". The adjective 'great' in this connection was a recent administrative 'refinement' of the name of a feature traditionally and universally known as 'the big ride'.

It is a pity that there is no explicit celebration of that marvellous species, Sitka spruce, the staple of Irish forestry for decades, and likely to remain so in the foreseeable future. The interior of a mature Sitka spruce wood, such as can be found in the Slieve Blooms and no doubt in other places also, need yield to nothing in terms of aesthetic quality (or spirituality, to refer to one of the section headings).

Once more we encounter that insidious plural *premia*, a word which has no validity in correct English. All authorities are agreed on 'premiums'.

Churchill's catty remark about Clement Atlee's modesty, quoted on page 52, might well have been eschewed, particularly in view of the high esteem in recent years for Atlee as Prime Minister. Far from being modest, I think Irish foresters have much to feel proud of, even if there is still a lot to learn. As T.S. Eliot puts it:

> All our knowledge brings us nearer to our ignorance,
> All our ignorance brings us nearer to death ...

Growing Broadleaves – Silvicultural Guidelines for Ash, Sycamore, Wild Cherry, Beech and Oak in Ireland

Padraic M. Joyce (principal author). 1998. COFORD, University College Dublin, Belfield, Dublin 4, Ireland. ISBN 0 9523938 9 1. 144 pages. Paperback.

Reviewed by Gerhardt Gallagher, Forestry Consultant, Forest Service.

This attractive book is a timely addition to Irish forestry literature, and a serious attempt to shed light on the issues facing forest managers here in this relatively unexplored area. COFORD and its authors deserve praise for bringing it to publication.

The authors represent a significant stratum of forestry experience, with a strong background in research. The accumulated knowledge of growing broadleaves is, as the foreword admits, still somewhat limited in this country. The presence, however, of Professor Huss as a contributor represents an important balance in terms of central European experience. It is interesting to note that the authors have opted quite clearly for the high initial stocking rates favoured in European forestry, not surprisingly perhaps in that broadleaf programmes will be based primarily on European species. The extent to which our higher wind speeds and exposure will constrain quality objectives remains to be seen.

Five species are described in detail: oak, ash, beech, wild cherry and sycamore. This selection obviously reflects the main components of existing broadleaf woodlands and new plantings. Early experience with wild cherry has been disappointing and will probably reduce its importance as a species with significant commercial promise. A minor section on birch, alder, aspen and willow might have been useful, given the growing perceived importance of riparian woodlands as a forest component, and the desire for additional forest diversity.

The guidelines *per se* are comprehensive, well laid out and easy to follow. Site/soil requirements, mixtures and forest operations, from establishment to tending and thinning, are well covered, although I was left in some doubt as to what the recommended best course was for sites with inherent nutrient problems – avoid or ameliorate?

It was useful to have production goals relating to timber usage. An overemphasis on hurley ash might be limiting, as there are many other potential niche markets for the species, with picture framing being this reviewer's own particular hobby horse.

Yield and production data clearly indicate that growing broadleaves is in general a long term process, and the end result is achieved through quality rather than quantity, although I qualify this in the context of new uses for small scale material. Ireland as a natural temperate forest region will require both the quality of broadleaves and the quantity of conifers to achieve the various goals of sustainable forestry.

Excellent photographs showing broadleaves in the Irish and continental setting, together with Wendy Walsh's fine drawings, make the book an enjoyable visual experience.

Growing Broadleaves is a must for forest owners and managers embarking on this complex journey. The investment in its publication is money well spent. The book is not priced, but could grace the shelves of any bookshop.

The poet, the sculptor and the forester – Sculpture in Woodland, the Devil's Glen Wood, Co. Wicklow

Introduction

Sculpture in Woodland was formed in 1994 to help establish a wood culture in Ireland, by creating a greater awareness of wood as an artistic and functional medium. The main aim of the project is to provide artists with a vibrant natural environment along with the resources and support needed to create and exhibit work of artistic excellence. Located in the Devil's Glen Wood near Ashford, Co. Wicklow, the project has attracted the best of contemporary Irish and overseas sculptors. Artists have been invited in the past to respond to the woods, as has happened in Castlewellan in Co. Down and Hazelwood, Co. Sligo. Sculpture in Woodland is, however, the first project structured in such a way as to build up a major collection of contemporary sculpture over a period of time.

