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IRISH FORESTRY

JOURNAL OF THE SOCIETY OF IRISH FORESTERS

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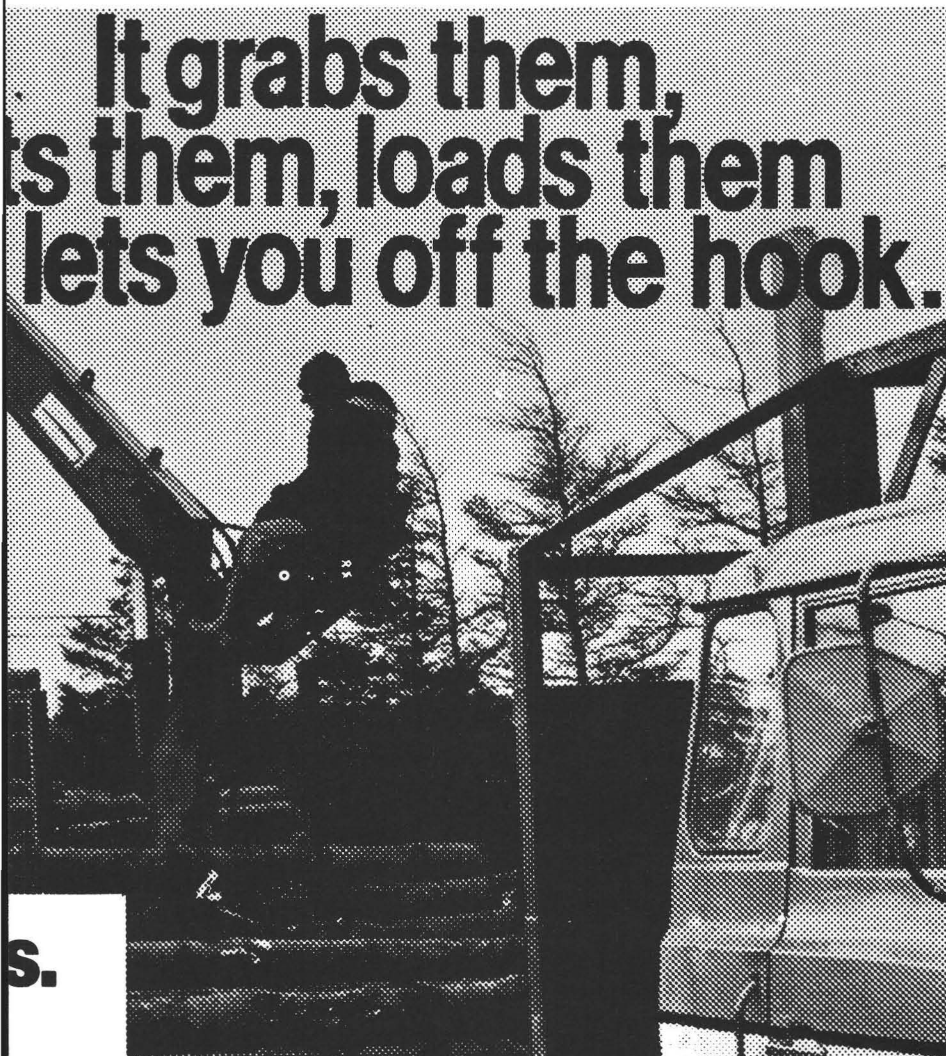
In this issue: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Notes for the Assistance of Contributors

The following notes are designed to aid the speedy processing of scientific contributions to the journal. Authors should comply with them in so far as this is possible.

1. Two copies of each paper should be submitted, in typescript, with double spacing and wide margins.

2. Diagrams and illustrations should be clearly drawn in black ink on good quality paper. Captions should be written on the back of each illustration. Illustrations, wherever possible, should be drawn in an upright position (x axis narrower than y). The approximate position of diagrams and illustrations in the text should be indicated in the margin.

3. Tables should not be incorporated in the body of the text, but should be submitted separately at the end (one table per page). Their approximate position in the text should be indicated in the margin.

4. Nomenclature, symbols and abbreviations should follow convention. The metric system should be used throughout.

5. References should be in the following form:
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   DICKSON, D.A. and P. S. SAVILL. 1974. Early growth of *Picea sitchensis* on deep oligotrophic peat in Northern Ireland. Forestry 47:57-88.
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6. A short summary of the paper should be included. It should precede the main body of the text.

7. Proofs will be sent to the senior author for correction. Proof corrections are costly and authors are requested as far as possible, to confine alterations to the correction of printer's errors.

8. Reprints can be supplied as required by the author. The cost of reprints will be charged to the author at a standard rate per page. *Reprints must be ordered when returning corrected proofs to the editor.*

Contents

Note: The opinions expressed in the articles belong to the contributors

Cover: A walk in the woods, Avondale Forest Park, Co. Wicklow.
(Photo: E. P. Farrell)

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EDITORIAL

European Wildlife Conservation Year

The European Information Centre for Nature Conservation has declared 1980 European Wildlife Conservation Year. The aim is to focus attention on the threat to wildlife presented by man's activities and to increase our awareness of the importance of wildlife in our total environment. The case for the development of natural resources is easily made. Who can deny the need to provide jobs, to create wealth so that all can live in dignity. Most of us by now realize that development is achieved only at a cost, the loss of resources, the elimination of something which existed before. When a forest is established an ecosystem is destroyed, to be replaced by a new one, strongly influenced by man. This loss is the price to be paid by society, albeit often a small one in relation to the gain.

Agriculture and forestry are not subject to controls on development such as are exerted by the planning authorities on building and industrial development. In the case of state forestry, at least, it may be argued that external control is unnecessary, although a plea for centralized land use control was made, in a different context, in a previous editorial[1]. The state services are responsible bodies anxious, it is to be hoped, to cause the minimum of damage to the environment. But do all their members and all who practice forestry understand the importance of our wildlife, can they distinguish real from mythical pests and are they aware of the vulnerability of many species to intensive silvicultural practices?

Man is a predator, often needlessly. The drainage of vital wetlands for marginal agricultural gain, the eradication of hedgerows for convenience, the branding as pests of animals such as the badger, the indiscriminate use of pesticides and herbicides, these all take their toll and may lead to the destruction of creatures who play perhaps a significant if sometimes poorly understood role in the balance of nature.

1. Sylvie rules here — O.K.? Irish Forestry, 1977. Volume 34(2):61

The Society of Irish Foresters

The Society of Irish Foresters was founded in 1942 to advance and spread in Ireland the knowledge of forestry in all its aspects.

The main activities of the society centre around:

(a) Annual study tour

(b) Indoor and field meetings on forestry topics

(c) Production of two issues annually of Society's journal "Irish Forestry"

(d) Annual Forest Walks held on 2nd Sunday of September

There are three types of membership:

(a) *Technical:*
Persons employed full time in forestry or in a closely connected branch of natural science, or who have been so employed for 5 years or persons who have a degree or diploma in forestry.
Annual Subscription £4.00

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Persons studying forestry at universities, schools or colleges.
Annual Subscription £2.00

In all cases membership is subject to the approval of the council of the society. Enquiries regarding membership or Society activities, should be made to: Honorary Secretary, c/o Royal Dublin Society, Dublin 4.

Submissions to the journal will be considered for publication and should be addressed to: Dr. E. P. Farrell, Editor, Irish Forestry, Department of Agricultural Chemistry and Soil Science, University College, Belfield, Dublin 4. The attention of contributors is drawn to "Notes for the Assistance of Contributors" on page 70.

Sales and advertising are handled by: Mr. M. O'Brien, Business Editor, 17 Watson Road, Killiney, Co. Dublin. Tel. 01-867751.

The Importance of Lodgepole Pine in Irish Forestry[1]

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CLASSIFICATION

The genus Pinus, of which *Pinus contorta* is a member, is one of the most widely distributed genera in the northern hemisphere. It contains over 90 species extending from the polar region to the tropics. It is the only northern hemisphere genus which occurs naturally south of the equator (Wright 1962). Within this very large genus, *Pinus contorta* belongs to the subgenus Pinus or hard pines and within this subgenus to the subsection contortae. Allied to it within this subsection, are *Pinus divericata* (banksiana), *P. virginiana* and *P. clausa,* all of which are native to North America. Two of these species are found in eastern North America and the other two in western North America (Critchfield and Little 1966).

PALEOHISTORY

The earliest recorded presence of *Pinus contorta* on the North American continent was 26 million years ago during the Miocene period. It did not become widely distributed until the Pleistocene period, 1.5 million years ago, when records indicate that it may have extended 100-400km further north than its present day range. During the Wisconsin ice age much of the northern distribution of the species was wiped out. As the ice sheet did not extend further south than northern Washington the species widespread distribution in western United States was not greatly affected. This southern refugium may have been the base from which it reoccupied its present northern range. Fossil records show that the species was the first to colonise the glaciated terrain in both the Fraser River lowlands and in the Rocky Mountains following the retreat of the ice sheet. It has not however, been conslusively shown that the southern refugia were the only ones from which the species

1 Presented at "Symposium on Lodgepole Pine", Pomeroy, Co. Tyrone, April, 1979.

IRISH FORESTRY, 1980 Vol. 37, No. 1: 7-22

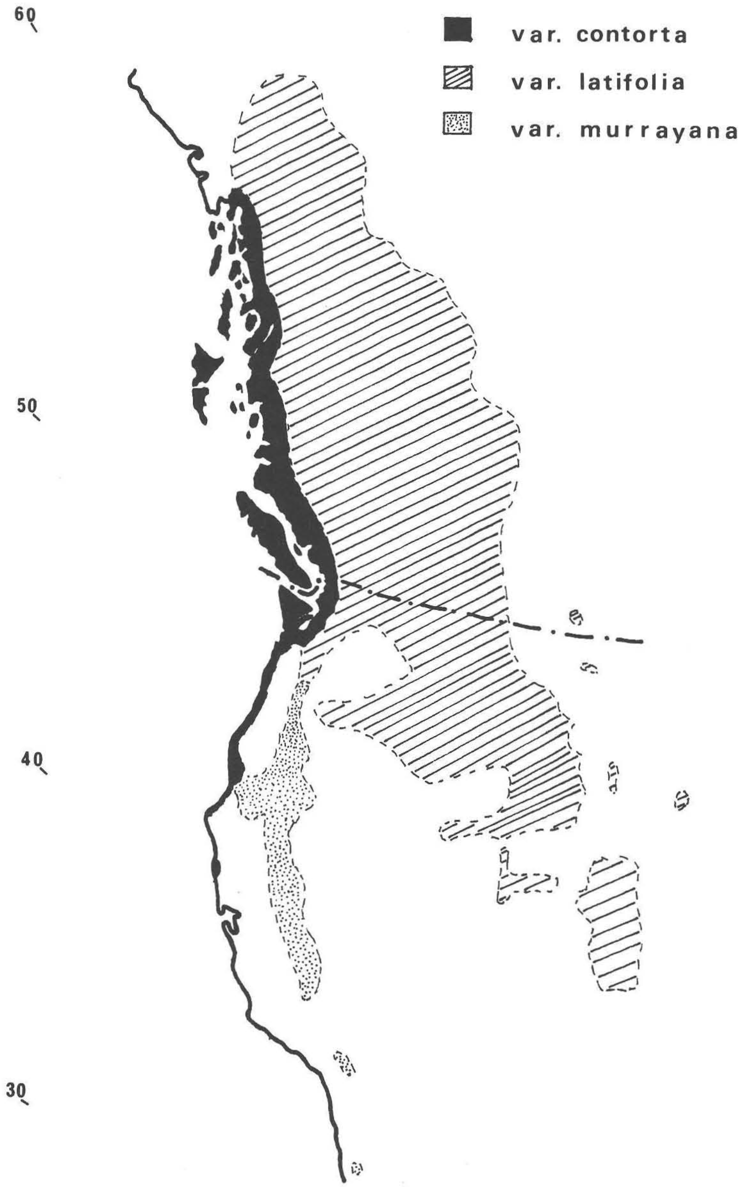

Fig. 1 — Approximate geographical distribution of the three subspecies of *Pinus contorta*.

could have re-colonised those recently available sites. Other suggested refugia include (1) unglaciated parts of the Yukon (2) ice free areas east of the Canadian Rocky Mountains and (3) the north Pacific coast. Strong contra agruments exist to show that these refugia did not exist. (Critchfield 1978).

DISTRIBUTION

Whatever the origin, the present day distribution of the species is extremely large covering a very wide ecological amplitude, both climatic and edaphic. It is found growing from southeastern Alaska and interior Yukon in the north to Baja, California in the south and east as far as the Black Hills of South Dakota. Its north — south distribution covers 33° of latitude while east — west it covers 33° of longitude (Fig. 1). Of all the pine species it has the greatest elevational range, from sea level along the Pacific North West coast to 3900m in the Sierra Nevada Mountains (Fowells 1969). The interaction between the species and the wide variety of climatic and edaphic conditions on which it occurs has resulted in the species being classified into three distinct groups (1) *Pinus contorta var. contorta* found mainly along the Pacific coast mountains of British Columbia and California. (2) *Pinus contorta var. latifolia* covering the Intermountain region and Rocky Mountain systems from central Yukon to eastern Oregon and southern Colorado and (3) *Pinus contorta var. Murrayana* found mainly on the Cascade and Sierra Nevada Mountains in Oregon and California. (Critchfield 1957).

Throughout its coastal distribution it is found mainly on very poor site types which are unfavourable for the growth of possible competitors. To the north the site types are mainly bog and muskegs while further south in Washington and Oregon they are cliff faces and sand dunes. Immediately inland from the coast the species is found on serpentine soils on San Juan islands and in western Washington and on nutrient poor glacial drift areas in the Puget Sound. Climatic conditions throughout this part of the distribution are typically cool and moist with a narrow range of temperatures (Critchfield 1978). Because of the poor nature of the soils the number of associated species is very limited. On the bog ecosystems lodgepole pine can be associated with poorly growing western hemlock, red cedar and yellow cedar (Valentine et al 1978). On the sand dune sites it is mainly pure but where soil nutrient level is somewhat higher it is found in association with Sitka spruce and red alder (Franklin and Dyrness 1973). Growth and form throughout the coastal distribution is poor with maximum development taking place in the southern part of this distribution. This section of the species can be broadly classified as a coloniser after fire or other disturbance.

Most of the commercial stands of the species occur within the var. latifolia group and are found on well drained calcareous tills having a silty loam or clay loam texture. Climatic conditions in this region are characterised by hot dry summers with low rainfall and cold winters with heavy snowfall. Growing season is short with frosts occurring every month. The species occurs mainly in pure stands in this portion of its distribution. The wide expanse of pure stands in this part of the overall distribution is attributed to the species' ability to aggressively colonise fire ravaged sites.

Tree form is generally good. Growth is characterised by a high density of stems per unit area and individual trees having low volumes. Due to the high number of stems growing on any site overall stand volume is high. A stand in British Columbia for example at 80 years yielded 430m^3/hectare (Fowells 1965).

Extensive pure areas are also found within the var. Murrayana distribution of the species on pumice and volcanic ash soils. The climate in this region is characterised by low summer rainfall, wide diurnal temperature fluctuations and a relatively short growing season. Much of the precipitation occurs as snow. Stands are generally pure in this region, though in some more fertile areas ponderosa pine is also present. The predominance of the lodgepole pine is thought to be due to its ability to withstand frost on the better drained depressions, while on the poorly drained areas ponderosa pine is not able to compete (Franklin and Dyrness 1973). The stands are climax ones rather than successional as occurs in other parts of the species distribution. Growth form is generally straight and slow. On exceptional site, yields of 550m^3/hectare have been recorded with a stocking of 1960 stems/hectare (Fowells 1965).

Discovery

The species was reported to have been seen by Lewis and Clarke in 1805 on their voyage of exploration but was not recorded scientifically until 1825 by David Douglas. He recorded its presence at the mouth of the Columbia River at Cape Disappointment, Washington (Kent 1900). Its name is attributed to David Douglas as a result of observing the curious form of dead trees of the species on pumice soils near Klamath Lake, Oregon, the branches of which curved downwards and inwards (Veitch 1881). However it was not until 1885 that it was first introduced to Great Britain. The inland form var. Murrayana though not discovered until 1852, reached Britain one year ahead of the coastal form var contorta, in 1854 (Elwes and Henry 1910).

SPECIES IN IRELAND

The first known record of its introduction to Ireland was in 1884 when a number of specimen trees were planted at Cong, Co. Galway (Forbes 1928). The next recorded planting was at Avondale in 1916 when the then Director of Forestry Mr. A. C. Forbes compared a provenance of var. contorta to a provenance of var. Murrayana in an attempt to ascertain which "species" or provenance was the most suitable for Irish conditions. When reported on in 1928 the growth of the coastal provenance was fifty percent taller than the inland provenance (Forbes 1928). These differences were probably instrumental in influencing the Director of Forestry to choose coastal provenances in preference to the interior provenances as is borne out by the seed purchase patterns of that time (Guillebaud 1933, Mooney 1966).

