IRISH FORESTRY

JOURNAL OF THE SOCIETY OF IRISH FORESTERS

Volume 47, No. 1, 1990

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Sales and advertising are handled by: Mr. J. Gilliland, Business Editor, Irish Forestry, 17 Ryecroft, Bray, Co. Wicklow. Tel. 867467.

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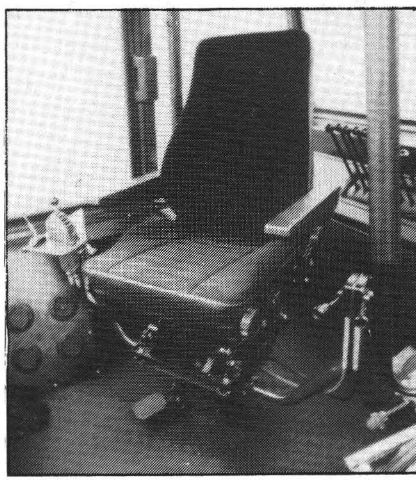

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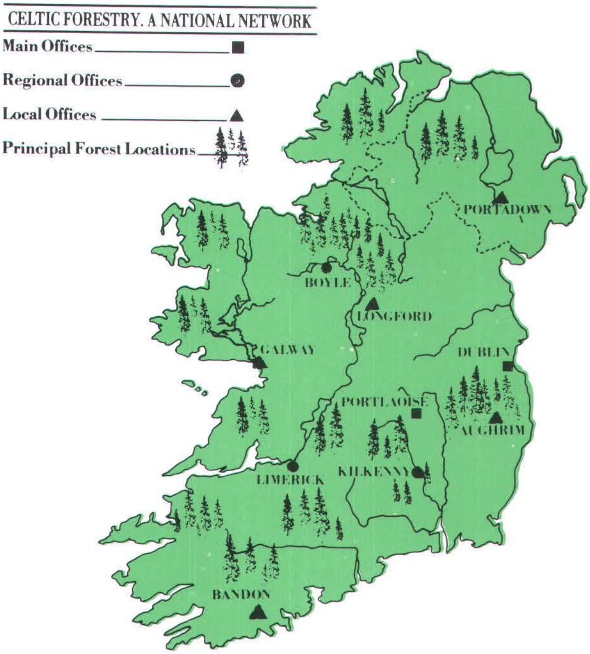

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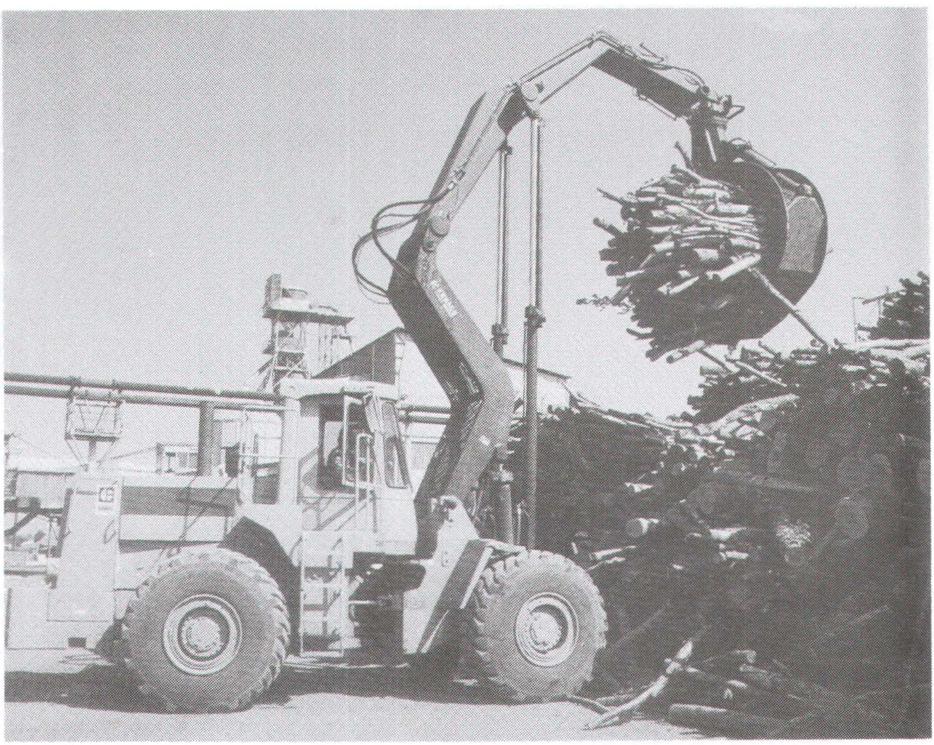