Sculpture in Woodland began as a collaboration between artist and forester, and has since broadened to include educational bodies, arts organisations, state agencies, corporations, local authorities and the community. While the project is international in its approach to commissioning works, it places strong emphasis on community involvement. Sculpture in Woodland creates a strong sense of place within this important local amenity, with the artists' response respecting the *genius loci* the area evokes.

The committee is voluntary and includes a broad cross-section of people, companies and organisations from the arts, business and local communities. In 1995, Coillte generously presented the project with 600 acres of woodland in the Devil's Glen. Wicklow County Council provided the initial funding to establish the project, and was later joined by the Arts Council and a number of local and corporate organisations.

The Devil's Glen

The Devil's Glen was chosen as the location for Sculpture in Woodland because of its rich historic, natural and artistic heritage. Owned by Coillte, the area is densely wooded but fully accessible to the public. The company maintains an amenity area, forest roads and woodland walks. Although the Glen has some natural forest cover, most of the 250 ha woodland comprises plantation forest established mainly from 1939 onwards with both introduced and indigenous species. In keeping with the pioneering spirit of species selection and a groundswell in favour of exotics during this era in state afforestation, foresters drew from a broad menu of species. Exotics included western hemlock, Douglas fir, Norway spruce, Japanese and European larch, silver fir and Sitka spruce, as well as widespread species such as Scots pine, beech and sycamore. Native species of ash, oak, yew, holly and birch are also growing in the Glen. Across the River Vartry dividing the Glen is the private estate owned by the Tottenham family, which has a semi-natural sessile oak wood along with excellent coniferous plantations. Although an amenity wood, the Devil's Glen is first and foremost a working forest. The artists responded very positively to the commercial management of the wood. They looked on the felling and replanting cycle as a dynamic force, whereby the forester makes his or her own unique mark, but all within the framework of renewal and sustainability.

Geology

The geology of the Devil's Glen was a major influence in choosing the area as the site for the project. The Glen was cut out gradually by meltwater during the end of the last Ice Age. The river rushed from the melting Wicklow ice cap and carved the V-shaped profile. This is similar to the Glen of the Downs, but contrasts with typical U-shaped Wicklow valleys such as Glenmalure. The rocks of the Devil's Glen, which date back 520 million years, are among the oldest in Co. Wicklow. They are sedimentary in nature, formed from sand, silt and mud deposited in a marine environment during the Cambrian Period. Since then, there have been many changes as the sediments were gradually caught up in a collision of continents. As a result, the original beds of sediment are now tilted and folded layers of hard rock. The pressure of the crumpling caused a slaty parting or cleavage to form finer grained sedimentary rocks. Veins of white quartz, up to several centimetres wide, are present throughout.

The River Vartry

The River Vartry rises south-west of the Sugarloaf Mountain and makes a spectacular entrance into the Glen at the waterfall known locally as the Devil's Punchbowl. The river, now much smaller than when the meltwater sculpted the Glen during the last Ice Age, was by all accounts quite impressive up until the Vartry Reservoir was built near Roundwood in the 1860s. Up to then, the roar of the waterfall echoed around the valley and the mist could be seen for miles around. It was this "Satanic power announcing some great impending doom" which probably gave the Glen its popular name.

Historic and artistic significance

The Devil's Glen has a strong historic and artistic significance. It was used as a hiding place by Irish insurgents following the collapse of the 1798 Rising. After the abortive attempt to capture nearby Newtownmountkennedy in May of that year, it was reported that 60 of the attacking force who took refuge in the Glen were killed.

The Glen was a popular area for artists during the 18th and 19th centuries. Paintings of the time clearly show the oak woods on the Ballycurry side of the Vartry. The area now owned by Coillte carried fewer trees. The most famous Irish artist to visit the Glen was James Arthur O'Connor, who captured its brooding qualities around 1828. His major oil painting, *A View of the Devil's Glen*, is, according to John Hutchinson, "one of the most impenetrable of O'Connor's romantic landscapes; the high horizon and gloomy clouds offer the viewer no easy escape from the painting's melancholy mood."

The Seamus Heaney connection

The literary connection is also strong. The renowned playwright, John Millington Synge, spent his summers in nearby Glanmore Castle. More recently, Seamus Heaney, Irish poet and recipient of the Nobel Prize for Literature, was influenced by "the strange loneliness" of the place shortly after he came to live in the area in 1972. It was therefore fitting that Heaney should perform the unveiling of the latest sculpture, *Antaeus* by Michael Warren.