PATTERN OF SEED IMPORTS

The first commercial importation of seed was made in 1911 when 0.2lbs of var. Murrayana was obtained from Rafn of Copenhagen. This was followed by a further 0.43lbs, in 1915, of the same origin. It was not until 1923, when State afforestation was undertaken on a large scale, that larger quantities were obtained from Manning Seed Company. In all probability these earlier collections were of coastal origin though no record exists to prove unequivocally that they were. In the intervening years up to 1977 11,485lbs of seed were imported. The pattern of the origins in the twenties was predominantly coastal. In the thirties, though imports were predominantly coastal, there was a definite swing towards inland provenances mainly from the var. latifolia distribution. At the end of this period the Lulu island provenance made its first appearance. A further increase in the amount of inland and Lulu island seed occurred in the forties with a correspondent drop in the poundage of coastal origins. It was in this decade that the first home collected seed was used. The really major swing away from coastal origins occurred in the fifties when Lulu island became the main source of supply. Inland origins were also used during this period but unlike earlier importations they were mainly from the var. Murrayana distribution. In the early sixties it was realised that the full volume production potential of the species was not being achieved by most of the origins used in the fifties. As a result there was a dramatic drop in the importation of seed of both inland and Lulu island origins with a correspondent increase in the quantity of seed of coastal origin. This trend was further accentuated by an increased use of home collected seed of known coastal origin (Fig. 2).

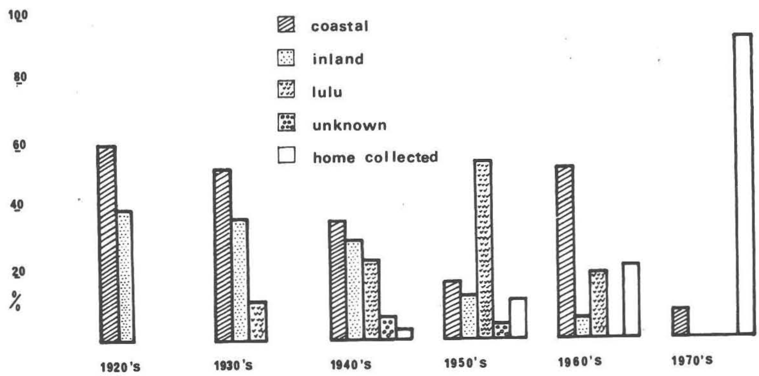

Fig. 2 — Seed Purchase Pattern 1920-1977

PATTERN OF PLANTING

Where records are available, the early pattern of planting places lodgepole pine as the fifth most important species after Sitka spruce, Scots pine, Norway spruce and European larch. During this period in the early thirties the percentage of lodgepole pine planted ranged from 6 to 15%. No figures are available for the forties. In the early fifties, however, it became the most widely used species when its use ranged from 26 to 40%. This expansion of its use corresponded with the increased afforestation programme in the west of the country. Its position as dominant species lasted three years and from then until 1977 it has always ranked second to Sitka spruce. This pattern is reflected in its reduced use in the sixties. It nevertheless remained high ranging from 22 to 31%. In the early part of the seventies it dropped to its lowest level for twenty years at 21%. However as the decade progressed it was returned to a high level of 35% of plants used (Anon 1933-1977, Anon 1976-1977) (Fig. 3).

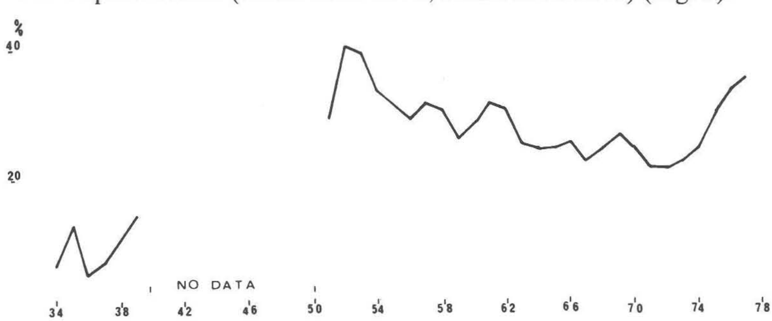

Fig. 3 — Percentage of Lodgepole pine Planted 1933-1977

PRODUCTIVITY

No readily available data exists for the total area of productive forest of lodgepole pine in the State at the present time. The earlier inventory of 1968 covered planting between 1923 and 1958, and recorded an area of 18,700 hectares (O'Flanagan 1973). The recently completed 1975 inventory covered plantings between 1959 and 1968, the data of which are at present being processed. A small area in private woodlands has also been recorded (Gallagher and Purcell 1976). The bulk of the area in the earlier inventory was planted pure with only 11% being in mixture. Classified under broad provenance headings, 8,400 hectares, representing 45% of the total area in state forests in 1968 was of coastal origin. The Lulu island group represented 37% with an area of 6,900 hectares, while the inland group with 18% of the area had 3,400 hectares. The productivity differences between these broad groups was quite large. The most productive, as might be expected, was the coastal group with a range of productivity from yield class 6 to 16 and an average value of 12. The bulk of the area within this group, 72% was present in yield classes 11 and 16. The range of yield classes for the Lulu island group was from 2 to 12 with an average value of 6. However the bulk of the area, 59% was present in yield classes 6 to 8. The third broad group, that of the inland provenances also had a productive range of yield class 2 to 12 with an average value of 6. As with the Lulu group 67% of the productive area of the inland group fell within the confines of yield classes 6 to 8 (Fig. 4). The values for the coastal lodgepole are likely to be revised upwards as a result of findings in the recent (1975) Inventory (Clinch 1977).

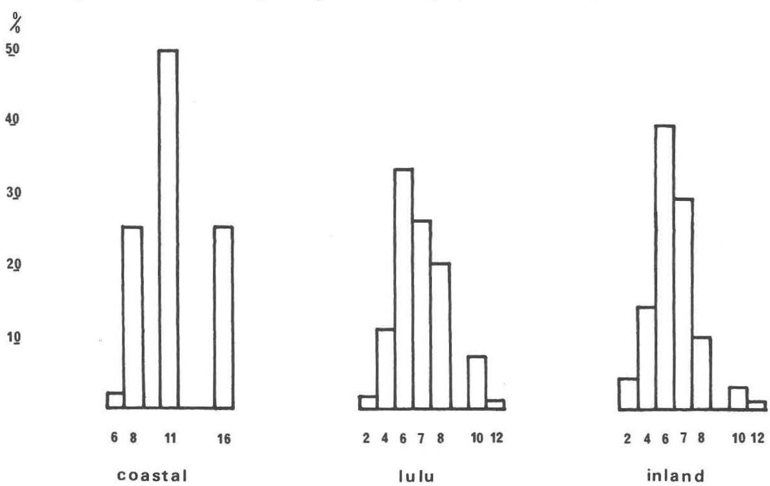

Fig. 4 — Percentage Area by Yield Class 1968 Inventory.

Of the total recorded productive area planted up to the end of 1958, 55% was with less productive provenances. Taking the average values for each group there is a shortfall of four yield classes between these less productive areas and what might have been had coastal provenances been used. (Hamilton et al 1974; Anon 1976). This over a 40 year rotation has resulted in a loss of production of $373m^3$/hectare equivalent to £9, 300 assuming sawlog prices for final crop.

RESEARCH

In the late 1950s and early 1960s it was observed that the seed lots imported during the early part of the fifties as coastal origin, were not as productive as had been hoped. This prompted a survey of older stands which revealed that the most productive areas were of coastal origin, probably Washington (Mooney 1957), but exact location details were not available. In an attempt to verify the origins of these older stands a ten provenance experiment was laid down in 1962 using seed supplied by a commercial seed merchant. The provenances comprised six reputedly coastal origins, two interior British Columbian origins and two interior Oregon origins. The experiment was outplanted on seven sites in 1965. At the end of three years in the field the pattern of growth, which the experiment was to follow, had been established. On all sites the coastal provenances, reputed to be from Washington and Oregon, were the most vigorous. The coastal British Columbian provenances were grouped second while all the interior provenances were third (O'Driscoll 1972). Of major importance even at this stage was the unreliability of commercial seeds lots for provenance work. One seed lot within the experiment was replicated by year. Differences both in growth and morphology rapidly emerged, indicating the inaccuracy of the stated origin. All of the British Columbian coast group bore markedly Lulu island type characteristics. At the end of nine years the ranking had not altered, the coastal Washington and Oregon provenances being still the most vigorous. When extrapolated on yield class graphs the overall average production for 7 sites was coastal type yield class 14, Lulu island type 8 and inland type 6 (Table 1).

Recognising the limitations of the first series of experiments, a second was laid down in 1965 with 16 provenances using, where possible, source authenticated lots. These comprised nine coastal origins, four inland origins, two home collected ones and one second generation New Zealand origin. Both the home collected and New Zealand origins were included for comparison purposes. At the end of the nursery stage the south coastal provenances were the most vigorous, followed by the north coastal type and poorest of all were the interior provenances (O'Driscoll 1972). In 1967 the experiment was transferred to seven sites. At the end of nine years the group ranking was still the same as it had been at the end of the nursery stage (Fig. 5). When the average for all sites is taken, a yield class value of 16 was found for the south coastal group, 10 for the north coastal group and 6 for the interior group. If only the most productive site is taken the yield class value for the south coastal group is raised to 18 and to 12 for both north coastal and inland groups (Table 2). At age 45 this difference would amount to $280m^3$/ha. In monetary terms given current prices this would amount to £7,000 for sawlog or £840 for pulp.

Table 1 — Growth of Series I Provenance Experiment

Provenance	Classification	9 yr old hts(m)	Y.C. extrapolated
Olney 1961, O.	south coastal	4.0	14
Lincoln, O.	south coastal	3.9	14
Long Beach, W.	south coastal	3.8	12
Olney 1960, O.	north coastal	2.8	8
Lot 6857, B.C.	north coastal	2.8	8
Vancouver, B.C.	north coastal	2.8	8
Penticton, B.C.	var. latifolia	2.2	8
Quesnel, B.C.	var. latifolia	2.1	6
Chester, C.	var. Murrayana	1.8	6
Lot 6000, C.	var. Murrayana	1.7	6

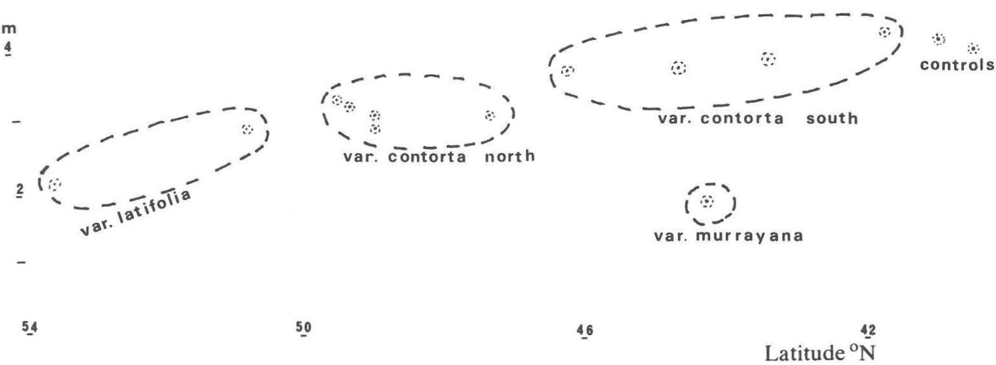

Fig. 5 — LP Series II Height at 9 years (1976)

Table 2 — Growth of Series II Provenance Experiment

Provenance	Classification	Ht. at 9 yrs. (m)	Yield Class Av. of 4 sites	Yield Class Best site
Crescent City, C.	south coastal	4.3	16	18
Ballynoe	south coastal	4.1	14	16
North Bend, O	south coastal	3.9	14	16
Long Beach, W	south coastal	3.8	12	16
Newport, O	south coastal	3.8	12	14
Qualicum, B.C.	north coastal	3.3	10	12
Mendocino, C.	south coastal	3.2	10	12
Sechelt, B.C.	north coastal	3.2	10	12
Cowichan, B.C.	north coastal	3.1	10	12
Hoodsport, W.	north coastal	3.1	10	12
Forth Mt.	north coastal	2.9	10	12
Salmon Arm, B.C.	var. latifolia	2.9	10	12
Fort St. James, B.C.	var. latifolia	2.1	6	8
Sisters, O	var. Murrayana	1.9	6	8
Montana	var. latifolia	1.6	6	8

The third and last series to be laid down was that of the IUFRO collection comprising 58 provenances plus two home collected lots. This series was outplanted in 1971 on five sites. Due to the large number of provenances represented in the experiment it was not possible to have them all on each site. This problem was overcome by grouping the provenances into regions and ensuring that each region was represented on each site. At the end of 6 years there was a decrease in height growth with increasing latitude among the coastal provenances followed by the Washington, Vancouver Island, mainland B.C; Queen Charlotte Islands Alaskan and interior provenances in descending order of vigour (Table 3, Fig. 6). It is not possible at this age to put a meaningful yield class value on the different provenance groupings.

From a general observation of these three series of experiments it has been possible to divide the coastal distribution of the species into two broad sub groups, a south coastal type typified by a dense heavy crown and a north coastal type typified by Lulu island type characteristics. The former extends south from southern Washington along the coast. The latter extends south into the Puget Sound

Table 3 Most vigorous provenances within each group.

Series III Provenance Experiment

Group	Provenance	Av. ht.at 6 years
South Oregon	Carter Lake	2.9m
Washington	Long Beach	2.3m
Vancouver Is.	Lund	2.0m
Mainland B.C.	Garibaldi	1.8m
Q.C.I.	Mayer Lake	1.5m
Alaska	Petersburg	1.3m
N. Inland	Champion Lake	1.4m
S. Inland	Trout Lake	1.2m

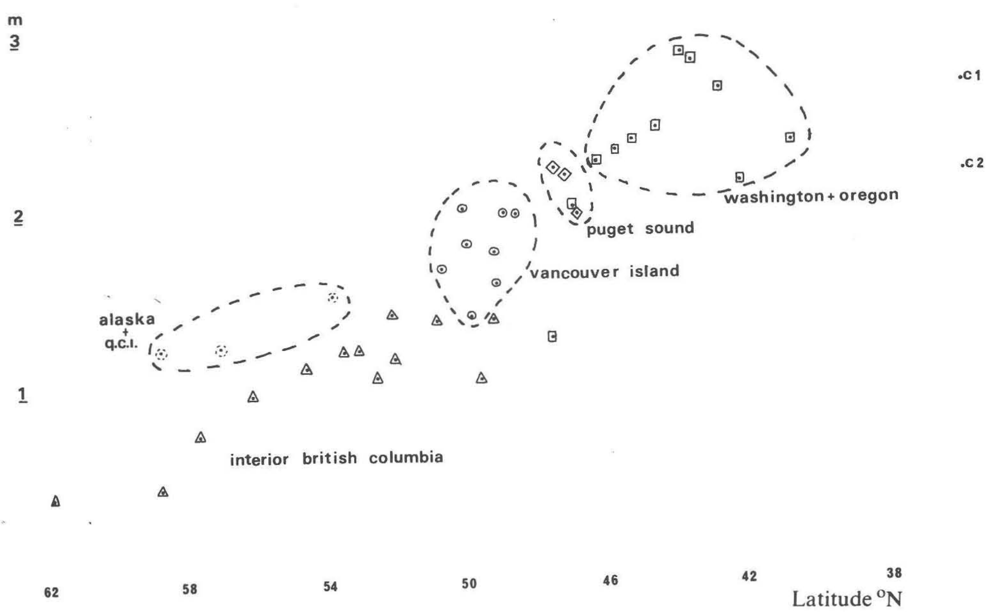

Fig. 6 LP Series IV IUFRO Height at 6 years (1977)

region and north along the coastal of Vancouver Island and mainland British Columbia. In all experiments to date the most vigorous provenances have always come from the southern end of the species distribution while the north coastal group has ranked intermediate between the south coastal and inland groups. This pattern of growth corresponds very well with those of the earlier plantings.

The most vigorous provenances which yielded the large timber were from the southern sub group of the coastal distribution though in all probability not as far south as the most vigorous in the IUFRO experiment. The form and growth of the Rainier type, planted in the 30's, corresponds reasonably well with that of the southern arm of the north coastal sub group. Both have the characteristics of slower growth, upswept branches and generally less vigorous appearance. The inland provenances both in the earlier plantings and in the experiments clearly show lack of vigour, the poorer the site the worse it is.

One somewhat disturbing feature however of the south coastal provenances planted in the last ten to fifteen years has been the high incidence of basal sweep. When assessed within the 1967 provenance experiment, differences between provenances in percentage stems affected and length of stem affected were statistically significant. It was however also evident that basal sweep was present in all provenances but the degree of its expression varied with the provenance. In the south coastal group percentage stems affected ranged from 64 to 79%, with the north coastal group it was from 33 to 47% while for the inland group it was from 18 to 39%. The corresponding length of stem affected ranged from 0.7 to 0.9m for south coastal group, 0.5 to 0.7m for the north coastal group and 0.4 to 0.7 for the inland group (Table 4).

The extent of the incidence of basal sweep has caused many to cast doubt on the usefulness of the south coastal group of provenances for Irish forest conditions. Assuming saw log prices the actual loss in revenue on the final crop of the south coastal group with the most severe basal sweep would amount to £700 in a £10,000 return per ha. at 45 years. Returns for box wood and pulp would be proportionally less and may even be negligible in the case of pulp. For the north coastal and inland groups the loss in revenue due to basal sweep would be £600 in £7,600 for saw log material.