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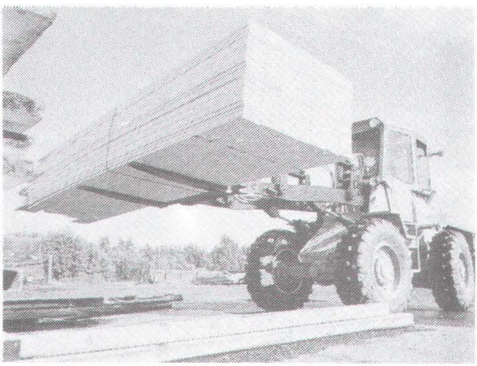

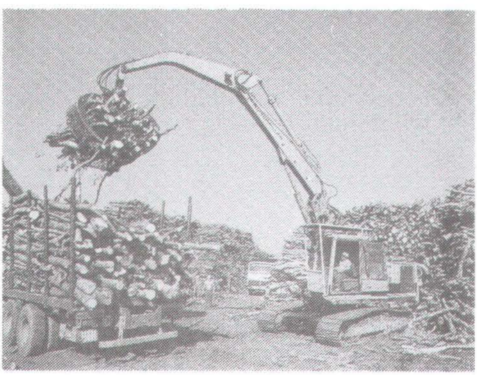


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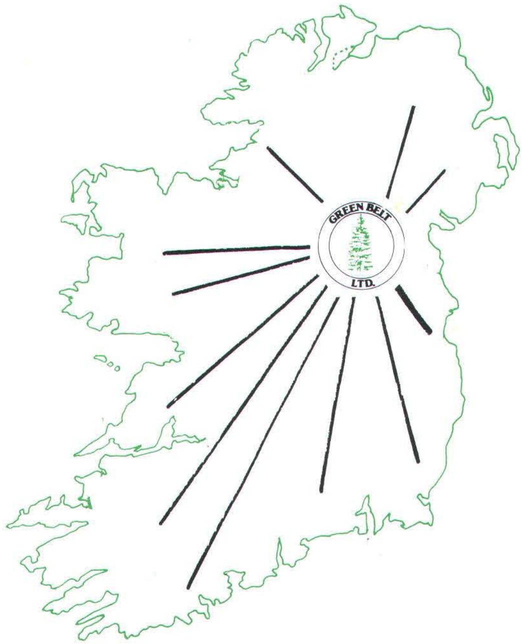

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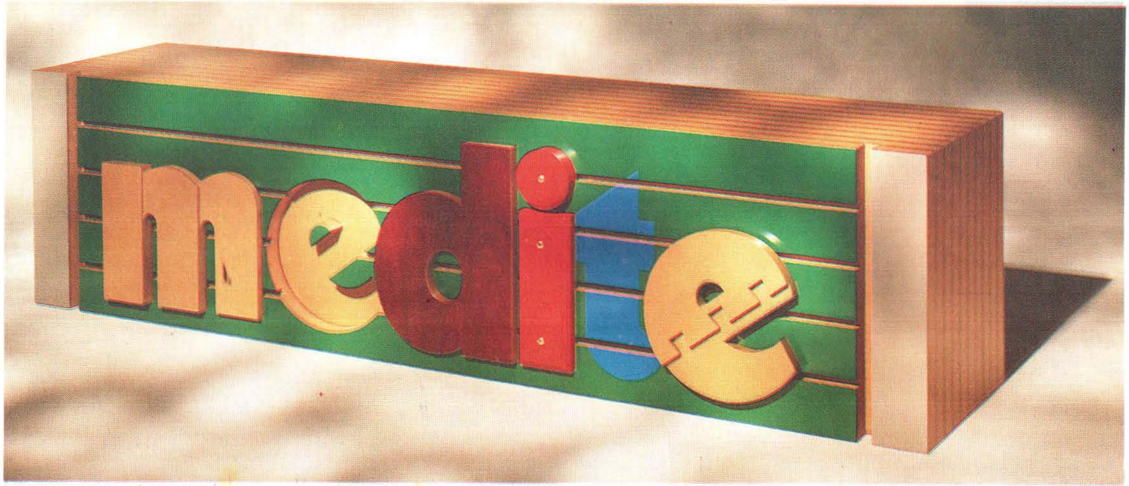