It was in the Glen that Heaney says "I put my 10 pence in a box in the car park wall, took my Forest Service Nature Trail booklet and explored the woods. Here, I got used to the forest walks. Deep down, these walks survive in a special way. They are like fossil

fuel, a kind of a reserve tank that the spirit can switch over to when its resources are low. Today, Coillte keep the ecology as well as the economy of the woods in balance: to keep the rhythm of planting and felling in good order; to keep the green lungs of the country breathing and the dark roots drinking." His love of the place is reflected in his poems, in particular, the haunting *Glanmore Sonnets*:

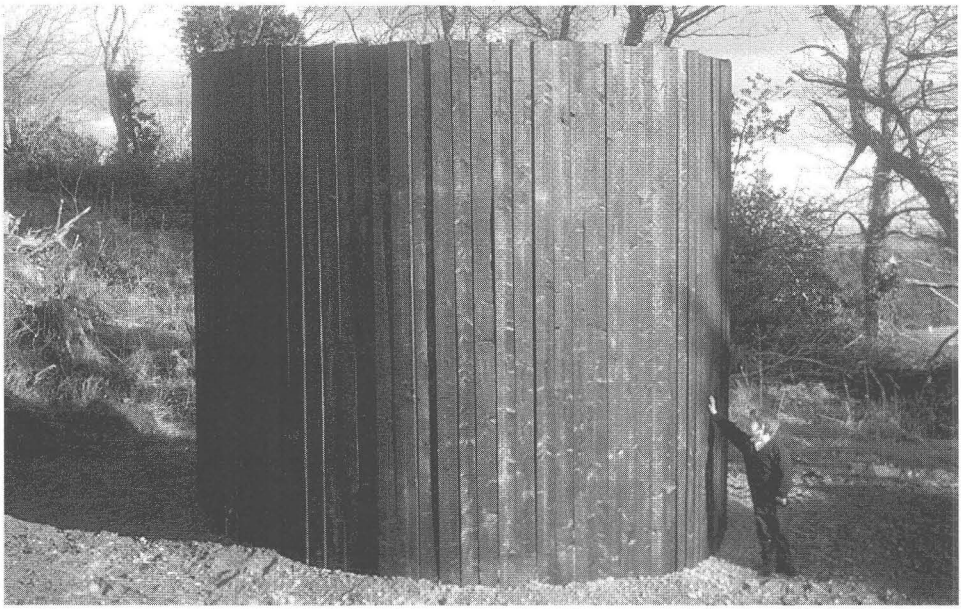
> This evening the cuckoo and the corncrake
> (so much, too much) consorted at twilight.
> It was all crepuscular and iambic.
> Out on a field a baby rabbit
> Took his bearings, and I knew the deer
> (I've seen them too from the window of the house,
> Like connoisseurs, inquisitive of air)
> Were careful under larch and May-green spruce...

In choosing the Glen as the location for this project, it was impossible to ignore these powerful visual, historical and literary signposts. These have also been important to the artists who have responded imaginatively to this unique environment. While the Glen has been physically shaped first by nature and later by farmers, foresters and engineers, the project organisers felt that it was time for artists to make their mark on this landscape. To do this, they worked with local Coillte and FÁS staff. For raw material, they selected timber mainly from the same species range used by foresters of the 1930s to establish the wood: larch, Douglas fir and Sitka spruce.

Work by seven sculptors

The first sculptures were commissioned in May 1996 and four artists - Naomi Seki of Japan, Jorge du Bon of Mexico, Maurice Mac Donagh of Ireland, and Kat O'Brien, Canada - completed the first works in the Devil's Glen the following September. These were followed by Derek Whitticase of England and Jacques Bosser of France. Each artist responded to the forest environment not only with expected creativity, but also with a profound understanding of the rich heritage of the area. In a message to the artists and organisers, President Mary Robinson summed up the mood of Sculpture in Woodland: "The sculptures will help stimulate fresh interest in wood as a creative medium and establish a wood culture in Ireland."