Nevertheless it has been suggested that the use of slower growing inland or north coastal provenance would overcome this problem. However if older south coastal plantings are observed it is seen that basal sweep is not such a serious problem. It can be speculated that this was due to the site type and methods of planting used. It would appear that with the increase of plantings on ploughed ground and on more exposed sites, there has been a marked increase in the frequency of basal sweep. This is in agreement with experience in

Table 4 Extent of Basal Sweep in Series II Experiment at 12 years.

Provenance	Classification	% Stems affected	Length of Stem affected
Crescent City, C.	south coastal	79.5	0.8m
Ballynoe, Irl.	south coastal	77.5	0.9m
Newport, O.	south coastal	74.8	0.8m
Long Beach, W.	south coastal	72.5	0.8m
North Bend, O.	south coastal	71.7	0.8m
Kaingaroa, NZ.	south coastal	71.6	0.9m
Mendocino, C.	south coastal	63.9	0.7m
Cowichan, BC.	north coastal	47.3	0.6m
Hoodsport, W.	north coastal	46.9	0.7m
Qualicum, BC.	north coastal	46.8	0.7m
Sechelt, BC.	north coastal	43.4	0.7m
Sisters, O.	var. Murrayana	41.7	0.5m
Salmon Arm, BC.	var. latifolia	39.2	0.7m
Forth Mt. Irl.	north coastal	32.9	0.5m
Fort St. James, BC.	var. latifolia	23.3	0.4m
Montana	var. latifolia	18.2	0.4m

Britain (Lines 1972) where it was most severe on exposed and poorly drained soils. The main disadvantage of the inland or north coastal provenances is their slow growth even on the most productive sites. In addition it is open to speculation whether the returns on supposedly better material would compensate sufficiently for the extended rotation. This problem may be better solved by greater attention to planting stock and to methods of establishment and site selection.

Utilisation

The timber quality of home grown timber has been shown to be excellent. In a test carried out in the early sixties at Princes Risborough, lodgepole pine was shown to saw and season very well and in fact was superior to Sitka spruce in both these characteristics. It was generally denser than Sitka spruce which implies that it has superior strength qualities. Spiral grain was found to be of very little importance, in comparison with spruces, where it can be a major problem. In one sample the percentage of compression wood was high occurring on the side opposite to that of the prevailing wind. The species' permeabilility was poor making it difficult to treat with timber preservatives (Anon 1965).

These tests were carried out on trees from basically the same provenance group. A study in Britain between a Washington coast provenance and an interior British Columbia provenance from Prince George showed that there was a significant difference between provenances in all characteristics measured. The tests applied particularly to pulp properties as no sawing tests were carried out. In the coastal provenance density was 20% greater than that of the interior provenance, Compression wood was also much higher. Pulp yield was greater in the south coastal provenance. Because of greater tracheid length in the Prince George provenance both breaking length and burst factor of the interior provenance was superior. It was also found that vigour had no effect on the density (Henderson and Petty 1972).

Experience with the marketing of home grown timber has shown that it makes excellent panelling and high quality furniture. Much of the present output from state forests is being used for pulp and pallet wood. Where large timber is available it is converted to panelling and can commend a premium of £20 per m^3 standing. Unfortunately due to the small area of older coastal provenances there is not a lot of this type of material available.

FUTURE

Experience to date in Irish forestry has shown that the most productive provenances are from the species south coastal distribution. Of recent years some disquiet has arisen with regard to the degree of basal sweep recorded in younger stands. Suggestions have been made that an inland or a north coastal provenance should be used to overcome this problem. However, no hasty decisions should be taken as it must be remembered that the site types at present being planted are more extreme than earlier ones. Were these to be planted with slower growing provenances they might fail completely or require such a fertiliser input as to make the entire operation uneconomic. Their longer rotation period required to get them to sawlog category would also throw some doubt on their economic value. To be an economic proposition they would need to be planted on site types normally planted with Sitka spruce. A further suggested alternative is interprovenance hybrids. These have been shown to grow straight and vigorously in Great Britain (Faulkner et al. 1977). There, however, remains the one problem of producing sufficient reproductive material, be it seed or cuttings, to make it a viable proposition. This problem may of course be overcome in the future. A more immediate and possibly a more rewarding remedy would be to attempt to reduce some of the possible contributing factors to basal sweep in the coastal provenances. This would involve examining all the methods and techniques of establishing crops of this provenance, treating the species in its own right and evolving a silviculture suited to it as distinct from spruce management. The influence of stand treatment such as pruning and recent machine grading tests are encouraging in this respect. (Gallagher 1975, Phillips 1978). In this way the vast potential of these provenances for growth and yield would be utilised to the full.

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Future Markets for Irish Wood Products

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INTRODUCTION

The utilisation of small roundwood was probably the problem of greatest concern to private growers and State foresters in 1979. At present, Irish forests are capable of producing approximately 420,000m^3 of pulpwood *per annum* and this is expected to increase gradually to about 900,000m^3 by 1990 (1). This wood might be used in the manufacture of a vast array of end products from plastics to shatterproof glass and possibly may be used in manufacturing animal foodstuffs or as a source of energy. However those, at present minor uses of wood develop in the future, it is unlikely that they will have any major effect upon the utilisation of pulpwood within the next 5-10 years. We are therefore left with the traditional products for small dimension roundwood and mill residues, i.e. to process them into particleboard (Chipboard), fibreboard[1] and, pulp and paper. The users of small wood have all experienced very difficult market conditions over the past few years. However, there are indications that these difficulties are now easing and that the markets for processed wood products are set for renewed growth.

PARTICLEBOARD

Estimated consumption of particleboard in Ireland in 1978 was about 110,000m^3 (equivalent to 154,000m^3 of roundwood). 50,000m^3 of this was imported adding £3½ million to our imports bill (2). Thus, it is evident that the building of even one modern mill (assumed capacity 150,000m^3 *per annum*) would more than adequately cater for the home market and that any increase in the production of particleboard must aim for the export market.

1 Fibreboard includes — Hardboard, Fibre Building Board and Insulation Board.

In this context it is encouraging to note that there was a dramatic resurgence in the U.K. particleboard industry last year (1979), leading to much greater activity and an increasing share of the market for British manufacturers (Table 1).

Table 1 Nett Apparent Consumption of Particleboard (m^3) in the U.K. in the Periods January-July 1978 and 1979 (3).

Year	Total Consumption	% Increase	Imported	% Increase	U.K. Produced	% Increase
1978	1,074,000		814,000		260,000	
1979	1,221,000	13.6	863,000	6.1	358,000	37.5

$1m^3$ particleboard = $1.4m^3$ WRME

The principle suppliers to the British market in this period were, Belgium (157,378m^3), Sweden (144,604m^3), Finland (128,868m^3), Federal Germany (79,970m^3), Spain (60,413m^3) and Portugal (51,870m^3). Ireland's share of this market was 5,965m^3. The value (incl. insurance and freight) of the imported material in Britain in the seven month period was about £74/m^3. This contrasts with the minimum EEC agreed price of £60/m^3 in 1978.

Total consumption of particleboard in Britain is expected to reach 2.1m^3 million in 1979 (4). 1.3m^3 million of this will be imported material. However, despite the fact that Britain is currently the largest importer of particleboard in the EEC, it is still low in the particleboard consumption league, with a *per capita* consumption of 28m^3/1000 people, as compared with West Germany and Finland with 96m^3/1000 people (5). Thus, although production of particleboard has increased in Britain from 250,000m^3 in 1976 to 700,000m^3 in 1977, there is still plenty of scope for market expansion. In addition it is now clear that the acute over-capacity situation of the 1974-78 period is gradually being absorbed by a combination of market growth and mill closures. The Annam factory of Weyroc Ltd., Flakeboard Ltd. of Monmouth and

Munster Chipboard at Waterford have ceased trading. On the Continent a few mills have closed and many have been and are deliberately working below capacity. However, this over-capacity in Europe, assessed at 20-25% in 1978 was reduced in 1979 and is likely to be less than 5% in 1980 (4). Growth is also foreseen in the European markets for wood based panels in 1979 and 1980 (2). The rate of growth may be much slower than in the pre-1973 era, but it should amount to 4%-5% or 1.5 million m^3 of board material. These estimates of market growth have given the industry a renewed degree of confidence and some British manufacturers are already expanding their scale of activity and re-equiping to meet the expected increase in demand. Caberboard Ltd. of Cowrie, Stirling, have this year invested £800,000 in replacing machinery (5).

In addition, technological innovation in the particleboard industry may not only make this material economically more competitive, but also may expand its share of the total timber market by substituting in many applications for blockboard, plywood and even sawn goods. Bisen-Werke in West Germany have, for example, developed an oriented structural particleboard which has strength properties approaching those of structural timber (5). In addition some Canadian firms now find that dried, pulverised conifer needles, which contain phenol-type chemicals with good adhesive properties, can replace 50% of the expensive resins currently used in particleboard manufacture. Furthermore, the use of melamine-formaldehyde glues which are much more water resistant then urea formaldehyde ones, combined with edge sealing now permits the use of particleboard in many outdoor situations. These developments should further encourage an already expanding market for this product.

FIBREBOARD

Fibre building and insulation boards however have had a declining share of the total panel market since 1970 (Fig. 1). The sales of these products have primarily been curtailed because of low cost competition from other panels such as plasterboard and thin particleboard.

In addition, high energy costs involved in the wet method of production are rising disproportionally in relation to other materials. Energy use as a proportion of direct manufacturing costs is 25% and rising. Prices obtainable for the products are such that many mills have ceased production over the past two years. Ironically, this has created a better market balance between production and consumption and has led to an increase in price. An increase of about 10% in hardboard prices and perhaps a slightly smaller uplift in insulation board prices seems to be the average

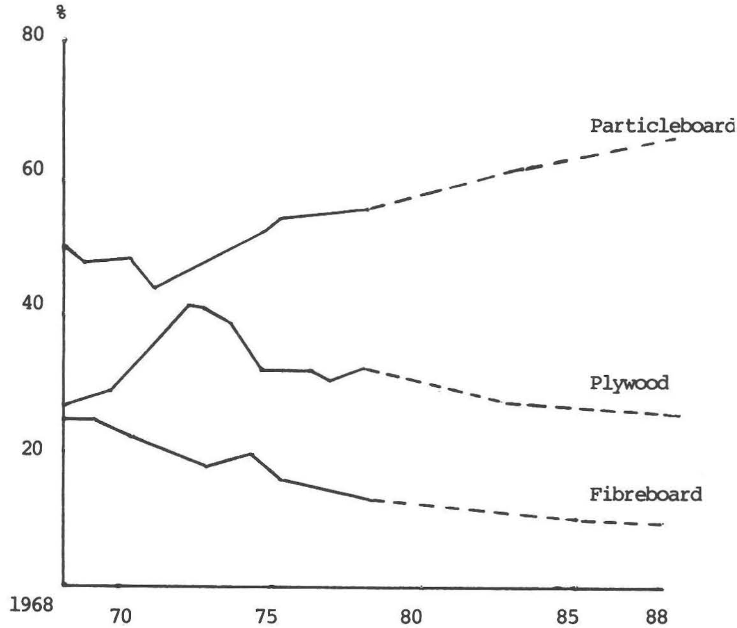

Fig. 1 Panel Market Share. U.K. (6)

forecast for 1980 (7). However, the survival of many mills in 1978 and 1979 has been due to the fact that they belong to a complex of otherwise profitable woodgoods enterprises. Most suppliers to the British market now concentrate on value-added products in an attempt to compensate for negative market growth and the reduction in demand for standard 3.2mm hardboard has frequently been offset by mills in this way. In the light of these developments it is perhaps understandable that there is no rush to build fibreboard mills in Europe. At the same time, demand for medium density fibreboard (480-880kg./m^3) is now showing every sign of outstripping domestic production capacity in the U.S., despite a dramatic growth in production capacity over the past five years (8).

PULP AND PAPER

The utilisation of pulp production capacity in Europe in general has been falling throughout the 1970s. Much of this under-utilisation has occurred in the groundwood[1] sector. In Britain some 69,000 tonnes of capacity has been withdrawn from production

1 Groundwood = Mechanical pulp.

since 1973, reducing the mechanical sector from 225,000 tonnes to 156,000 tonnes (9). In part, this reduction in capacity has been the result of decreasing prices for newsprint and other mechanical pulp-based products. However there is no lack of faith in the future of mechanical grade production, but planned increase in capacity is based on the thermomechanical process[1] which offers technological and environmental advantages over the conventional stone groundwood process. At comparable freeness (freeness is generally used as a parameter to control the quality of stone groundwood) thermomechanical pulp is superior to groundwood in a number of important properties (Table 2).

Table 2 Some Properties of Thermomechanical Pulp Relative to Groundwood (10).

Property	Groundwood	Thermomechanical Pulp
Bulk	1.00	1.10
Breaking Length	1.00	1.30
Tear Factor	1.00	1.70
Shives	1.00	0.30
Burst Factor	1.00	1.40

These improvements in quality permit the use of greater proportions of mechanical pulp in the mix with more expensive refined pulps for the production of fine quality papers. Indeed, already post-refiner chemical treatment of thermomechanical pulp are achieving properties far removed from those of pure mechanical pulp and so these partially refined mechanical pulps are forming an increasingly larger proportion of the furnish in fine paper manufacture.

The market share for sulphite pulps had steadily decreased over the past five years and there is every indication that it will continue to do so (8). This situation is highlighted by the threatened closure of the Wiggins Teape mill at Fort William which has never returned

1 Involves pressure refining as in fibreboard manufacture.

profit in its twelve years in existence and which in 1978 recorded losses amounting to £2.7 million on a production of 60,000 tonnes of pulp (9). On the other hand the importance of sulphate pulp has grown rapidly over the past decade and it seems likely to retain its position as the most important pulp grade in paper making. The future growth rate in consumption of paper making pulp is expected to slow to about 1.5% *per annum,* but a substantial deficit of world pulp and paper is predicted by the mid-1980s (8). Possibly, in anticipation of this situation, one of the major Swedish pulp producers has raised the price of its pulp to European paper producers by £70 per tonne since 1977, to bring the price of chemical pulp to £238/tonne in 1979. On the market side it is worthy of note that Britain currently imports 90% of its wood pulp requirements, while Italy imports 95% and Holland 96% (9).

Implications for the Marketing of Irish Forest Produce

From this brief review it is clear that the European market for some forest products is still expanding and that Britain in particular is a large scale importer of these materials. At the same time freight charges often account for a high percentage of the value[1] of these products and since the majority of processed wood goods available in the U.K. come from non-EEC countries, they are subject to import duty. Thus, exports of processed wood goods to the U.K. from Ireland would be likely to have a competitive edge of between 15%-35% on the British market, *vis-a-vis* existing suppliers (7). Britain will this year (1979) have an adverse trade balance in wood goods well in excess of £2,000 million, and the EEC region will have a similar negative trade balance of approximately £13,500 million.

By 1990 we will have over 1,000,000m^3 of smallwood and wood residues available for processing (1). From this raw material we may be manufacturing any or a mixture of products as follows:

434,000 tonnes of thermomechanical pulp.

OR

200,000 tonnes of chemical pulp.

OR

714,000m^3 of particleboard.

OR

200,000 tonnes of thermomechanical pulp + 300,000m^3 of particleboard.

1 Including cost of insurance and freight.

By current world production levels these quantities of materials would not have any marked impact on world trade. For instance, the world production of mechanical and chemical pulps is about 30 million tonnes and 77 million tonnes respectively (11). In view of the market situation as outlined in this paper it is tempting to assume that it will be easy to sell these Irish wood products abroad. However, the closure of some of our processing plants and the difficulties which others have experienced must alert the forestry industry to the fact that small individual processing units cannot compete with multi-national integrated complexes especially during periods of trade recession or oversupply. Since prices are fixed by these multiproduct concerns it is clear that they can accommodate ailing sectors of their operations during periods of difficult trading conditions, without unduly affecting their overall profitability. Thus to make an impact on the available markets the industry in Ireland Must have available to it modern, fully integrated, export oriented industrial capacity, located near the timber supply. Given this kind of processing facility there appears to be considerable scope for innovation in the wood processing sectors and a considerable opportunity not only to utilise our smallwood supply but also to add substantially to its value.

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Forest Guided Walks

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Most articles written on guided walks deal with the subject matter to be discussed at various stops along the trail. Few articles deal with the psychological needs of the forest guide. It is hoped that this contribution may help in this area.

It has become common for a forester to be asked to guide a group of visitors through his forest. If such a request comes your way the first thing to do is to decide on *the best route for you.* Successful guided walks are very much a matter of confidence. To sustain this confidence the route you choose should favour discussion on subjects or aspects of forestry that interest you.

At the same time be clear in your mind why visitors want to come for a walk in your forest. They come for enjoyment. They come out of curiosity. They come for a pleasant walk and with the hope that the guide will tell them something of interest about the natural world. And if the guide is good enough he can, on occasion, lift his audience to revelations about matters that lie above the ordinary plane of daily living. the visitor has not come to have his brain filled with facts and statistics and economics — these he can get in a library.