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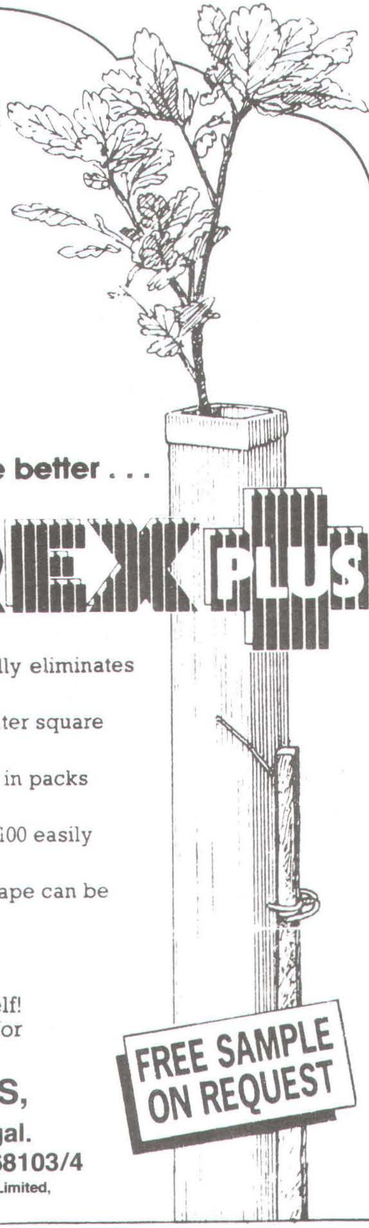

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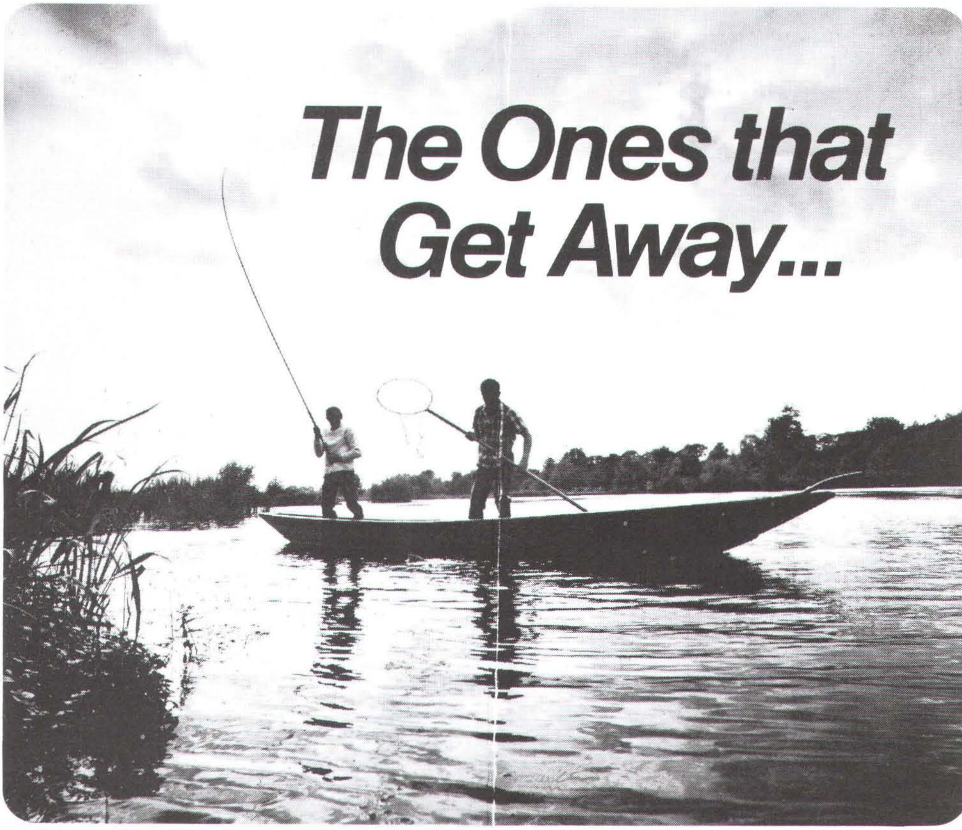