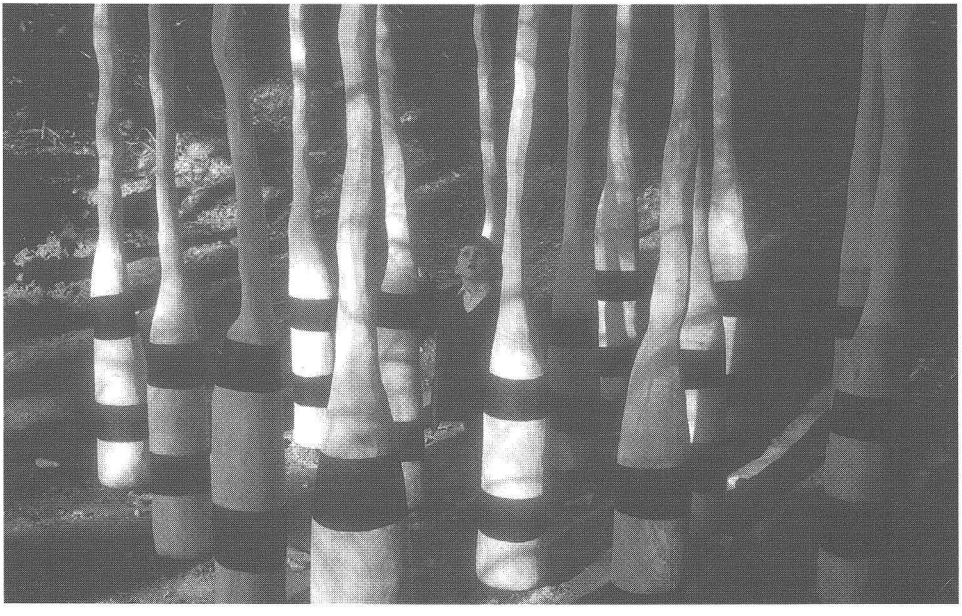
The project has received positive media reaction and has been featured on both RTE radio and television, and in the national press. The following briefly describes three of the first six works completed.



Round by Maurice Mac Donagh, Ireland (Sitka spruce)

Mac Donagh's piece comprises Sitka spruce logs from forest thinnings arranged as a vast cylinder. To Heaney, *Round* seems "like an embodiment of everything that the words 'holding action' stand for – it's like a silo full of solidity and spirit." When asked to make a statement about his piece, Mac Donagh said in 1996 "*Round* takes the form of a large charred minimal cylinder constructed from concentric circles of Sitka spruce. This follows the process by which the tree itself forms wood and underlines the theme of the work; exploring the nature and substance of trees and how we experience them. My concerns are not therefore the historical or socio-economic relevance of woods, but sculptural issues such as mass, density and gravity which trees evoke. My aim in this process is the distillation of these properties of trees to imbue a silent presence in my piece."

Mac Donagh received the Oireachtas Sculpture Award, 1993, and an Arts Council Bursary, 1996. He has had major solo exhibitions at the Irish Museum of Modern Art, Project Arts Centre, RHA Gallery and the Eigse Arts Festival, Carlow. He was the Irish representative at Expo 92, Seville.



Pound by Derek Whitticase, England (Douglas fir, painted)

Whitticase uses wood in many of his works, usually carved and painted in a way which allows the wood grain and texture to be seen through the paint. In this piece, he carved Douglas fir logs in his studio over a 4-week period, and then spent several weeks in the Glen erecting the piece with FÁS workers. Seamus Heaney said that *Pound* feels "like a kind of a dream-stockade, a space staked out for the security of body and soul." Of his work, the artist says "The word 'pound' has connotations of weight, monetary value, a secure enclosure and force, all of which are important to this piece. Pound is about space being valuable and about valuing our environment. The piece creates an enclosure that can be entered and experienced within as well as without. The natural organic forms of the 16 columns reflect the environment of the forest, while also invoking images of bars or caging. This dual existence of internal and external space creates tension within the piece, presenting the viewer with a simultaneous experience of internal/external, personal/shared space."

Liverpool-born, Whitticase has been working in Old Leighlin, Co. Carlow, for 8 years. He has exhibited in solo and group shows in Ireland and Europe, and lectures in the College of Art, Dun Laoghaire.

The Seven Shrines by Kat O'Brien, Canada (various timbers including Douglas fir, sycamore, maple, silver fir and Sitka spruce; seven sculptures in total)

Kat O'Brien used wood found in the forest, except for a piece of maple brought from Canada where she now lives. Her pieces commemorate seven generations born since the Great Famine. Her work is in sympathy with the forest and her own heritage - both sides of her family are rooted in emigration forced by the Famine. The artist says of her work "The seven shrines commemorate the seven generations born since the beginning of the Irish Famine. (Just as a tree grows by adding a concentric layer each year around the heartwood at its centre, so water pulses out from a central disturbance and a sound travels outward from its origin.) Though we speak of our mother tongue and our mother country, it is rarely the women among us who are commemorated in our histories and public monuments. By contrast, there are many women cursed as demons. The shrines invoke the intimacy of the forest to redirect the power of those legends towards reconsideration of the lives of seven generations of people who have no fame on the battlefield, no special days to honour, no mention in song or no places celebrating their contributions. As you walk the circular path, you are invited to discover the environment around each shrine and to consider your own path through the concentric pilgrimage of the last 150 years."