Before the big day, walk the route. Never assume that you are so familiar with your forest that you can forego this ground check. Conditions change, and it is the new occurrence, the fallen tree, the fresh growth of fungi, that draw attention to themselves and prompt questions.

If your walk is an open invitation to the general public assume that your audience will range from small children to relatively old folk. Therefore temper your proposed walk time and length of walk with this in mind. For the same reason stay clear of steep gradients.

It is reasonable to expect that few in your audience will have had training in forestry — so avoid technical language. Keep it simple. Don't talk down to your audience; you may be an expert in forestry but the people in front of you are knowledgeable in their own fields. Sometimes, it appears, guides feel that their standing in the eyes of

IRISH FORESTRY, 1980, Vol. 37, No. 1: 31-35

the audience is enhanced by the use of technical language. In most cases the opposite proves to be the case. Your business should be that of *communications* and not ego building. Probably the best attitude to adopt is that of the whole group, leader included, setting out on a quest of discovery together.

This matter of technical language is too important to leave without making some comments. Too many walk leaders founder on this rock. By your training, forestry words are familiar to the point that they become part of your daily vocabulary. This is not the case with your audience.

'Symbiosis' and 'photosynthesis' are obviously technical words, but to the lay-man so also is 'compartment'; 'ride'; 'humus layer'; 'frost lift'; 'ribbon planting'; 'yield class'. Using words which demand explanation slows the natural flow of conversation which should exist between the guide and his audience. In the end communications begin to slip. You are in danger of becoming a bore. So it is worth repeating — don't try to impress, cut out the technical, keep it simple.

On the day of the outing you should not be responsible for the general organisational problems of signposting, carparking etc. Arrive well before the walk is due to start. There is wisdom in this in that it allows you to meet and mix with visitors as they arrive. This informal contact is important in that it helps enormously to dispel any shyness that the walk leader may have. At the same time it allows him to evaluate his audience, and they in turn can more readily accept him as the leader of the group when the time arrives.

When the time does indeed arrive to start the walk gather the group together. Identify yourself and establish the length of the walk and the time it will take. A walk of about 1½-2 hours and covering about 1½ miles (2.4km) is about right. People have not come for a hike, they have come to hear you explain something about the countryside.

What do you do if it is pouring rain? Under these circumstances the leader will have to use his own initiative. If it has been raining all day and people still turn up it is reasonable to assume that they are prepared to go on the walk come hell or high water! But if it starts to rain just when the walk is about to commence the situation is different. You may have a large percentage of visitors who may not willingly like to walk in the rain or who may be inadequately prepared for wet weather. In this case ask their views. State emphatically that you are quite prepared to go on the walk if sufficient people are interested. Ask them for a show of hands to continue with the walk. If you get a small handful of people still willing to go, start on your walk after you have offered regrets about the weather conditions to the remaining visitors. Suggest that they have probably made a wise decision since you see that quite a few are inadequately dressed for wet conditions and suggest that they might visit your forest when conditions are more pleasant etc. *Then gather up your remaining willing visitors and start your walk.* You have to be courteous but firm here and keep a tight rein on circumstances. Never forget that you are the boss. It is then up to them to decide if they wish to join the walk. Indecisiveness here on your part can spoil the outing for the numbers still willing to go.

The best group size, from my experience, is around 20-25 people. If the group runs to over 60 people you have a problem on your hands. At this density, even when you are clearly visible to the people at the back of the group, the dividing distance and the crowd of people between makes effective contact impossible. the use of a 'loud-hailer' does not solve the problem — you merely become as a barker at a circus and you destroy any close communication that would have been possible with those visitors at the front of the group. There is a danger indeed of the whole outing becoming trite, whimsical and self defeating.

It is best therefore to try and anticipate the size of the crowd and to have an additional guide on hand if the need arises. If circumstances force you to conduct a large crowd then you must simply live with the fact that the group is too large for the shared sense of discovery that is necessary for a satisfactory forest walk.

Now that you have gathered the group together set off on your walk. Don't hurry. One of the common mistakes at this stage is that the leader strides off into the woods with a half dozen vigorous people at his heels. The rest of the group become strung out like a necklace of beads behind. The problem is then made worse by the guide immediately launching into whatever it is he has to say at his first stop. By the time he has finished making his observations perhaps only half of the group will have gathered about him, and off he goes like the hare again. This state of affairs is completely unsatisfactory.

It is my observation that the problem is always that of nervousness. So steady up and slow down if you feel that this is happening to you. Take your time between stops. Consciously reduce the length of your stride. On the way from one stop to the next talk to those around you. When you reach your next stop wait until the bulk of your group arrive. Talk generalities about forestry or wildlife, or football if necessary, while you are waiting. When most of the group are gathered around break away from the small talk and launch yourself into whatever it is that you want to say about this new area.

If you are asked a question to which you don't know the answer be honest and say so. Indeed such an admittance can help break the ice and allow the group to warm to you. As you become experienced you can introduce humour into your delivery and open up your personality a bit more. Humour can be a dangerous commodity unless you know how to handle it. If you lack the confidence to carry it through, humour can easily backfire and simply make you look silly.

It is often the case that you will have an 'expert' in the group. He normally gets his chance if you make a wrong pronouncement. You hold up a piece of 'sheep sorrel' and call it 'wood sorrel'. A pained look passes across the face of the 'expert'. He now waxes, if not eloquently, then certainly at length, on the subject most dear to his heart. When he has had his say, quench the feeling of the need to strangle someone, and thank the guest for his help, repeat the question and offer a condensed form of the answer. Once this is done change the subject as prudently as possible. Get back on to your strong suite.

The reason for this tactic is that on occasion an 'expert', once encouraged, may try to be of further assistance at every opportunity that arises. It is important that you remain firmly in control of the group at all times. Don't let part of this control slip away to another person. You cannot function at your best under these conditions so make sure that they don't arise.

In communicating with your audience *explain out their understanding*. Probably the best examples of effective communications are the parables in the Bible where everyday situations are used to explain difficult concepts in the simplest of terms. Don't talk of cubic metres of wood, talk of kitchen tables and floor boards, talk of the number of rafters locked up in a 50 year old spruce. Talk of the number of spruce needed for the wood requirements of an average house. In a word don't use statistics where you can paint word pictures.

At the concluding stop on the walk don't simply peter out in your delivery. You must leave clear signals with your audience that the walk is now over. You might mention the main points that you made during the walk. Present these now in a wider framework and draw some definite conclusions from the day's outing.

Your walk is now over. Your audience will start to disperse. It is wise at this point not to suddenly dash off to your car and roar out of the forest as though you cannot stand the place. Stay around for a few minutes and make yourself available. Some of your audience may have been too shy to ask questions while on the walk; they may now approach you. Others may want to know more general information on forestry. For the sake of such questions be available for a few moments at the end of the walk.

A Final Note

For those leaders who might feel themselves dreading the arrival of the big day; who are convinced that they will be shy and awkward and wooden, remember that all the people in your audience are human like yourself. Talk to them as though you were leaning over the garden wall talking to your next door neighbour. And above all remember that they are appreciative of you giving your time to explain something about the things which give you a great measure of contentment. So go out there, relax, go for a stroll with your audience — and enjoy the day!

Swedish Forestry
A Question of Balance

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ABSTRACT

Growing stock in the Swedish forests has increased greatly over the past fifty years. However, a large increase in industrial productive capacity in recent years has given rise to concern over a possible wood shortage. Two government commissions have been appointed to consider forest policy. The first produced radical proposals to promote the utilisation of existing forests. These proposals, which involved a departure from the principal of sustained yield were rejected by the government. The second commission made three alternative proposals. After considerable debate the government adopted a policy of aiming to achieve a high level of productivity, while giving close consideration to environmental aspects and the public interest. The question which must now face the forest manager is whether it is possible to achieve a high level of forest production while accepting the environmental restrictions imposed upon him.

INTRODUCTION

Although Sweden has less than 1% of the world's forest area, she occupies a prominent and important position as a producer of forest products. In 1976, Sweden was the world's fifth largest producer of both saw-timber and pulp and the seventh largest manufacturer of paper. Sweden is an old forestry nation, long possessed of stable government and a strong forestry tradition. Skogshögskolan, The Royal College of Forestry, until recently located in Stockholm, celebrated its 150th anniversary in 1978. Despite this, Sweden has seen great changes, both economically (Sweden was one of the poorest countries in Europe 100 years ago) and in the forestry sector. There has been a large increase in standing volume over the past 50 years. Annual increment increased from 50 million m^3 in the 1920s to 80 million m^3 at the beginning of the 1960s. Production in the forest industry has increased more rapidly. Saw-timber production was 7.2 million m^3 in 1953. In 1974, it was about 14 million m^3. During the same period, pulp production increased from 3.2 million tonnes to 9.8 million tonnes. The forest industry's annual use of raw material has increased from 30 million m^3 to 62 million m^3 (underbark volumes) over 25 years. Industrial capacity continued to increase until fears of a wood shortage led the government to invoke an act restricting expansion within the forest industry. By 1970, annual increment had fallen to 75 million m^3. Trade in roundwood and chips, in which up to 1974 Sweden had had an export surplus, has since shown a reversal and in 1975 and 1976, Sweden was a net importer of these categories of forest produce.

It is the purpose of this paper to look at the new forest policy which has emerged from the conflicting interests of a giant forest industry, which has expanded beyond the level where it can be satisfied with safety from native timber resources, and a vocal, educated public claiming the forest, "naturen" (lit. The Nature), as a part of their heritage and acutely aware of the hazards of intensive management to the environment.

DISTRIBUTION FEATURES

The 23.5 million ha of productive forest land represents 57% of the country's total land area. The state owns 19% of this forest land, the Swedish Church and municipal authorities own 6%, 25% is in the hands of forest companies and the remaining 50% is privately owned. The state forests are concentrated in the north, where the climate is less favourable, stocking density is lower and the soils are poorer. Whereas mean annual increment is calculated at 3.2m^3 per ha per annum for the country as a whole, the figure for the state forests is 2.0, 3.9 for the company forests, which are located mostly in central Sweden and 4.8 for the privately owned forests, which are situated mainly in the south. There are about 240,000 private owners, 54% of them with forest of less than 25ha. The private forests are responsible for more than 60% of total wood production. Species distribution is 38% pine (*Pinus sylvestris* L.), 48% spruce (*Picea abies* L.) and 14% broadleaved species, mostly birch (*Betula* spp.).

DEVELOPMENTS SINCE 1920

When Sweden's forest inventory was initiated in the 1920s, standing volume was registered at 1800 million m^3. At this time, the growing stock was recovering from a period of exploitation forestry. The expansion of the mining industry and the direct participation of the mining companies in forestry had resulted in an intensive exploitation of the country's forests. A system of selection fellings had been practised, regulated only by so-called "dimension laws", which prescribed only that the trees selected for felling must be over specified dimensions. This practice, which was most prevalent in the north, led inevitably to a decrease in growing stock and a deterioration in stand quality. The situation was remedied by the 1903 Forestry Act which put on forest owners the obligation to replant after felling. Growing-stock increased, although as a result of the selective felling systems adopted to encourage natural regeneration in the 1920s and 1930s, large areas of poorly stocked, slow-growing forest remain, particularly in the north. Consequently, age-class distribution is uneven, with a surplus of overmature forest and deficiencies in the younger age-classes.

Growing-stock has continued to increase up to the present as shown in Fig. 1. Annual increment, which peaked at over 80 million m^3 in the early 1960s, has since declined to about 75 million m^3. One

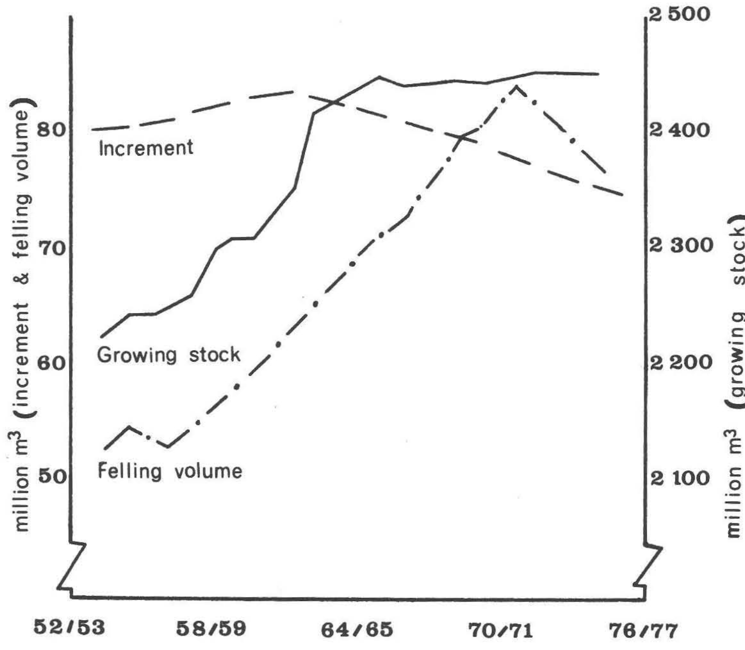

Fig. 1 Increment, growing stock and felling volume of Swedish forests 1952-1976. (From Skog för framtid, SOU 1978:6).

of the main reasons for this decline has been a concentration of final fellings in stands of relatively high current annual increment. Felling volumes have increased greatly over the past 25 years. In the middle of the 1950s, the volume felled annually was about 50 million m^3; today it is about 75 million m^3, thus equalling annual increment. During the same period, there has been a large increase in the proportion of total fellings which have come from final felling as can be judged from the fall in the area thinned annually (Figs. 2 and 3). While it is difficult to separate cause and effect in this connection, it is interesting to note that during this period, which has seen the rapid development of mechanisation, employment in forestry has fallen to less than half of what it was in the mid-1950s and productivity, measured in terms of days work for all forest operations per m^3 timber felled, has increased from 1.1 days per m^3 in 1950 to 0.13 days in 1975.

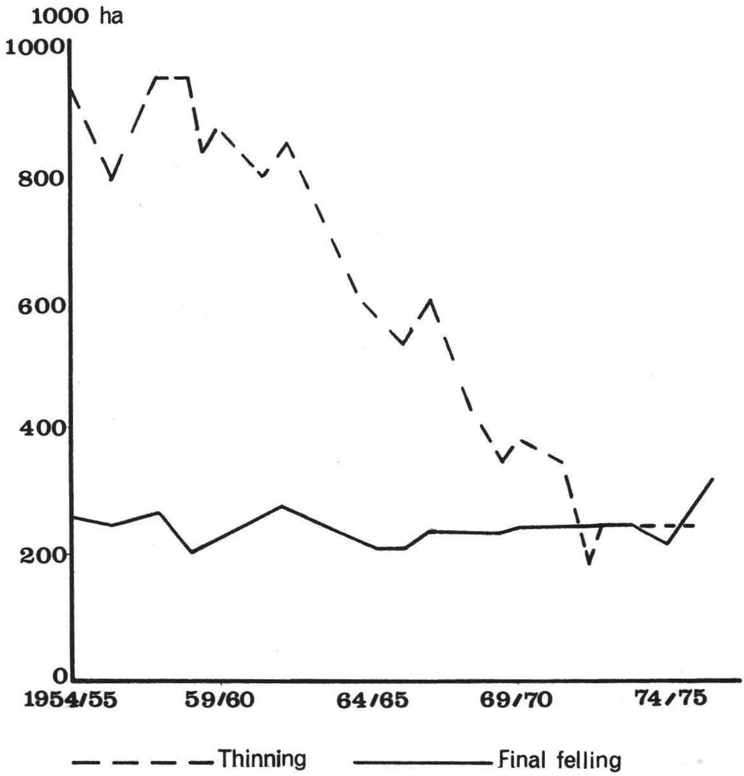

Fig. 2 Area of thinnings and final fellings in Swedish forests 1954-1976. (From Svensk skog, Skogsstyrelsen, 1977).

During the late 1960s and early 1970s the Swedish forest industry expanded greatly. During the early 1970s, overproduction by the world pulp and paper industry depressed prices. However, a sharp increase in demand in 1973 and 1974 resulted in large price increases. The recession led immediately to a fall in demand in 1975 and the government subsidised stockpiling by the forest industry. The fluctuating price of forest products on the world market since the 1940s and the consequent low level of the forest owner's net conversion value per m^3, calculated at fixed monetary values, have made forestry an unattractive investment for most of this period. The position was particularly bad during the late 1960s and early 1970s and has improved only in the past six years.