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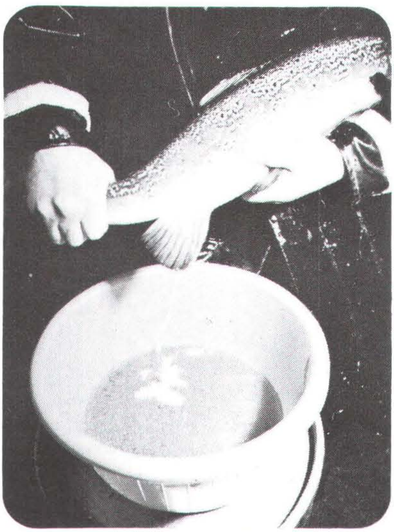

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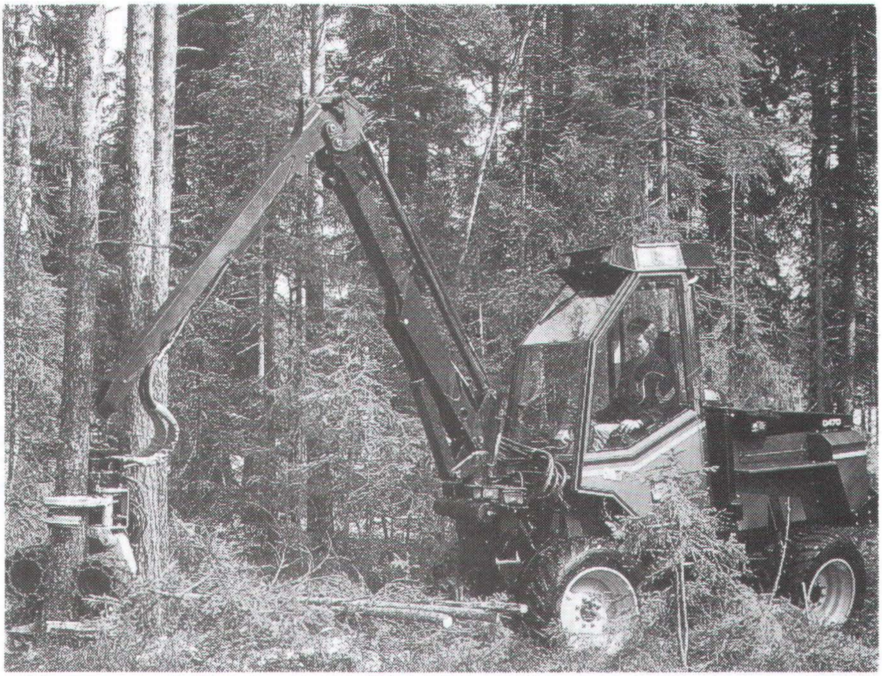

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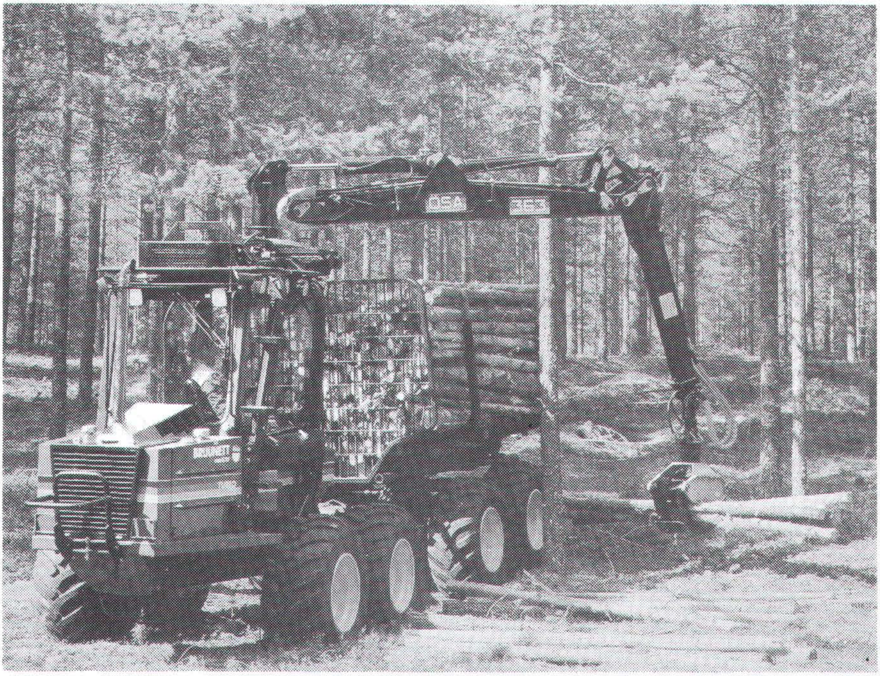

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The State-of-the-Art: Harvesting in the Nordic Countries[1]

Jari Ala-Ilomäki

The Finnish Forest Research Institute, Dept of Forest Technology.