O'Brien has exhibited in Ireland, USA, China and Canada, including the United Nations World Conference on Women, Beijing, and Eau de Passion series in Chicago and New York.

Heaney on Warren

The final sculpture commissioned for the project was *Antaeus* by Michael Warren (see front cover). This is essentially three large inverted arches made from European larch and poplar, and placed at the entrance to the Devil's Glen Wood. Warren is now recognised as a major international sculptor and has been working predominantly in wood for over quarter of a century. He is one of the few artists in Ireland who fully understands the aesthetic and functional possibilities of wood, and the challenges in using it.

When Seamus Heaney unveiled the sculpture, he spoke warmly and convincingly about contemporary sculpture and Warren's piece, which, as he put it, "gives us a wonderful, mysterious sense of crossing a threshold...getting deeper into where we are and what we

are." He said that he had a deep personal connection with the work, not least because he had written two poems in which he identified "with this ancient Antaeus figure": "The Antaeus syndrome is the opposite to what we might call in Ireland the Oisín syndrome. You remember that when Oisín returned from Tír na nÓg, he immediately grew old as soon as he touched the ground. Well, with Antaeus, it was entirely the opposite. Every time he touched the ground, he got access to new powers. If he was thrown on the earth in a wrestling match, he came back mightier than ever. The longer he stood his ground, the stronger he stood it. In this, he is a wonderful image for the status of art work and, in particular, sculpture. The longer the work stands here, the stronger it will appear as a shrine to energy and endurance, and the greater will be the invitation to enter the wood."

Heaney said he identified with the work because he locates his "own artistic energy in the ground of County Derry."

The unveiling of Warren's sculpture marked the completion of the first phase of Sculpture in Woodland. There are now a significant number of pieces in the Glen, which Coillte maintains and keeps open to the public throughout the year. The medium to long term objectives of Sculpture in Woodland are: to continue to support artists in creating work in the Devil's Glen; to maintain a significant collection of contemporary work; to provide for a phased development of a visitor's centre; and to enter into partnerships with arts, educational and administrative bodies in promoting the project. The committee wishes to continue the partnership with existing supporters, in particular, Coillte and Wicklow County Council. These have shown vision and courage in supporting a project which, at first glance, might not sit easily with conventional corporate sponsorship.

The emphasis on wood is central to Sculpture in Woodland. Many of our overseas artists are at ease with wood. Irish artists have been slower to respond, but increasing numbers of Irish sculptors are now exploring wood as a creative medium. Sculpture in Woodland provides the artists with the space and environment to maximise the medium.

At the unveiling of Michael Warren's *Antaeus* in the Devil's Glen Wood, Ashford. Left to right: Michael Warren, Seamus Heaney, Donal Magner (Chairman, Sculpture in Woodland), Maria Warren, Martin Sheridan (Secretary), Cristina Warren and Nuala Aherne MEP.

Taking the long view

As with the forest in which they are located, the sculptures need to be fully explored to be fully understood. While we encourage everybody to believe that an effortless understanding of art is open to all, there is a visual language to be learnt, and artists and art administrators need to share their own experience of the work. The same theory can be applied to the forest and the practice of sustainable forest management. Forests like the Devil's Glen are more than a commercial crop. They are now an intrinsic and natural part of the Irish landscape. While most of them didn't even exist 60 years ago, they have already been accepted as an aesthetic, commercial and social asset by the community. The sculptures in the Devil's Glen add to our understanding of woodlands because they enrich our lives. They do not compete with the trees but are an intrinsic part of the forest. As Seamus Heaney said of Michael Warren's sculptures, "The grain of the wood in them speaks to certain elements ingrained in your own self. If you stand in front of them, you are immediately at one with all that is solid and set up in the actual fabric of the timber he has worked, and yet, you are simultaneously at one with something more palpable yet vitally true inside yourself."