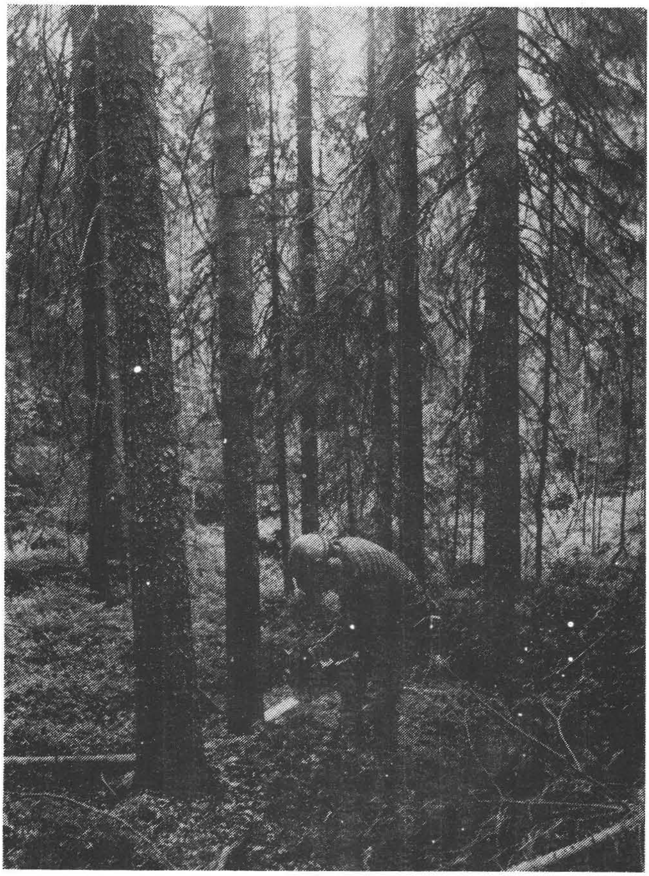

Fig. 3 Thinning operation in a mixed conifer forest in central Sweden. (Photo: Jöran Fries).

SILVICULTURAL TRENDS

Some of the less desirable trends, from a silvicultural viewpoint, in Swedish forestry, can be attributed to the low level of return obtainable. Among these may be included the very low level of establishment achieved following regeneration. According to the National Board of Forestry, who conduct annual studies of growth development, regeneration is inadequate on more than 60% of felled areas. Beating up is, however, practiced. Consistently poor results have been obtained with natural regeneration, partly because an inadequate number of seed trees have been left. When the use of DDT was banned in Sweden some years ago, forestry received a dispensation and the practice of dipping plants before planting-out, as a protection against pine weevil (*Hylobius abietis* L.) was continued until 1975, when it was forbidden in forestry also. No effective replacement is available. To a certain extent, foresters have fallen back on the old practice of leaving clear-felled areas fallow to allow weevil numbers to pass their peak. Thus, in 1975, plants worth some 5,000,000 Swedish Crowns (£580,000) were left unused in nurseries and went to waste. The ban on DDT has led to a considerable increase in soil scarification as a preplanting treatment. Plants not treated with DDT are better protected against insect attack when the soil around the plant is laid bare. While advocates of DDT claim that its total national use within forestry was small (about 10 tonnes in 1974) and that, in view of its widespread dispersion and low levels of application per ha, its use should not be judged on the same basis as in agriculture, bodies devoted to the protection of the environment maintain that the ban should not be revoked. The problems facing present-day forestry are, they say, of foresters own making, the result of the introduction of intensive silvicultural techniques without adequate consideration of the ecological consequences.

FUTURE FOREST POLICY

Future Swedish forest policy has been the subject of two recent government commissions. The big question facing these commissions has been the role that forestry should play in society and in the national economy in the future. The first commision (SOU 1973) sought to radically alter the direction of Swedish forest policy. The commission held that traditional forest policy aimed to create and maintain resources, rather than to stimulate utilisation. The new policy should promote the utilisation of existing forests. This change in policy was inspired by two fundamental characteristics of forestry in Sweden at that time (the beginning of this decade). The first was the diminishing importance of the forestry sector in the national economy. In the early 1950s, production in the forest industry accounted for 45% of the country's exports. By 1973-75, the figure was 23%. Forest workers made up only 1.3% of the total workforce and forest industry employees 2%. This development, which took place against the background of a rapidly *expanding* forest industry, was due to structural changes within Swedish industry, with increasing emphasis on production within the engineering and chemical industries. Consequently, the commission argued, the principal of sustained yield, which had guaranteed a continuing supply of material and source of employment in the past, could be dispensed with. Forestry was no longer needed to provide employment for a high proportion of the workforce. The goal now should be to stimulate the forest industry, encouraging the rapid utilisation of the surplus reserves of native timber. The commission proposed an expansion of cuttings to a level of about 90-95 million m^3 per annum and possible to 100 million m^3 within 10-15 years. This latter figure was some 25 million m^3 greater than the annual increment at the time of the commission's discussions. Obviously, this level of cutting could not be maintained indefinitely. The period covered by the plan was 15 years.

The commission's report was rejected by the government and another commission established (SOU 1978). This commission advocated adherence to the principal of sustained yield. They used a long-term simulation model based on data from the National Forest Survey to analyse and describe the balance between potential utilisation and annual increment and the long-term consequences of following a series of fundamental policy decisions. They put forward three alternative policies for consideration. The first was that present policy should remain virtually unchanged. Thus, gross fellings should amount to about 75 million m^3 per year over a 100 year peiod, and, in consequence, the present forest industrial plant should work to about 85% of its capacity.

The second alternative, advocated by the commission itself, anticipated a significantly higher level of output, increasing to 80 million m^3 per year in the 1980s and to 89 million m^3 per year in 100 years. During the 1980s, the forest industry could expect to operate at 90% capacity. This alternative entailed a large increase in fertilisation and drainage operations and interestingly in increased use of *Pinus contorta* Dougl. in order to increase annual increment and to bridge the potential gap caused by the uneven age-class distribution.

Sweden, like Ireland, has a poor native flora and a considerable number of exotic species have been grown experimentally. Species which have been tested include, besides *Pinus contorta, Larix russica* (Endl.), *Picea mariana* Mill., *Abies lasiocarpa* (Hook.) Nutt., *Pseudotsuga menziesii* (Mirb.) Franco and *Picea sitchensis*

(Bong.) Carr. The latter has been grown, very successfully in small experimental stands at Tönnersjöhedens Research Forest in Halland, near the west coast. The climate here is not unlike our own, although annual precipitation, at just over 1000mm would seem borderline for Sitka spruce. Nevertheless, rapid growth rates have been recorded. By far the most successful exotic in Sweden is *Pinus contorta,* today the centre of a great deal of discussion and some controversy. *Pinus contorta* has been used in Sweden for the past 50 years, but early plantations were poorly distributed and lacked adequate provenance documentation or comparison. Interest in the species has increased over the past 10-15 years, due largely to the efforts of some of the larger companies, who saw the value of increasing the proportion of the raw material supplied to their mills, from their own forests. In 1975-77, between 40 and 45 million plants were produced each year, representing some 10% of all plants produced and corresponding to a planted area of perhaps 20,000ha per annum. Growth of interest in the species results from forecasts, on the basis of ongoing research, that volume increment will be 20-25% greater than in the native Scots pine. This is based on overbark measurement and when allowance is made for the thicker Scots pine bark, the productivity advantage increases to 30-60%. Even when compared with *planted* native pine an increase in wood production of 10-25% is anticipated and in addition, optimum rotation should be 15-20 years shorter. The species has proved most successful in the northern part of the country and shows comparatively, to the best advantage on the poorer mineral soils. Hardiness and survival capacity are the principal factors in provenance selection. In the far north, seed from Yukon sources has proved most successful, while in central Sweden, locations in British Columbia have given the best results. The commission laid great emphasis on the use of *Pinus contorta* in their second alternative programme. This called for a planting programme of 28,000ha per annum. According to this, 6% of forest land would be under this species in 50 years, with a projected increased output of 2 million m^3 per year (overbark). The concentration of *Pinus contorta* in central and northern Sweden, would mean that at the end of a 100 year period, the species would cover 14% of the total forest area of these regions. This is the cause of widespread concern among critics of this alternative, who feel the risk of ecological catastrophe, in the form of insect or disease attack, is too great. Concern has also been expressed about the stability of the species.

The attitude expressed towards the general use of *Pinus contorta* is typical of the concern of a considerable body of opinion about the pace and direction of current developments. The commission's second alternative would increase the area fertilised from 150,000ha to about 300,000ha per annum in the 1980s and to

450,000 in the 1990s, this level to be maintained thereafter. In Sweden, nitrogen fertilisers are by far the most important, deficiency of this element being widespread. Fertilisers are normally applied by air to pole-stage crops, with reapplications at 6-8 year intervals. Growth increments of up to 40% may be expected from fertilisation. Ammonium nitrate is now the preferred source of nitrogen, as it has been clearly established to be superior to urea. Unfortunately, with ammonium nitrate, the effects on water quality can be quite serious. Rapid increases in the nitrate content of the groundwater may occur following applications of ammonium nitrate and, for a short time, safety levels for drinking water may be exceeded. This problem and possible influences of nitrogen fertilisers on the soil microflora and the leaching of nutrients also give rise to concern.

The commission's third alternative was to follow a policy of ecologically inspired restrictions. Chemical control techniques would be severely restricted, the use of fertilisers reduced and limitations put on drainage operations. In consequence, fellings must be reduced to less than 70 million m^3 per year and, due to reduced use of herbicides, the proportion of hardwoods, principally birch, in the growing stock would increase markedly.

Despite prolific regeneration of birch, most experts believe that conifers must continue to be the basic raw material of the Swedish forest industry. Conifers have higher volume production and although large dimension birch fetches a high price from the sawmills, most of the birch in Swedish forests will never make better than pulpwood-dimensions. The short-fibre pulp which birch yields is of inferior quality and so the price paid for pulpwood is low. Indeed, sometimes it is impossible to find a market for it. While there is little scientific evidence to back it up, many would maintain, however, that a small proportion, perhaps up to 10% of birch in a young stand has a beneficial effect on organic matter decomposition and nutrient cycling. Thus, total elimination of birch, which would be extremely difficult in view of the long distance the seed is carried, is rarely the desired objective. Aerial application of herbicides and mechanical cleaning are the standard means of hardwood control. While the former is a much cheaper if less selective technique, it has been the subject of heated controversy throughout the 1970s. In recent times it has become an important political issue, with members of protest groups occupying areas due for spraying, thereby preventing or impeding operations. Shortly before last year's elections, the State Forest Service suspended spraying operations for the remainder of the season, leaving some 10% of its programme uncompleted.

The campaign against spraying of chemicals in forestry is closely linked to the role of the forest in Swedish society and the traditional rights of every citizen to use the forest for recreation, camping and picking berries. These long established rights are jealously guarded and interventions, such as spraying or fertilisation, are seen as unwarranted interference and as a threat to the maintenance of these rights. Thus, the spraying of herbicide is viewed as an immediate interference with the right to pick berries and as a long-term ecological threat.

The Government's Decision

The forest industrial sector, lacking centralised control, overreacted to economic developments in the mid-1970s and now has excess capacity. Should forest production be increased to satisfy, as far as possible this demand or should all risk of ecological damage be avoided and society be given the controlling interest in the utilisation of its forests and the protection of its rights? In other countries, such as Finland, where the forestry sector is dominant in the national economy, such a question would be answered rather easily, but in Sweden, prosperity presents the luxury of choice and the dilemma of decision.

The government's response to the commission's proposals and the controversy they generated was to try to find a middle ground. Thus the new forestry act, passed by parliament in May 1979, states that the forests will be managed with the objective of providing a high and sustained yield while taking every precaution to protect the ecosystem and to safeguard the public interest. The government has clearly stated that industry's existing productive capacity cannot be allowed to control the level of forest production in the long term. In its concern for the environment, the government has rejected the more radical proposals of the commission. Care is called for in the use of exotic species. Taking into account the risk of insect and fungal attack and the relatively poor quality of its saw-timber, further research is needed before greater use of *Pinus contorta* can be recommended. Accordingly, the National Board of Forestry is to be given powers to restrict the use of exotic species. The use of DDT is not to be reintroduced, the use of chemicals in general is to be limited where possible, forest fertilisation is not to receive any further government promotion and drainage of peatland areas is to be controlled pending the completion of a Nature Conservancy inventory of the country's wetland resources.

Conclusions

Sweden has come through a period of intensive discussion and detailed consideration of her forest policy. In the early years of the decade, the first government commission saw a necessity to stimulate the forestry sector in order to meet the demands of industry. They produced a radical, if unacceptable proposal. The tone of the second commission was much more conservative. But of the three alternative proposals put forward, they advocated acceptance of the most radical in order to stimulate a significant increase in productivity. However, in the course of the debate that followed, the original objective, to reach a consenus on how to achieve a balance, within the sustained yield concept, between production and utilisation, was lost sight of. Debate centred around ecological issues and the influence of silvicultural measures on the environment. The end result may seem less than satisfactory to many. The government position has been clearly stated, the forest industry will not control forest policy. Nevertheless, while it is the intention to promote and sustain a high level of productivity, the environmental constraints on the forest manager are severe.

In the past it has been possible to increase production i.e. felling volume, without long-term risk because it never exceeded annual increment. Now with annual increment declining steadily over the past twenty years and at present equal to felling volume (Fig. 1), the task of increasing the latter presents a greater challenge. Progress has been made in recent years which has allowed the utilisation of material of smaller dimensions than previously. Plant geared to the processing of birch and other hardwoods has been expanded. The results of PHU (Project Whole Tree Utilisation) published three years ago, show that in harvesting the 62 million m^3 (underbark) utilised annually, 50 million m^3 is left in the forest. It is estimated that of this, 7.7 million m^3 could be utilised in the pulp industries and a further 7 million m^3 as fuel. However, there is still a great deal of uncertainty surrounding the economics and the practicality of this scheme. Whole tree utilisation was not considered by the commission, nor by the government in its proposals. It must be assumed therefore that at least a part of any increase in felling volume must be accounted for through increases in growth increment.

One wonders if it is possible for the forest manager to increase growth increment while accepting new restrictions on the techniques to which he has become accustomed and which have served him well in the past.

ACKNOWLEDGEMENTS

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Whole Tree Harvesting in Sitka Spruce. Possibilities and Implications

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ABSTRACT

A study was carried out in a 50 year old crop of Sitka spruce, Yield Class 20, in order to determine:

(i) The extent to which total production could be increased through implementing complete tree harvesting, and

(ii) The effect this would have on site fertility.

The result showed that the stemwood and bark represented 62%, the slash 20% and the roots 18% of the total dry matter production. Although inclusion of the slash in the final harvest would result in a very large increase in the amounts of nutrients removed, it is concluded that this would have serious consequences for site fertility only on impoverished mineral soils with low reserves of organic matter. Data are included on the actual value of the nutrients (N, P and K only) in the slash and on its energy content.

INTRODUCTION

Traditional methods of harvesting forest crops involve the removal of tree stems only and the leaving behind on the site of the other components such as branches, needles, cones and roots. Because the stemwood and bark are known to account for only about 50 per cent of the total dry matter production in coniferous crops (Keays and Hatton, 1976; Young, 1974) considerable interest has centred in recent years on the possibility of increasing

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production from forestry through the practice of more complete — tree harvesting systems. Although a more intensive harvesting system than that currently practiced may appear a remote possibility at this point in time, particularly with the recent problems in certain wood processing industries, the interest in whole tree harvesting nevertheless continues to increase on a world-wide scale. It has been added to considerably by the concern regarding future energy supplies and the possibilities for supplying part of these from forest residues (McCarthy, 1979). Advances in technology, both in timber processing and in the mechanics of forest harvesting, now seem certain to make the concept of whole tree harvesting increasingly attractive. Mobile total tree chippers have been developed in a number of countries and are already in practice on a limited scale in parts of Scandinavia and North America (Anonymous, 1977).

The main disadvantage of total tree harvesting is that it involves a considerable increase in the amounts of nutrients and organic matter removed from the site which may have serious long term repercussions for site fertility. This concern was expressed in a number of papers presented at a recent symposium in North America on "The impact of intensive harvesting on forest nutrient cycling" (Leaf, 1979) and was manifested in the results of a recently reported Irish study (Carey and O'Brien, 1979). This showed that the inclusion of the slash and roots at harvesting would increase overall production by nearly 75 per cent. However such a harvesting system would increase the removal of nitrogen, phosphorus and potassium by 68, 80 and 65 per cent respectively over and above that in a normal harvesting operation. This is mainly because of the higher concentration of nutrients in the needles and twigs relative to the stemwood components.

Because forest crops are known to recycle considerable quantities of nutrients and organic matter mainly through litter-fall, brashing and pruning operations as they develop and mature, the results from an unthinned 33 year old crop do not necessarily reflect the position in a crop at the end of a rotation. Consequently it was decided in 1976 to extend the initial studies to a clearfelling situation in which the crop had been managed normally and had reached the age of maximum mean annual increment. This article presents the findings from this study and attempts to draw conclusions on the potential and implications of practicing whole tree harvesting in Sitka spruce in Ireland. The study was confined to the three major nutrients, nitrogen, phosphorus and potassium. Other essential elements such as calcium and magnesium are also removed as a result of harvesting operations but may be of lesser importance.

Methods

Field: The crop had been pit planted in 1927 at Glen Imaal State Forest, Co. Wicklow (National Grid ref. Glenmalure TO6 94) on a soil transitional between a shallow peat containing a large quantity of fine sand particles and a peaty podsol over a granite/shale base. The site was situated 250 metres above sea level and was reasonably sheltered. Crop statistics given in Table 1 show that the stand was 32% overstocked relative to the normal Forest Management Tables (Hamilton and Christie, 1971) but was probably representative of the situation in many other stands in this country at clearfelling age.