[1] Paper presented at Society of Irish Foresters' Annual Symposium, St. Patrick's College, Maynooth, April, 1990.

Summary

Forest management systems in the Nordic countries are generally characterised by repeated selective thinnings from below. An increasing share of thinning cuttings and mechanised harvesting, plus the increasing importance of environmental aspects are common features to logging in the Nordic countries. Log-length method is used almost entirely. Despite attempts to mechanise forest work, motor-manual cutting still has its place in modern forestry.

The one-grip harvester is the most common multi-function machine type. It can be used both in thinnings and clear cuttings. Two-grip harvesters are not equally capable of working in thinnings, where the damage to the remaining trees is to be minimised. The role of processors in cutting is rapidly getting smaller. The dominating machine in off-road transportation is the wheeled forwarder.

Farm tractor-based machinery still has a remarkable role in logging. Light tracked machinery has been developed for early thinnings and poorly bearing sites. These two groups form a minor, yet important part of the logging machine fleet.

In the near future, early thinnings with low productivity in mechanised harvesting and high costs in motor-manual harvesting will be the main question to be solved in the field of harvesting. The development of light machinery and multi-tree processing technology is therefore likely to take a remarkable step forward. Environmental aspects also have a strong influence in machine development.

1. A Brief Glimpse of Forestry in the Nordic Countries

Nordic countries, although often considered as an homogenous group, in terms of landscape and forestry differ a lot from each other. Landscape varies from Denmark's flatland through Finland's softly rolling hills to the mountains of Norway. Finland, being the most forested country in Europe, has 66% or 20.1 million ha of the total land area covered by forests, whereas the corresponding figure in Denmark is 12% or 512,000 ha (Fig. 1) (Anon.

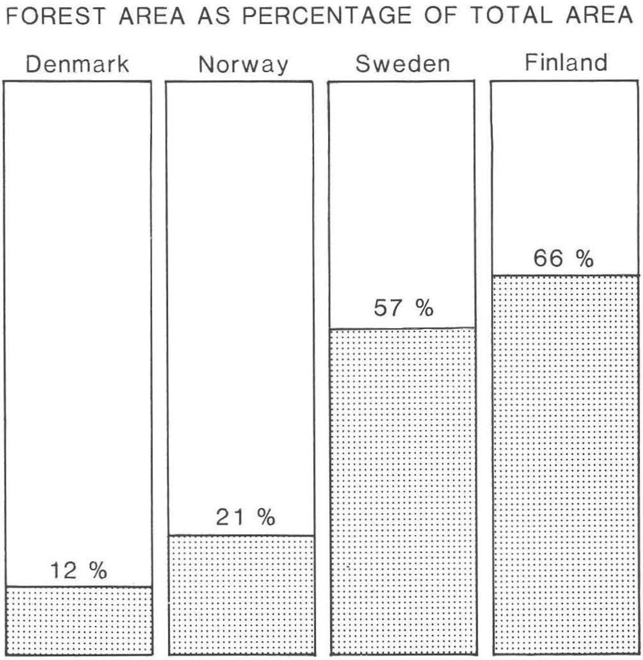

Figure 1: Forest area as a percentage of total area in some Nordic countries (Anon. 1982 and 1989).

1982 and 1989). Iceland, of course, is a very special case among the Nordic countries; it is a volcanic island with hardly any forests.

The selection of tree species varies as well. In the northern part of the area in question, including Finland, Norway spruce *(Picea abies),* Scots pine *(Pinus sylvestris)* and birch *(Betula pendula* and *Betula pubescens)* dominate. In Denmark, the most important coniferous species are: Norway spruce, Sitka spruce *(Picea sitchensis),* silver fir *(Abies alba),* Douglas fir *(Pseudotsuga menziesii)* and mountain pine *(Pinus mugo).* The most important broadleaved species are: beech *(Fagus sylvatica),* oak *(Quercus robur),* ash *(Fraxinus excelsior)* and sycamore *(Acer pseudoplatanus)* (Anon. 1982).