In Ireland, we have commenced the work of restoring our lost forest resource. Sculpture in Woodland aims to restore an aspect of our lost woodland heritage which included many traditional skills and crafts which have been developed and refined in other countries. This will not be achieved in the short term. Foresters, who traditionally take the long view, fully understand that creating a wood culture will need perseverance and hard work. A quiet revolution is, however, well underway, with an increasing number of furniture designers, engineers and architects now using wood as an aesthetic and functional medium. In the Devil's Glen, it is the artist's turn to respond to the forest in new and exciting ways. The result is stimulating and challenging, but is only the beginning of the first chapter of Sculpture in Woodland.

Donal Magner
21 November, 1998
Chairman, Sculpture in Woodland

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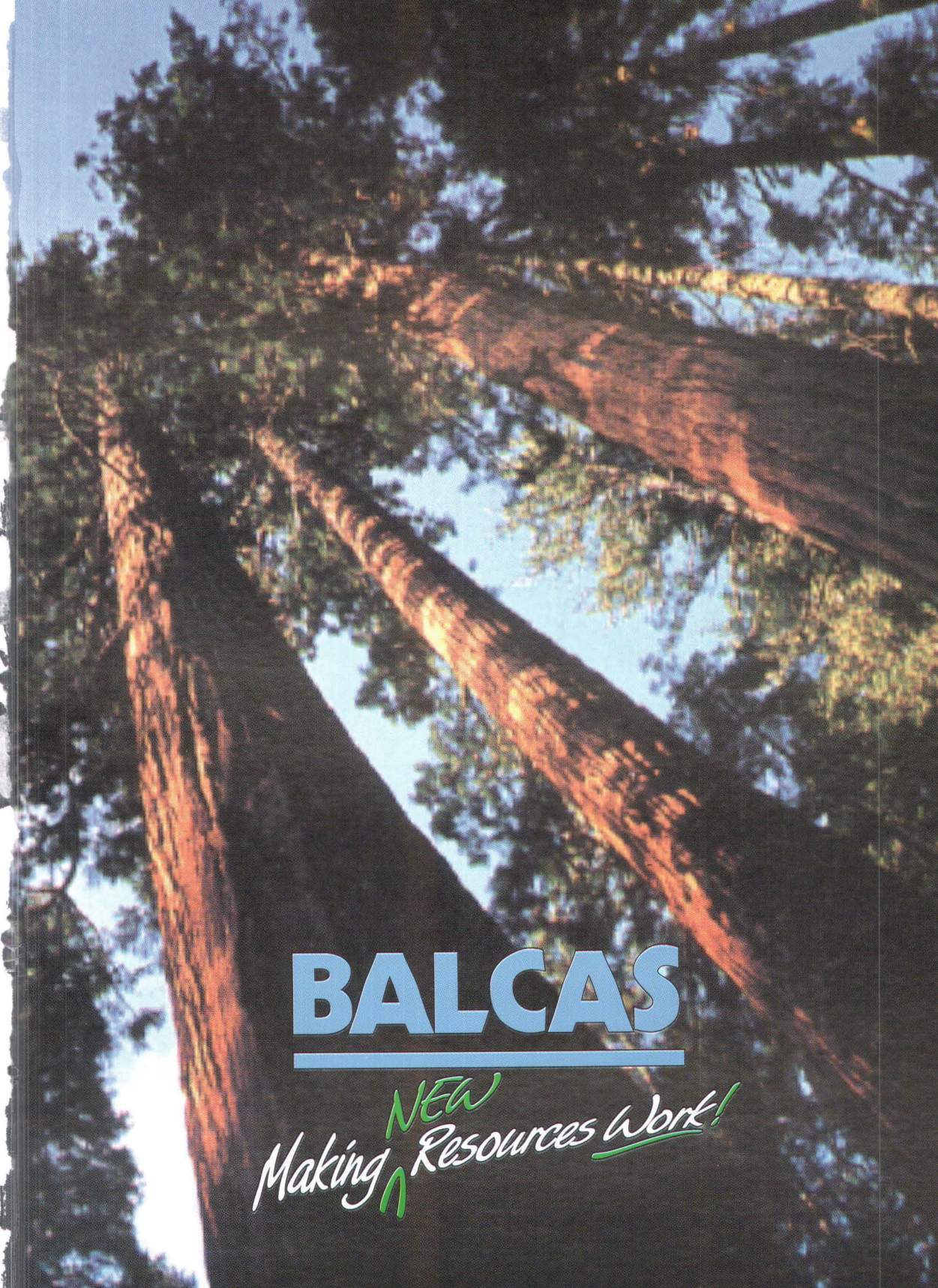
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