Table 1 Crop details

Age (yrs)	Top ht. (m)	Basal area ($m^2\ ha^{-1}$)	Density stems ha^{-1}	Yield class	Volume to 7cm ($m^3\ ha^{-1}$)
50	29.0	50.1	468	20	606

Selection of sample trees: A 0.25 ha plot was laid down in the centre of the stand and the diameter at breast height of all trees recorded to the nearest 0.1cm. Diameters ranged from 16.3 to 57.2cm and the total number of trees in the plot came to 117. This included 15 Norway spruce which were excluded from the sampling population but were included in the calculation of standing basal area and the final estimates.

The stand table for the Sitka spruce in the sample plot (102 trees) was divided into ten equal number classes and one sample tree selected randomly from each of these. Sample tree dimensions are given in Table 2.

Destructive sampling: A large sheet of P.V.C. was placed around the base of each sample tree. All branches were then removed (by climbing) using a short handled pruning saw. The branches were dropped onto the P.V.C. and separated into the following components for subsampling.

1. Dead branches: Branches to which no live foliage was attached.

2. Live coarse branches: Branches greater than 1cm diameter to which live foliage was attached.

3. Live fine branches: Branches less than 1cm diameter to which live foliage was attached.

If the diameter of any individual branch in categories 1 and 2 varied either side of the 1cm cutoff point that branch was then subdivided accordingly.

The total fresh weight of each category of branches was determined on the site to the nearest 0.5kg using a spring balance suspended between two standing trees. Subsamples were then taken from each category for moisture content determination and nutrient analysis. For the dead branches this was done by selecting about eight branches at random and chopping these up into 15cm lengths. A similar procedure was adopted for the live coarse branches but the final subsample was further divided into bark and timber, the moist bark being easily removed with a sharp knife. In the case of the live fine branches a large subsample weighing approximately 3kg was taken from about eight branches to enable a good estimate to be made of the needle/twig ratio. Although some live needles were also attached to the live coarse branches the previous study showed that the small amount of D.M. and nutrients involved did not justify their subdivision into a separate category (Carey and O'Brien, 1979).

Following removal and subsampling of the branches the main stem was felled, the cut being made at about 0.50m from the base. (The reason for leaving a high stump was to facilitate removal of the root system).

The main stem was then subdivided into 10 equal length sections. These were transported by lorry to a central point for weighing.

One disc 2cm in width was taken from the lower end of each section for the determination of moisture and nutrient contents and the wood:bark ratio.

The root systems were excavated with the aid of a rear mounted tractor excavator. Although the method appears crude the overall recovery of the root system appeared high (at least 95%) and while some fine roots were obviously not recovered their D.M. and nutrient contents would be small compared to the overall root system. That part of the main stem still attached to the stump was removed and included with the main stem category. The root systems were subdivided with a chain saw into easily transportable sizes and washed free of soil in a nearby stream. They were then allowed to air dry for some hours before recording of fresh weight and subsampling for moisture and nutrient contents. The subsampling of the root systems was very subjective and no attempt was made to separate fine from coarse roots. This was again based on the results from the earlier project which showed that fine roots (less than1cm) accounted for only a very small proportion of the total root D.M. and nutrient content (Carey and O'Brien op. cit.).

Table 2 Diameter Breast Height, Basal Area, Length and Volume of the Sample Trees.

Tree No.	1	2	3	4	5	6	7	8	9	10
Diameter B.H. cm	19.9	26.8	31.0	33.0	35.8	37.2	40.3	42.6	45.6	51.0
Basal area m^2	.03079	.05641	.07547	.08553	.10060	.10868	.12755	.14253	.16331	.20428
Total length (m)	20.8	25.8	25.9	25.7	30.6	27.4	30.9	30.0	26.6	28.5
Length to 7cm diam (m)	17.2	22.2	22.4	22.4	26.6	24.1	27.1	26.4	23.5	23.5
Volume to 7cm m^3	.32197	.75821	.89488	.86151	1.3402	1.3819	1.7428	1.7741	1.9388	2.2366

Soil and Forest Floor: Ten samples of the forest floor were taken at random within the stand using a 25 x 25cm metal frame. All organic matter encountered including twigs — which were sparse — was included. The boundary between the forest floor and forest soil was clear and abrupt and the two easily separated. One representative soil pit was opened and sampled for determination of bulk density, net soil volume (proportion of soil less than 2mm fraction expressed as a percentage of the total soil weight free of stones) and nutrient content. Because there were clear horizon boundaries at 30 and 55cm the nutrient contents were determined for 3 separate layers, 0-30, 0-55 and 0-100cm.

Laboratory: Moisture contents were determined by drying at 105°C to constant weight. Duplicate samples for chemical analysis were dried at 90°C. Nitrogen, phosphorus and potassium were ditermined on the tree and forest floor samples using conventional methods cited in the previous study (Carey and O'Brien op. cit.). Total N, P and K in the soil samples were determined following air drying using standard techniques. Soil bulk density was determined by the waxing technique.

Statistical: The nutrient contents for the various components were determined from their dry weights and nutrient concentrations. A series of linear regressions were then calculated relating both dry weights and nutrient contents of the components to the basal area of each of the sample trees. Because the relationship proved good in most instances, reliable estimates could be made of both nutrient and dry matter contents for the mean tree and from this the whole sample plot.

Results and Discussion

The dry weights for the various components of each of the sample trees are given in Table 3. Moisture contents varied considerably between components and trees. The bole wood had an average moisture content of 50% (on a fresh weight basis). The dead branches had an average moisture content of 32% and the bark on both live branches and tree stems a mean moisture content of 65%. The total dry weights of the ten sample trees varied between 225 and 1290kg.

The results of the chemical analyses for the different components on each sample tree are presented in Table 4. As expected nutrient concentrations vary considerably between components. Highest concentrations occur in the needles, bark and cones, the lowest concentrations being associated with the wood samples. These findings are in agreement with results from the previous study

(Carey and O'Brien, 1979) but there are considerable differences between some of the nutrient concentrations for the two sites. There is also considerable variation between some of the nutrient levels for similar components on different sample trees. For instance there is a 300% variation in the concentration of phosphorus in the dead branches. The variation is equally high for phosphorus concentrations in the roots. These variations are most likely directly related to the difficulties involved in sampling these components (which include bark and wood material) representatively and are mainly responsible for the high error associated with some of the final estimates (Table 5).

The data presented in Table 5 have been grouped into the three major crop components, slash, (includes all branches, needles and cones), stemwood and bark, and roots. As can be seen a high degree of confidence can be attached to the estimates with the exception of the nutrient concentrations in the roots.

The estimates of dry matter and nutrient contents are reproduced in Table 6. Included are data on the percentage distribution for each component and on the D.M. and nutrient content of the forest floor. Data are also given for the *total* nutrient content of the soil to 1 metre at the site concerned. These latter figures only include the soil fraction less than 2mm in diameter and do not provide any real indication of the amounts that are or may become available to forest trees. However, they do give a broad indication of the total nutrient reserves in the site.

Table 6 shows that the wood and bark account for 62% of the total quantity of dry matter in the crop, the slash 20% (71 metric tonnes ha^{-1}) and the roots 18% or 64m tonnes ha^{-1}. Although the slash fraction only accounts for one fifth of the total dry matter it contains approximately half of the total quantities of N, P and K in the crop. Its removal from the site under a more intensive harvesting regime than that currently practiced would therefore at first sight appear to have serious implications for site fertility. For instance, if the amounts of nutrients in the slash are divided by the approximate quantities considered necessary to sustain growth (60, 3 and 15kg) it is apparent that it contains the equivalent of about 8 years supply of nitrogen, 15 years supply of phosphorus and 14 years supply of potassium. However, the amounts of nutrients involved are quite small relative to the considerably larger quantities being used nowadays to sustain high production under intensive agriculture.

The effects of the removal of the slash ultimately depend on the nutrient and organic matter reserves in the site which in this particular instance are quite large. Reference to Table 6 shows that the nutrient contents of the slash represent less than 3 per cent of the total amounts present in the top 30cm of the mineral soil. Although

Table 3 Dry weights of components of each sample tree (kg).

Sample Tree No.	1	2	3	4	5	6	7	8	9	10
Dead Branches	22.3	29.7	28.6	28.5	29.6	90.9	36.4	61.3	39.2	88.1
Live coarse branch wood	6.6	13.5	17.5	10.7	41.9	36.7	44.0	31.7	50.9	74.3
Live coarse branch bark	1.0	2.7	8.2	2.1	9.8	10.7	11.7	9.4	9.1	16.9
Live fine branch twigs	7.6	25.3	17.3	16.6	32.5	42.6	46.2	36.1	51.0	52.1
Live fine branch needles	8.9	27.4	18.0	18.2	30.4	46.7	37.6	42.9	77.8	54.0
Cones	0	0.8	0.9	0	3.1	3.7	0	2.7	5.0	1.6
Bole wood	136.0	232.6	299.2	280.6	495.0	529.7	557.5	582.0	549.3	799.2
Bole bark	10.1	15.5	18.5	17.9	30.5	29.3	30.0	40.0	27.5	52.1
Roots	33.0	94.5	95.0	96.3	155.0	119.7	228.5	208.1	210.0	152.5
D.M. above ground	192.5	347.7	408.3	374.7	673.7	790.3	763.4	806.1	809.8	1138.2
Total slash D.M.	46.4	99.6	90.6	76.6	147.3	231.3	175.9	184.1	233.0	286.9
Total D.M.	225.5	442.2	503.3	471.0	827.8	909.9	991.9	1014.2	1019.8	1290.7

Table 4 Chemical Analyses Used in Nutrient Content Estimates (% D.M.)

Tree Number	1	2	3	4	5	6	7	8	9	10
Dead branches										
N	.44	.54	.48	.44	.40	.30	.32	.39	.37	.50
P	.02	.03	.02	.01	.02	.01	.01	.02	.02	.02
K	.02	.02	.02	.01	.03	.02	.02	.02	.04	.02
Live coarse branch wood										
N	.10	.14	.10	.13	.14	.10	.10	.14	.09	.12
P	.0041	.0081	.0048	.0060	.0071	.0092	.0049	.0061	.0080	.0091
K	.05	.04	.04	.05	.03	.05	.05	.04	.06	.07
Live coarse branch bark										
N	1.00	.68	.64	.54	.65	.67	.80	.72	.75	.49
P	.099	.086	.082	.073	.079	.080	.122	.089	.095	.062
K	.38	.39	.40	.35	.39	.44	.48	.39	.49	.36
Live fine branches										
N	.81	.70	.77	.69	.74	.78	.63	.71	.80	.87
P	.09	.10	.09	.08	.09	.11	.08	.09	.12	.11
K	.32	.42	.37	.35	.38	.42	.33	.32	.49	.45
Live fine branch needles										
N	1.52	1.45	1.39	1.27	1.41	1.39	1.19	1.33	1.46	1.60
P	.17	.12	.11	.11	.11	.11	.09	.10	.13	.12
K	.79	.57	.50	.66	.58	.52	.51	.40	.66	.64

Table 4 Continued

Tree Number		1	2	3	4	5	6	7	8	9	10
Bole Wood											
	N	.07	.07	.08	.08	.06	.08	.07	.05	.05	.05
	P	.033	.002	.003	.003	.005	.002	.004	.003	.004	.003
	K	.03	.04	.03	.04	.06	.02	.03	.03	.02	.02
Bole Bark											
	N	.80	.51	.56	.46	.42	.50	.62	.62	.53	.40
	P	.078	.063	.068	.057	.048	.065	.076	.086	.066	.043
	K	.28	.33	.39	.30	.28	.33	.48	.45	.35	.27
Cones											
	N	—	.78	1.14	—	1.18	.91	—	.67	.94	1.66
	P	—	.09	.19	—	.19	.13	—	.10	.16	.29
	K	—	.38	.35	—	.25	.19	—	.21	.28	.44
Roots											
	N	.36	.30	.34	.24	.30	.27	.24	.30	.17	.17
	P	.03	.02	.02	.01	.02	.03	.02	.03	.02	.01
	K	.19	.15	.22	.11	.14	.19	.18	.13	.15	.12

Forest Floor

N	P	K
1.68	.07	.05

Table 5 Regression Equations, Coefficients of Determination, Crop Estimates and Confidence Intervals for D.M. and Nutrient Estimates.

		Intercept	Slope	R^2	Crop Estimate kg/ha	95% confidence limit (kg/ha) + −
Slash	DM	4.51379	1393.65625	.91	71,939	4,960.0
	N	.00019	9.62744	.88	493	41.1
	P	.02726	.64543	.75	46	4.7
	K	.02150	3.62854	.80	196	23.4
Stemwood and Bark	DM	41.81152	3939.53809	.95	216,954	10,062.0
	N	.16155	2.60900	.78	209	16.8
	P	.00670	.22554	.82	14	1.4
	K	.09035	1.27307	.64	107	12.1
Roots	DM	38.93408	916.09351	.75	64,120	6,495.5
	N	.22210	1.19837	.40	165	21.9
	P	.11065	−.36585	.39	33	70.2
	K	.13320	.84458	.44	105	14.0
Total crop	DM	85.26343	6249.06641	.90	353,006	15,523.5
	N	.38383	13.43482	.91	867	48.6
	P	.14457	.50534	.55	93	6.0
	K	.24505	5.74613	.84	408	29.9

the nutrient contents of the forest floor at this particular site are considerably less than those found in other (younger and more dense) stands of Sitka spruce (Carey and Farrell, 1978) they nevertheless represent a sizeable reserve and are very likely to be more available in the short term than those contained in the slash or mineral soil. It would seem reasonable to assume therefore that the overall release of nutrients from the forest floor and mineral soil would at least equal if not exceed those quantities present in the slash component. The forest floor also contains a sizeable reserve of organic matter (23 metric tonnes ha^{-1}).

On this particular site therefore the introduction of a whole tree harvesting policy would not appear to have serious consequences for either the nutrient or organic matter reserves. However, on an impoverished mineral soil such as those derived from Old Red Sandstone, with low reserves of organic matter and nitrogen, the situation would be very different and the practice undesirable.

Table 6 Dry Matter (t ha^{-1}) Nitrogen, Phosphorus and Potassium (kg ha^{-1}) Estimates for Major Crop Components, Forest Floor and Soil to 1 metre. Data in parentheses represent the percentage of the total for the crop in each instance.

		D.M.	N	P	K
Wood and Bark		216 (62)	209 (24)	14 (15)	107 (26)
Slash		71 (20)	493 (57)	46 (49)	196 (48)
Roots		64 (18)	165 (19)	33 (36)	105 (26)
Total		351	867	93	408
Forest Floor		23	386	16	11
Mineral Soil	0- 30cm	—	18154	1623	8265
(Glen Imaal)	0- 55cm	—	20647	2529	23678
	0-100cm	—	22389	4707	57067
Blanket peat soil (Nephin Beg State Forest)*	0-100cm	86.2	20540	405	195

* Based on unpublished work by Carey, M. L. and O Carroll, N. Forest and Wildlife Service, Dublin.

Data are included in Table 6 on the total nutrient content of a blanket peat soil to 100cm at Nephin Beg forest in the west of Ireland in order to make a broad comparison between two very different situations in relation to nutrient and organic matter reserves. Thus, it is seen that although the amounts of total nitrogen in the two systems are roughly the same, there are considerably less reserves of phosphorus and potassium in the peat soil. However, the amount of phosphorus in the peat soil is almost ten times greater than that present in the slash category for the Sitka spruce at Glen Imaal although the quantities of potassium are more or less equal. The data would appear to suggest therefore that the removal of the amounts of nutrients present in the slash component of Glen Imaal would not have serious consequences on blanket peat soils.

However most of the N and P in peat soils is present in organic form and availability for future tree rotations is a matter for conjecture at this point in time.

Slash consists essentially of branches and needles and a small quantity of cones (less than 1 metric ton ha^{-1}). Table 7 gives a breakdown of the actual distribution of organic matter and nutrients between the needles and branches for the Glen Imaal data. From this it is apparent that although the needles represent approximately one quarter of the total dry matter content of the slash they still account for nearly one half of the total amount of nutrients present.

Table 7 Distribution of Dry Matter and N, P and K within Slash (kg ha^{-1}). Based on data in Table 3.

	DM	N	P	K
Needles	16936 (23%)	235 (48%)	19 (41%)	96 (48%)
Branches	55000 (77%)	258 (52%)	27 (59%)	102 (52%)
Total	71939 (100)	493 (100)	46 (100)	198 (100)

From the point of view of conserving nutrients therefore, and at the same time increasing production, a harvesting system utilising the branchwood parts only of the slash and leaving behind the needles would appear to have advantages although it may present some technical difficulties.

Data are presented in Table 8 on the actual replacement value of the N, P and K (1979 prices) in the slash. Although these show that the total value comes to £187 ha^{-1} the data do not obviously imply that the removal of these materials will result in such an expenditure on fertiliser materials for obvious reasons.

Table 8 Value of Nutrients in Slash (£/ha).

	Branches	*Needles*	*Total*
N	75.0	68.0	143
P	9.4	6.6	16
K	14.3	13.7	28
Total	98.7	88.3	187

An estimate of the *fresh* weight of the slash at Glen Imaal (using the data given in Table 3) gave a figure of 139 tons ha^{-1}. Because forest produce is normally sold in the moist state, it can be calculated from Table 8 that if a price of £1.34 per ton net could be obtained for slash material it would compensate for the cost of the nutrients involved. Studies have been carried out in Sweden on the suitability of logging residues for particleboard manufacture (Anonymous, 1977). It was concluded that although chipped slash was less suitable for manufacturing purposes than tree stems, most of the technical problems encountered could be easily overcome.