The rotation for conifers varies from 40 years in Denmark to up to 200 years near the northern tree limit. Forest management systems are characterised by repeated selective thinnings from below, except in Denmark, where row thinnings are used. An increasing share of thinning cuttings and mechanised harvesting, plus the increasing importance of environmental aspects are common features of logging in the Nordic countries.

The importance of forestry in the economy of the country is greatest in Finland and Sweden. Accordingly, specialised forest machinery is mostly used in logging. In Denmark and Norway a large share of logging machinery is farm tractor based. Also cable logging systems are widely used in the mountainous parts of Norway.

In the following, the description of current logging systems will concentrate on Finland and Sweden. These countries, however, represent the-state-of-the-art of mechanised tree harvesting in the Nordic countries. When it comes to future trends, the Nordic countries can more or less be considered as a group.

2. Current Logging Methods in Finland and Sweden

2.1 General aspects

Finland and Sweden, though very much alike, have some differences which strongly influence logging. First of all, the share of peatlands of the total land area is significantly greater in Finland (32%) than in Sweden (22%) (Heikurainen, 1984). In fact, Finland is one of the world's richest countries in peatlands. Moreover, the share of drained peatlands is much greater in Finland compared to Sweden. According to Kuusela (1978), 43.6% or 4.1 million hectares had been drained by 1976.

Table 1: Some figures of logging by forest industry companies in Finland and Sweden (Puun, 1990).

	Finland		Sweden	
	1987	1992	1987	1992
Annual drain, mill. m^3	28	34	41	44
Clearfelling, %	61	61	77	73
Thinning c., %	39	39	23	27
Degree of mechanisation, %				
clearfelling	55	72	78	88
thinning	8	25	47	69
all	35	53	71	83
Average stem size, m^3				
clearfelling	0.26	—	0.26	—
thinning	0.11	—	0.11	—
Average removal, m^3/ha				
clearfelling	168	—	189	—
thinning	64	—	52	—
Average off-road haul. dist., m	315	—	400	—

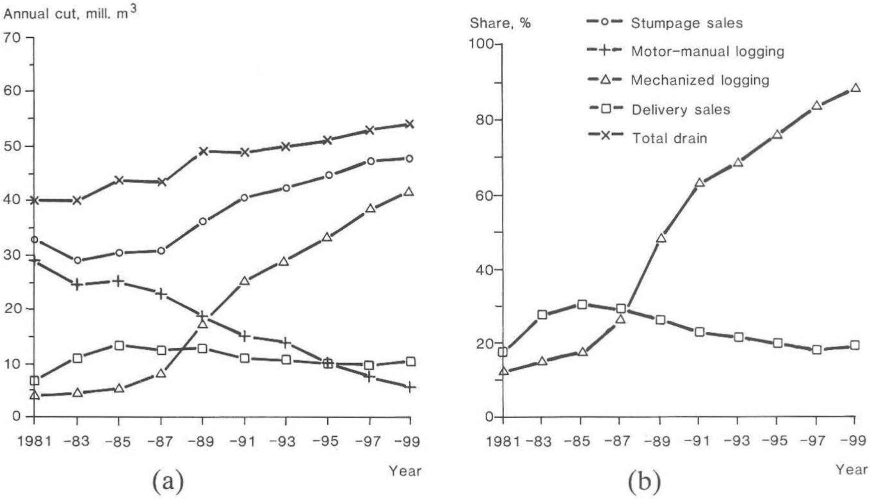

Figure 2: Development of logging in Finland (a) and the share of mechanised logging and delivery sales (b) in 1981-99 (Örn, 1990).

Another important factor is the difference in the basis of forest work payment, with Finland having a piece rate system and Sweden a time rate or a combination of piece and time rate. Nearly all forest machines in Finland are owned by private contractors, whereas in Sweden forest industry companies own 35% of the machines. The share of company-owned forests is clearly greater in Sweden. Environmental restrictions on logging are stricter in Sweden, but in both countries the condition of the site after logging must be good in order to keep private forest owners, who own a large proportion of forests, willing to sell wood in the future.

Table 1 gives an overview of logging in Finland and Sweden, excluding logging done by private landowners (Puun, 1990).

The degree of mechanisation in Finland, although one of the highest in the world, lies well behind Sweden due to, among other reasons, the differences in forest work payment system and forest land ownership (Figs. 2a, 2b, 3a and 3b). The share of mechanised logging is expected to rise rapidly. The log-length method is used almost entirely and rack distance usually varies between 20 and 30m. The selection of trees to be removed is done increasingly by the logger or machine operator.