Because of the growing interest in the energy value of forest crops and residues in recent years an estimate was also made of the energy content of the slash category. In order to do this use was made of calorific values given by Madgwick, Jackson and Knight (1977) for needles and branches of *Pinus radiata* as follows:

Branches 4.68k cal/g.o.d.
Needles 4.87k cal/g.o.d.

(The values for Sitka spruce would not differ appreciably). When these figures are applied to the data in Table 7 and converted to British thermal units and expressed as coal, oil and turf equivalents using conventional conversion factors it emerges that the slash in the Glen Imaal stand contained the equivalent energy content of:

52 tonnes of coal or
35 tonnes of oil or
113 tonnes of sod turf

A considerable amount of the total dry matter production (18%) is also accounted for by the roots, a large proportion of which is included in the stumps. Although it may appear to be a far reaching idea to consider harvesting the stump and root fraction, machines have been developed in a number of countries in recent years which are capable of extracting large tree stumps and roots on both peat and mineral soils (Anonymous, 1977). Such excavation is likely to cause considerable disturbance of the soil which could have either good or bad effects depending on the nature of the site. For instance, it could result in a loosening up of the profile on compacted mineral soils thus reducing the need for other forms of cultivation at the start of the second rotation. However, on sloped areas the practice could result in serious soil erosion. On deep peat soils the removal of stumps and roots, although a far easier mechanical exercise than on mineral soils, would appear undesirable in that it would fracture the soil surface and thereby reduce considerably the bearing pressure. It could also result in serious drainage problems depending on the extent to which the watertable rises after clearfelling. However the fact is that the stump and root system contain a sizeable amount of material which in Swedish studies has been shown to closely resemble the fibre characteristics of the stemwood (Anonymous, 1977).

CONCLUSIONS

Conventional systems of harvesting forest crops are wasteful in that only a relatively small amount of the standing crop can be utilised. In this study the figure was 62% at 50 years of age. Because of the concentration of nutrients in the needles, the removal of the slash component, representing a further 20% of total production, would increase the nutrient drain considerably. The extra drain would however appear to be relatively small when compared with the remaining nutrient stores on a number of sites and the cost of replacement, should it be necessary, would not appear prohibitive. However, on soils low in organic matter, such as those derived from Old Red sandstone, the practice would be most undesirable.

It should be borne in mind that the data presented here refer to one particular crop only and considerable reservation must be attached to their extrapolation to other crops of different ages growing on different site types. Furthermore, tree growth is affected by other elements besides N. P and K and it may well be that the practice of whole tree harvesting could result in the supply of one or more of these becoming exhausted. What is certain is that as the gap between supply and demand for forest products widens on a world scale man will increasingly turn to forest residues as a basic raw material. Whether the slash and/or stumps are used for energy production, or the production of particleboard, or to manufacture animal foods — as is being researched in the Soviet Union (Anonymous 1977) — is not directly the concern of the forest manager. However, he does need to know what the production capability of his forest is and what the consequences may be of implementing more intensive tree harvesting systems. The data presented provide at least a base for more enlightened discussion.

ACKNOWLEDGEMENTS

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Notes and News

The Increasing Destruction of Spanish Forests

The serious problems of increasing ecological deterioration is being aggravated by a further form of destruction of natural resources, causing enormous short- and long-term losses: forest fires. It is the areas in the country faced with the problem of encroaching desert that are most subject to fires. In the last fifteen years forest fires increased in number by 225 per cent. Thousands of hectares are burned down every year. Since 1970 there have been over 25,000 fires, and hundreds of thousands of hectares have disappeared which no effort of replanting will ever be able to replace, since many years must pass before the forest grows again, during which time more fires break out. It is estimated that for every thousand hectares that are replanted, 25,000 more go up in flames. The experts have gone so far as to say that the fire which consumes the Spanish forests will end up by transforming the country into a desert. It is today a notorious fact that eight of the thirteen natural regions of Spain are suffering the consequences of an advanced process of desertization.

Man is the cause of 95 per cent of the fires which break out every year. While it is true that on occasions the harm is done indirectly as the result of forestry work, the burning of stubble, sparks from machines or railway locomotives, etc. in other cases a casual action that need never have happened brings about the catastrophe.(Spanish Government Information Service).

Growing Fuelwood Shortage

Millions of families in the rural areas of Africa and Asia are now reduced to eating most of their meals cold, according to a recent study by the UN Food and Agricultural Organisation, and there is evidence in some countries of a shift in small farm planting to foods that can be eaten raw.

The reason is a mounting shortage of wood, which is the basic fuel for both cooking and heating in most of the developing countries, even in the cities. This "poor man's energy crisis" has only recently begun to receive official attention but it is a growing problem that is not going to go away. It is mostly met with in predominantly agricultural areas where populations are growing and scattered trees and small patches of woodland are the sole source of firewood.

Fuel collectors in these areas have often reduced tree cover to less than one per cent of total land area. Tree losses on this scale invite soil erosion from wind and water.

Total fuelwood consumption in the developing countries, although hard to measure accurately, may be close to 1,300 million cubic metres a year and is growing. Fuelwood demand, the FAO study estimates, could climb by another 40% in the next 15 years.

The human burden of wood scarcity falls most heavily on the women of poor families in the rural areas. When wood sources near to home are exhausted, they must walk further and further for each day's supply. But at least the wood is free.

The use of alternative fuels is usually too costly for most of the rural poor. In parts of Asia where scavenging is no longer possible, as much as 10% of pitifully small family incomes may be spent on charcoal. Rich country interest in such exotic substitutes as solar energy, the report says, is totally divorced from today's realities for the majority of the world's poor.

There are many possible responses to the fuelwood problem, the report says, but none of them are easy. The main opportunity for substitution lies in the urban areas, where higher incomes generally permit use of alternative fuels. Yet there are many factors that inhibit the use of alternative fuels, even in urban areas. Cheap and poorly made cooking units using kerosene or butane are often dangerous. Much cooking in Africa involves simmering in a large metal pot for long periods of time, and for this a wood or charcoal fire is more suitable than a butane or kerosene stove. Habit is also a factor — a campaign in Mauritania to encourage the switch from charcoal to kerosene, a cheaper fuel there, has had little success.

The only long-term solution is planting more trees. Village level wood-lots and major reforestation programmes are already part of the development plans of many countries.(FAO, Rome).

I who have seen the world's forest die . . . . .

From Srinagar to Katmandu, the Himalayas, a short time ago covered with mossy forests, offer today to the eye of an airborne traveller, the spectacle of a bleak collection of ridges, hot and ravined. The lumbermen who supply India with furnace timber have passed by there. Their industry has already transformed the mountains of Lebanon, of Iran and of Pakistan into deserts. Soon the Himalayas, a verdant Switzerland, will become a burning Hoggar. I have also seen again the Ivory Caost where I remember travelling in 1952 under an uninterrupted canopy of trees for hundreds of kilometres from Abidjan to Bouaké or to Abengourou.

This forest, the largest in West Africa, no longer exists except for scraps, pompously referred to as "classified forest". It is hardly surprising that with this enormous vegetative sponge cut down, rainfall evaporates or percolates impoverishing the rain climate to the north, where the desert advances by several kilometres per year. One day, no doubt, at the turn of the century, the desert will arrive at the shores of the Gulf of Guinea. One cannot see how it can be stopped. Local catastrophe? No, worldwide! The dessication is spreading. The northern hemisphere will be unable to keep its green colour under the inflamed airstream coming from the deserts of the south, from Africa and Asia to Europe, from Mexico and South America to the U.S. But who speaks to you of it? Who cries for help, besides some specialists? None of our leaders has uttered a word about it to you. But, who then are these heads of state who fathom the future backwards?

Philippe de Baleine, *Le Figaro,* Paris.
Translated by John L. Buckley.

Wood Chip Fuel could replace 2M. tons of Oil in Sweden

Drastic increases in oil prices have resulted in a much greater use of timber as fuel in Sweden and this development could have a disruptive effect on other national priorities unless resourceful planning and controls are resorted to, according to a joint report from the National Boards of industry and of forestry.

On the one hand it is imperative that Sweden's heavy dependence on imported energy should be reduced, while on the other the country's forest industry sector must be guaranteed access to the 75 million cubic metres of timber it requires, the boards say. But studies show that Sweden's forests could yield sufficient combustible material — in the form of thinning waste and small-size birch — to replace up to two million tons of oil.

A nationwide information campaign on forest raw materials as fuel has accordingly been started up and the boards further recommend that a draft agreement be worked out to facilitate the creation of an efficient market for wood chip fuel. Regional wood chip fuel companies — with representatives of forest industry, forest owners, and consumers — could be set up in due course and the state should consider giving subsidies to district heating plants to enable them to acquire chip-boilers. At the same time the forest industry sector must learn to increase its felling rate, especially as regards thinning, and to employ new techniques that facilitate the use of forest energy resources.

Swedish International Press Bureau

International Symposium on Air Pollution and Forests

An international symposium on "Effects of Air Pollutants on Mediterranean and Temperate Forest Ecosystems" will be held June 22 — 28, 1980, in Riverside, California, U.S.A. The conference will focus on major areas of research in forest air pollution, including the effects of air pollutants on tree growth, on species composition of forest stands, and on forest wildlife, insect pests, and tree diseases. The effects of acid precipitation and heavy metals on forests, and the emission of nitrogen oxides, hydrocarbons, and other natural pollutants from forests, will also be discussed. One of the major purposes of the conference will be to examine progress that has been made in integrating data from diverse, highly specialised studies into ecosystem-level analyses.

European Wildlife Conservation Year

Tara Mines Limited, in cooperation with the Council of Europe, have produced a beautiful 1980 calendar and poster series on the theme of wildlife conservation. The calendar features typical European species most of which are found in Ireland and several of which have become endangered in recent times. They include birds such as the kingfisher, threatened by river pollution and drainage operations, the badger often mistakenly regarded as a pest of domestic stock and game birds and the peregrine falcon seriously reduced in numbers through the use of persistent pesticides. It is good to see the Forest and Wildlife Service featured amongst those contributing to this fine production.

Members on the Move

Our congratulations to two of our members who are shortly moving to new positions.

Professor Frank Convery, School of Forestry and Environmental Studies, Duke University, Durham, North Carolina who is returning to Ireland to take up a position in the Economic and Social Institute and Dr Peter Savill who is leaving the Forest Service in Belfast for the position of Lecturer in Silviculture in the Department of Forestry at Oxford.

Congratulations also to Professor Larry Roche, head of the Department of Forestry and Wood Science, University College of North Wales, Bangor, who has been elected President of the International Union of Societies of Foresters.

Letters

Dear Sir,

A recent meeting of the local section of the New Zealand Institute of Foresters debated the question concerning the gap between researchers and practitioners. Although no concensus was reached it was evident that many practitioners feel the gap is very important.

Individual views expressed were:

Means of communication by the Forestry Research Institute are "a disaster".

Scientists are "non-doers" as against practitioners, who are "doers".

Research reports are unreadable and have no relevance to practical forestry operations.

Not enough useful results are getting to the people who want them.

Much of the Forestry Research Institute's efforts in communication are examples of how not to get the message across.

A lot of research results are written in specialist gobbledygook for obscure journals.

Scientists have a self-perpetuating process; their research brings up more new research than results.

There is no one to evaluate the results of research so it doesn't get done.

Practitioners should be empowered to review research programmes and to have a hand in initiating them.

Counter-arguments put forward were:

Field foresters only take note of research when they want to.

Researchers are innovators and agents of change.

The job of research is to provide a range of alternative data, but the practitioner has to evaluate this before he can apply it.

The field forester has to work at being a consumer of research.

If researchers are not doing the right research it is the field forester's fault for not telling researchers what they want.

The Research Institute bends over backwards to inform enquirers.

Field foresters are stubborn and conservative.

Researchers must look well ahead to find out the problems which are looming up and work on them so that when field foresters suddenly find these problems upon them the researchers can give an answer.

What do Irish practitioners and researchers think? Is this journal an effective means of communication?

M.L. Carey,
Rotorua, New Zealand.

Maurice Henry Swan

The sudden death of Maurice Swan on the 4th February, 1980 came as a shock to all his friends and colleagues.

Maurice was born in Worcestershire, England, but he grew up in Co. Kildare. After a short incursion into teacher training at St Patrick's, Drumcondra, he entered University College, Dublin, where he graduated with an honours degree in 1940. At that time jobs in forestry were hard to come by and Maurice started his career as a working forester with the Castlecomer Estate Co. In 1942 he entered the then Forestry Division, Department of Lands, as forester and was successively attached to Dundrum, Ossory and Killakee forests. He was appointed Assistant Junior Inspector in 1945 and served on management at Limerick, Enniscorthy, Portlaoise and Galway before being appointed as land acquisition inspector at H.Q. in 1950.

His keen intellect and enquiring mind made him an automatic choice for research work when the fledgling Research Section was trying to gain its wings in 1957. Apart from another short period on land acquisition he was to spend the rest of his life associated with research as Senior Inspector and Asst. Chief Inspector. In his capacity as co-ordinator of forest research he was a firm advocate of a broadly based programme involving the Universities. The success of his work in this sphere is a lasting tribute to his dedication, tact and power of persuasion.

He was a founder member of the Society of Irish Foresters and served as council member, Editor and President. Until a few years ago he was to be seen at day outings and study tours although an inherent shyness kept his voice from being heard very often in the course of discussion. Yet nobody loved a good discussion or argument more, and in the company of his friends and colleagues he took a special delight in using his sharp intellect and incisiveness of expression to advantage. There are very few who honestly can claim to have won in a debate with Maurice.

Meticulous almost to a fault in everything he did, he set and demanded high standards. He had that gift, so essential in research, of understanding and reducing complex problems to their essential components. His attainments were many, but perhaps he will be best remembered for his enthusiasm, his dedication to his work and his kindness and consideration for others. He married Bridie thirty-one years ago and was very much the family man. To Bridie and to their children, Rosaleen, Margaret, Patricia and Brian we offer our deepest sympathy.

P.M. Joyce

Book Reviews

IRISH FORESTRY POLICY
National Economic and Social Council Report No. 46.
Government Publications £2.25.

After reading the NESC Report one must come to the conclusion that Irish Forestry has reached a watershed and, indeed, that the commissioning of this Report was timely. However, if there is a crisis in the industry the solutions are coming at forest pace; this Report was commissioned by the Minister for Economic Planning and Development in 1977 and, presumably, is now, in 1980 being considered by the Government.

The terms of reference for the Report were to study and advise on the potential and implications of forestry for social and economic development in Ireland. To an outsider it seems that Professor Convery over-reacts; certain sections of the Report read like an apologia for economic investment in Irish forestry. Such reaction may have been necessary in the early days of a national forestry programme, when capital investment was high and the prospect of financial return was distant. Nowadays, forestry in Ireland has proved that it is viable due, in no small way to a well organised approach to afforestation. What is now needed is a sensible approach to the management and utilisation of the forest product, as the endeavours of the early years bear fruit and come on-stream.

The Report sees an ongoing market for forest products, mainly in the United Kingdom and data is given to show that Irish wood products have a current price advantage over Swedish. One wonders if the author is too inclined to optimism, as the same chapter deals with the serious financial problems encountered by the two Irish particle-board factories, when the European market went through a recessionary phase. Here, as elsewhere in the Report, there is little mention of the future of the domestic market, which in 1977, imported wood and wood products to the value of £148 millions. How far can we go to replace these expensive imports?

To a non-forest person reading the Report, the most immediate and most urgent problem in forestry would appear to be an incapacity in this country to process the timber coming from our forests in the next twenty-five years, or indeed, in the next five years. Reading between the lines, one can sense a reluctance on the part of the State bodies to become involved in what must be high-risk enterprises. As an agriculturalist reading this Report a sound case seems to have been made for (a) an integration of the growing and processing of timber and (b) for this integration to be carried out on a scale which will allow the native industry to be competitive on a unit cost basis. Clearly, the stumbling block to this desirable solution would be the very considerable capital outlay which would be required. It is surprising that neither the consultant nor the NESC have commented on the possibility of seeking EEC funding for such a project; the location of our forest in the Disadvantaged Areas must add weight to such a proposal.

As it fell within the brief given to him, Professor Convery looks at the employment generated by forestry. Again, one is conscious of the need to justify forestry policy, this time in terms of the employment it generates. Although in-forest employment will fall, the deficiency is more than covered by the substantial increase in downstream employment and by the enormous social benefits accruing in the infrastructure in the areas where afforestation is in progress. Likewise, it is easy to make a case for the advantages of amenity forestry and the area seems to be adequately covered by both legislation and motivation.

The sections dealing with the private forest estate are comprehensive and logical. A very adequate case is made for support for all aspects of the private forest industry, and suggestions are made as to how private forestry can be improved by grant aid, information service and taxation rationalisation. The interesting proposals for afforestation of the drumlin soils are reviewed. How much support such proposals will receive from Government sources is questionable if one accepts the much-reiterated philosophy that the Government does not desire to acquire for afforestation land fit for agricultural purposes. Likewise, the approach to afforestation on the cutaway bogs is vague and this is obviously another area where clearcut policies need to be spelled out.