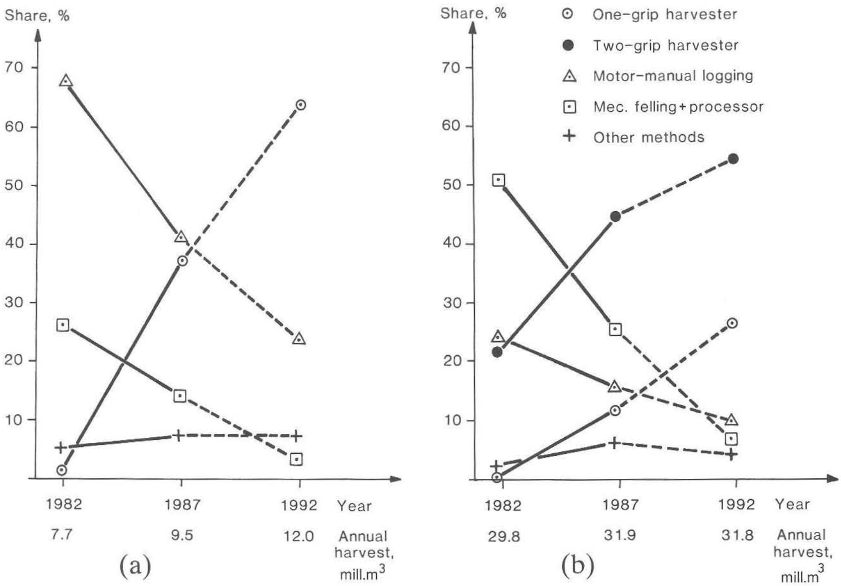

Figure 3: Logging methods in Sweden in thinnings (a) and clear cuttings (b) in 1982-1992 (Freij and Tosterud, 1988).

2.2 Motor-manual cutting

Despite attempts to mechanise forest work, motor-manual cutting still has its place in modern forestry. Even in the mid-90s its share is expected to be approximately 10 to 30% in company operations (Örn, 1990; Freij and Tosterud, 1988). Motor-manual cutting is most competitive in first thinnings. In Finland, it is considered the most economic method for first thinnings, whereas in Sweden it is no more cheaper than mechanised methods. In later thinnings and clear cuttings motor-manual cutting is usually the most expensive method. However, it is still profitable to cut the most valuable stems, such as big-dimensioned veneer birch, motor-manually to maximise the grade yield of the forest products.

Rationalisation has greatly improved the productivity of manual cutting. These measures include the lengthening of pulpwood logs to 3-5m and the relaxing of nominal length accuracy and delimbing requirements. In Finland, the average annual output of a chainsaw worker is 2,500-3,000m^3 (Hakkila 1989), whereas, due to the time rate system, it is somewhat lower in Sweden.

Motor-manual cutting has therefore reached the stage where its productivity cannot be significantly increased. The labour force of forestry is continuously decreasing and the timber demand of the pulp and paper

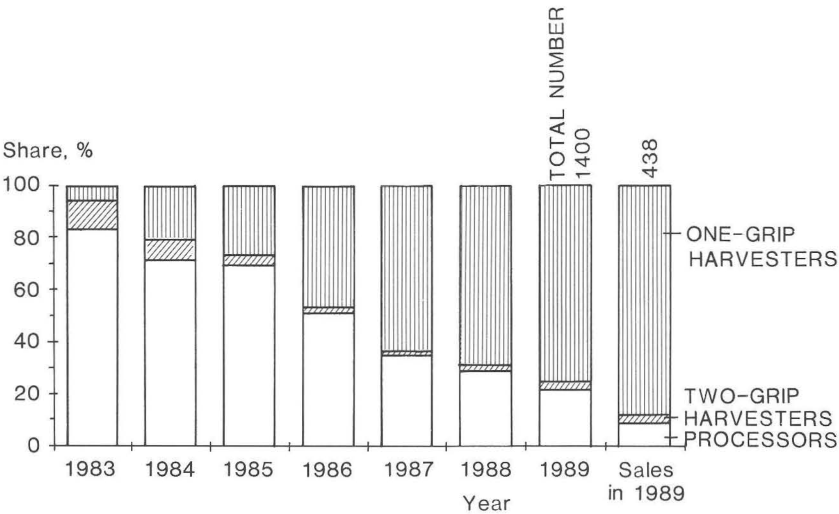

Figure 4: Cutting machine fleet in Finland in 1983-89 (excluding machines older than 6 years) and cutting machine sales in 1989 (Metsäkoneiden, 1989).

industries increasing, creating increasing pressure to replace chainsaw work with multi-function machines.