The most controversial area in the Report, from the point of view of the professional forester, is likely to be that concerned with the various institutional changes suggested by the consultant. One can see the need for regulatory boards, as the industry matures and develops. One can appreciate his concern to eliminate the two-tier system in the Forest and Wildlife Service and, thus, to streamline the general approach to forest policy. However, this arrangement holds throughout the Civil Service and it is difficult to see it being changed in one relatively small section. A more radical approach might be taken at this critical stage of the forest industry in Ireland by setting up a body equivalent to the Irish Sugar Company (CSET), which would be responsible for all aspects of forest production, processing and marketing. The Irish Sugar Company can be claimed to have been successful; an equivalent company for forestry would have the additional advantage that it would exercise relatively greater control over the supply of its raw material. Is there a 'general' in the forest service or industry who could undertake this task or must we look to some other sector for someone with a marshall's baton (hardwood!) in his briefcase.

In general this is a useful and interesting report, crystallising the problems of the forest industry in Ireland and suggesting reasonable solutions for them. If one would fault it in any fashion it is that Professor Convery is, at times, too moderate in the proposals he puts forward; more incisive suggestions might serve to highlight the urgency of the problems. However, this is a small fault. A more serious consideration is that, in the current period of Government change and economic depression, the importance of the issues raised in the Report may be overlooked or their resolution postponed. There is an onus on the people, who have developed Irish forestry and who are concerned with its future, to make sure that the content of the Report remains a live issue.

E.J. Gallagher.

IRISH RESOURCES AND LAND USE
Institute of Public Administration, Dublin
D.A. Gillmor (Editor)
295 pages; Hardcover; 50 sketch maps. £11.99.

Members of the Society will be somewhat pleased that the dust-cover of this book shows a map of state forests; there is little joy however for members who live and work in Northern Ireland since most of the book deals only with the Republic of Ireland.

There is however a lot to interest the forester in this new book, even though much of the information is available in other books, journals, etc. Dr Gillmor opens with a chapter on the nature and role of our natural resources and makes a strong plea for an integrated policy on management and use. The following chapter, Atmosphere, by Dr Bourke, includes, as well as a detailed account of the work of the Irish Meteorological Service, a section on practical aspects of weather data. Chapter 3, on

Water by Dr Drew, is more encompassing, dealing with hydrology; domestic, agricultural and industrial usage; water quality, etc., and he compares the Republic with Britain and Europe.

The current situation with respect to base metals, building materials, peat, coal, petroleum and natural gas are discussed by Professor Holland under the title "Minerals". A more detailed description of the surface geology of the country would be welcomed by the average reader. Dr Gardiner (Chapter 5, Soils) discusses the origin, nature and distribution of the Republic's major soils. He outlines their suitability for agricultural use and shows the distribution of marginal land (45% of the landscape) both by map and in tabular form.

Dr Gillmor uses seven page-size sketch maps to depict aspects of agricultural land usage in the state and deals succinctly with land improvement and productivity. He comments authoritatively on drainage, fertilizers, hedgerow removal, dangers of pollution, etc. One must however dispute his figure of 1.5 million tonnes of lime being needed annually to counteract soil losses. Mr McEvoy's chapter, Forestry, the shortest by a few pages, discusses the economic and non-economic aspects of forestry in Ireland with comments on the spatial distribution of both private and state-owned forests. His discussion on management and policy includes comments on wildlife, soil and water conservation, visual aspects of the landscape, etc. and he predicts that at least 500,000 hectares of the Republic's land will ultimately be afforested.

Dr Went gives interesting statistics both for our inland and sea fisheries and deals effectively with the problems of fish-stock conservation. Similarly, Dr Cabot's contribution (Wildlife) is more statistical than descriptive and he warns against the excessive use by other Europeans of our limited and fragile wildlife resources. He makes a plea for proper management and enlightened land-use planning.

Mr Mawhinney's chapter, Recreation, disçusses some of the visual aspects of the Irish countryside including our mountain and cliff scenery, our beaches and coastal waters. He emphasises the richness of the western counties and discusses the strong peripheral pattern to outdoor recreation and tourism. The recreational use of forests and water are discussed separately; the Lough Key Forest Park experience is highlighted.

Chapter 11, Transport, by Mr Killen, convinces us that transport constitutes both an important resource and a significant land user. Road and rail networks and usage, and water and air traffic are discussed . . In the final chapter, Urban Land, Dr Bannon comments on urban growth and urban land usage, and provides figures and estimates as to future demand for urban land. That 27,000 hectares, most of it land of very high agricultural potential, will be converted to urban use by 1991, one-third of it in Dublin alone, must be a concern to us all.

This is a well-produced, readable and interesting book with a good bibliography and index and few mistakes or errors. My only criticism is that Northern Ireland has been excluded and hence the book has a misleading title. This did not have to be so, since most of the information is available, and a little extra effort, and a few Northern Irish authors could fill the gaps. Anyone used to using and studying Irish maps such as road and rail networks, forest maps, distribution of wildlife, soil maps, etc., will find the blank north-eastern section of the country very displeasing. Had each of the chapters been enlarged one would have little hesitation in saying that this book was well worth it's price and in recommending it as a reference or text to accompany the Royal Irish Academy's Atlas of Ireland.

J.F.Collins

A GLOSSARY OF WOOD
Thomas Corkhill
Stobart and Son Ltd., (London). 656 pages. £7.50

This is a re-issue of a book first published in 1948. Its 10,000 terms in alphabetical order cover such topics as tree names, both common and botanical, types of timbers, their workability and uses. It also deals with joints in timber for use in the construction industry, particularly concerning roofing, flooring, windows, doors, machine wood working and mill work. In essence this book is an elaborate wood technologist's dictionary, since it also sets out in explanatory fashion the terminology relating to wood seasoning, wood preservation, construction methods and wood decay. There is a wealth of line drawings (over 1000) to further clarify many of the terms.

Unfortunately the book was not revised upon re-issue and so there are no references to the use of new materials (i.e. patricleboard) for construction which are nowadays widely used. Likewise much of the material on woodworking machinery is out of date.

Nevertheless, the book is a splendid source of information which specialists in the timber and woodworking trades will find extremely useful. However, its doubtful relevance to the practice of forestry makes it one which is unlikely to find a place on the bookshelves of many foresters.

John J. Gardiner,
Forestry Department.

Society Activities

ANNUAL GENERAL MEETING 1980

COUNCIL REPORT FOR 1979

Council Meetings:
Six council meetings were held during the year. Attendance of Councillors was as follows: J. Brosnan, E. P. Farrell, E. Hendrick, F. Mulloy (6); J. Dillon, L. Furlong, J. Gardiner, J. O'Driscoll (5); K. Ellis, E. Joyce, J. Kilbride, M. O'Brien (4); J. Prior, C. Tottenham (3); P. McArdle (2).

Society Meetings:
A successful symposium on the theme "The Challenge of the Second Rotation" was held at Belfield, U.C.D., in April. Four of the papers presented were published in Irish Forestry Vol. 36 No. 2. Ballyhoura forest was the venue for a well attended field day in September. To mark the 75th Anniversary of State Forestry in Ireland, Dr. Jack Durand delivered a public lecture entitled "State Forestry 1904-1979, 75 years a growing" at Belfield, U.C.D., in September. A lecture entitled "Swedish Forestry — seeking the way forward" was delivered by Dr. Ted. Farrell in November at the R.D.S.

The Society expresses its thanks to those who acted as field leaders and speakers.

Annual Study Tour:
Despite the postal strike the Annual Study Tour held in Scotland in May, was very successful and was attended by 44 members. Thanks are due to Mr. Goodwin, Tour leader, Dr. Peter Savill and all those who assisted with the organisation in conjunction with the Meetings Sub-Committee.

Guided Forest Walks:
Walks were held at 35 centres throughout the country on Sunday 9th September and were attended by approximately 7,000 people. The Society wishes to thank Mr. John Fennessy who organised the Walks and those members who acted as walk-leaders at the various centres. The assistance and co-operation of the Forest and Wildlife Service, Dublin, and the Forest Service, Belfast, is also acknowledged.

Annual General Meeting:
The 37th Annual General meeting was held at the R.D.S., on the 5th April, 1979. The minutes are available in Irish Forestry Vol. 36 No. 2.

Society Publications:
Irish Forestry Vol. 36, Nos. 1 and 2 were published. "Guided Forest Walks" and "Why Forests" were issued in connection with the Forest Walks. Work on the second and revised edition of "Forests of Ireland" continues.

Examinations:

The results of the 1978/'79 examinations were not available for inclusion in last year's Council Report. We are pleased to announce that all three candidates were successful at the Foresters Certificate Examination. Three candidates have presented themselves for the Foresters Certificate Examination to be held in 1980.

Elections:

Three positions of Councillor Technical and one of Councillor Associate for the period 1980-1982, were filled by election. The remaining positions had only one candidate each and they were, therefore, declared elected.

New Members:

A total of 40 new members were enrolled in the following categories:
Technical: 16 Associate: 18 Student: 16.

Signed: EUGENE HENDRICK,
Hon. Secretary.

MINUTES OF THE 38th ANNUAL GENERAL MEETING
Thursday, 26th march 1980, Thomas Prior House, R.D.S., Dublin.

Attendance:

The President Mr. F. Mulloy in the chair, present were: J. Brosnan; J. O'Driscoll; L. Furlong; D. McAree; L. O'Flanagan; J. J. Maher; P. J. O'Brien; E. P. Farrell; J. Dillon, N. Kavanagh; J. P. Connolly; P. Raftery; T. Kavanagh; C. I. Tanner; C. S. Kilpatrick; J. T. Kilbride; A. W. Simpson; B. Wright; J. C. L. Phillips; J. O'Connor; J. Gillespie; R. McCarthy; G. J. Cunningham and E. Hendrick.

Apologies were received from Messrs. D. Dickson; E. Joyce; P. M. Joyce; K. Ellis; S. Milner; N. O'Carroll and J. Prior.

A minutes silence was observed as a mark of respect to Mr. M. McCabe, Miss E. McCreesh and Mr. M. Swan, three past members of the Society who had died during the year.

Secretary's Business:

The minutes of the 37th Annual General meeting having been published in Irish Forestry 36(2) were taken as read and signed. The Council Report for 1979 was presented. A discussion followed on the publicity for the Annual Forest Walks. Mr. O'Flanagan suggested that some of the funds spent on purchasing and circulating the Forest Walks leaflets could be used to greater effect on local press advertising for the local Forest Walks. Mr. Connolly commented that it was usual to place advertisements in some of the local newspapers but that the cost was high. The President felt that the suggestion should be pursued. Mr. Brosnan in reply to a question from Mr. Mooney stated that the total membership of the Society was 703, comprised of 532 Technical, 143 Associate and 28 Student members. The adoption of the Council Report for 1979 was proposed by Mr. N. Kavanagh and seconded by Mr. Mooney.

Abstract of Accounts:

In presenting the statement of accounts the Treasurer pointed out the financial situation at the end of 1979 was healthy. Although the cost of printing of the journals

SOCIETY OF IRISH FORESTERS — STATEMENT OF ACCOUNTS FOR YEAR ENDED 31st DECEMBER, 1979

1978	*RECEIPTS*		*1979*
4,353.52	*ToBalance from Last Account*		5,977.69
	Subscriptions Received		
	Technical 1979	1,805.02	
	Technical 1978	104.55	
	Associate 1979	388.00	
	Associate 1978	15.50	
	Student 1979	15.00	
	Other Arrears	2.50	
	Advance Payments	134.50	
2,658.02			2,465.07
	Interest on Investments		
	Dublin Corporation Stock 9¾%	20.10	
	Savings Account	24.93	
	Educational Building Society	501.74	
334.29			546.77
	Journal		
	Sales	63.23	
1,572.80	Advertising	573.73	636.96
549.96	*Forest Walks inc. donation*		2,439.70
	Examination Fees		
	Miscellaneous		45.00
	Donations	3.00	
	Refund	4.00	7.00
9,467.59			**12,118.19**

1978	*PAYMENTS*		*1979*
	Stationery and Printing		45.40
1,499.81	*Printing of Journals*		2,467.10
520.35	*Postage*		496.18
69.00	*Expenses re Meetings:*		109.14
	Refund		3.28
33.25	*Bank Charges*		4.50
522.19	*Secretarial Expenses*		484.45
104.43	*Value Added Tax*		106.69
70.91	*Examination Expenses*		50.00
	Honoraria:		
	Secretary	30.00	
	Treasurer	30.00	
	Editor	30.00	
	Business Editor	30.00	
120.00			120.00
549.96	*Forest Walks*		2,444.70
	Balance:		
	Current Accounts	412.79	
	Savings	299.84	
	Educational Building Society	5,074.12	
5,977.69			5,786.75
9,467.59			**12,118.19**

I have examined the above accounts, have compared it with vouchers, and certify same to be correct, the balance to credit being £5,963.36 which is held in current and savings accounts at the Ulster Bank, and in the Educational Building Society, less £176.61 in uncashed cheques. There is also a holding of £206.19, in the Dublin Corporation 9¾% 1981-83 Stock and £100.00 in Prize Bonds.

Dated: February 22nd, 1980 — *Signed: W. H. Jack, Hon. Auditor* had increased by about £1,000 for 1979 this was offset by a larger starting balance at the beginning of the year. The decrease in advertising receipts was caused by the postal strike delaying payments for advertisements in the journal. Most of the payments due had been received at the beginning of 1980. Bank charges had been undercharged at £4.50 and the extra amount is to be entered in the 1980 accounts. The Treasurer stated that Council had discussed an increase in subscription fees but it had been decided it was not justified, taking into consideration the amount of monies held by the Society. The President congratulated the Treasurer and Honorary Auditor on the presentation of the accounts and opened discussion on them. Mr. O'Flanagan wondered if the money invested with the Educational Building Society should instead be invested with a merchant bank where it would earn a higher interest rate. Dr. Farrell, in agreeing that consideration should be given to alternative investments, suggested that the Society should seek financial advice on this matter. The President suggested that this was a matter the incoming Council could discuss. Replying to a question from Mr. McGlynn on whether the Society had any plans for spending the money held, the President stated that the funds were originally intended to be used on publishing the revised edition of "The Forests of Ireland". However, as the editor, Dr. O'Carroll, had found a publisher who was interested in publishing the book this expenditure would probably not now be incurred. Mr. O'Driscoll advised that any decision on using the money should be postponed until after the book has been published. The Treasurer clarified the position of members in the sterling area who had difficulty in paying their subscriptions through their banks (since the break in parity between the Irish pound and sterling). He had opened an account in Northern Ireland for this purpose and when the present banking staff dispute about sterling/punt transactions was resolved he will circularise the members concerned. On the proposal of Mr. Maher, seconded by Mr. McGlynn the accounts were formally adopted.

Presentation of Foresters Certificates:

The President Mr. Mulloy congratulated the three successful candidates at the Foresters Certificate examination, Mr. Thomas Kavanagh, Mr. Patrick J. O'Brien and Mr. James O'Connor and presented them with their certificates. He thanked Mr. Prior for his work as Examinations Convenor, Mr. McEvoy who had acted as registrar for the examinations and those who had acted as examiners. Mr. Prior was unable to attend as he was chairing the A.G.M. of the Central Forestry Examinations Board at Penryth in Scotland.

Elections:

The 1980 Council elections were confirmed as follows: President J. O'Driscoll; Vice-President J. C. L. Phillips; Secretary E. Hendrick; Treasurer J. Brosnan; Editor E. P. Farrell; Business Editor M. O'Brien; Technical Councillors J. Dillon, E. Joyce and J. Prior; Associate Councillor L. Furlong.

Presidential Address:

The President thanked the outgoing Council for their support during the year. He thanked Mr. Dillor and Miss Furlong for organising the Study Tour to Scotland and Mr. Fennessy for his organisation of the Forest Walks. In standing down as President he welcomed the new President and Vice-President and wished them well in their new posts. At this point the chair was taken by Mr. O'Driscoll. On behalf of the Society he thanked Mr. Mulloy. He referred to the achievements of the past President in hosting two very successful symposia and his active participation in the organisation of the Forest Walks.

Other Business:

A letter was read from Dr. O'Carroll, who was unable to attend the meeting, outlining progress on the second revised edition of "The Forests of Ireland". All of the book apart from three short sections, currently being edited, was ready for final revision. He had been in further contact with the publisher who was interested in publishing the book and the interest was maintained. Mr. Dillon stated that the Annual Study Tour would be based in Mullingar this year and that arrangements were being made for a day meeting to be held in the Carlingford area. Mr. Kilpatrick suggested that the work on the growing of willows for biomass at Lough Gall in Co. Fermanagh would merit a visit. The President replied that the Society was very conscious of the forest biomass topic and he felt that it would be a suitable subject for a meeting. Dr. Farrell stated that foresterers should be involved in this work and favoured the use of the term "energy forest" rather than biomass which he felt was too broad. The President concluded the meeting by thanking all those who attended. The meeting concluded at 10.00 p.m.