Since a majority of silvicultural operations is still performed by labour-intensive methods, it is important to maintain a significant share of motor-manual cutting to ensure the availability of a manual labour force for seasonal operations, such as planting and pre-commercial thinnings. In addition, private forest owners often consider motor-manual cutting to be silviculturally and ecologically the best harvesting method, especially in Finland. It is also always a safe cutting method for poorly-bearing peatlands.

2.3 Mechanised cutting

The one-grip harvester is the most common multi-function machine type. In Finland, for example, over 80% of the multi-function machines sold in 1989 (including the ones sold without a base carrier) were of this type (Metsäkoneiden, 1989) (Fig. 4). It has developed to an all-round machine, which can be used both in thinnings and clear cuttings, yet there are also more specialised models for early thinnings. One-grip harvesters, like all logging machines excluding small ones, work mostly from racks. The trees in the middle of the section between the racks have to be felled maunally if the machine cannot reach them. The reach of one-grip harvester cranes is usually about 10m.

At first one-grip harvesters were usually built on a new or used, shortened chassis of a mid-sized forwarder. Today, most of the units have a chassis especially designed for the purpose, which has improved their suitability for thinnings. The weight of the most common types varies from 9 to 15 tonnes and their price is between 1 to 1.5 million Finn marks (FIM) (1 FIM=0.16 Irish £). Annual output in thinnings is between 20,000 to 30,000m^3 and in clear cuttings up to 50,000m^3. Technical availability is up to 85%.

One reason for the rapidly increasing degree of mechanisation is the flexibility of the present one-grip harvesters. Conifer stands and the trees are quite easy from the mechanisation point of view: the initial density of man-made stands is approximately 2,000 trees per hectare, and stem form is generally good and they usually do not have thick difficult branches. The properties of broadleaved species, birch being the most important in this context, are less suitable for mechanised cutting, and especially one-grip harvesters often encounter difficulties in feeding and delimbing.

Two-grip harvesters are not as capable of working in thinnings where the damage to the remaining trees is to be minimised. Most of the present models are rather big and heavy and competitive only in clear cuttings with a large stem size. The weight of two-grip harvesters varies from 16 to 20 tonnes, and their price is almost 2 million FIM.

In Finland, less than 3% of the multi-function machines sold in 1989 were two-grip harvesters (Metsäkoneiden, 1989). In Sweden, where the proportion of clear-cutting is larger, 34% of cuttings made by forest industry companies in 1987 was done with the machine type in question (Freij and Torsterud, 1988). Their share is, however, diminishing, as can be seen in Fig. 3.

The role of processors in cutting is rapidly getting smaller (Figs. 3 and 4).

Light, farm tractor-mounted cutting units have also developed a lot during recent years. Orginally, farm tractor based logging machinery was simple and designed for the self-employed forest owners. The price of a modern farm tractor based logging machine is around 400,000 FIM. From the economic point of view, purchase of auxiliary equipment such as a boom-mounted one-grip harvester head is feasible only if it can be employed during 8 to 11 months of the year. This presupposes contractor type operation and puts new requirements on the farm tractor (Hakkila, 1989).

In professional cutting the ergonomic level of a farm tractor may be inadequate, though there are some improvements in the latest models. Among the private forest owners, farm tractor based machines have a reputation of being a smaller and lighter alternative to real forest machines, an alternative that is more gentle on the forest. This, however, may not always be the case since in forestry use, a farm tractor, initially meant to be used on a field, is closer to its limits of mobility than a forest machine.

In Denmark and Norway, farm tractor based logging machines are popular. In Finland, most of the processor-type units sold in 1989 were for farm tractors. The trend in new models is towards one-grip harvesters. The reach of the crane is usually limited to 5 to 7m, so a large share of the trees between the strlip roads may have to be felled manually. The productivity is very much dependent on conditions. According to Heikka (1988) the output of some farm tractor-mounted processors varied from 2.1 to 12.2m^3 per effective hour.

Light cutting machines were developed to solve the problems of first thinnings such as, the high cost of manual cutting, strict environmental requirements and the harvesting of light material from Finland's drained peatlands. At first, these machines were rubber-tracked and their weight was around 5 tonnes. Some of the later versions weigh up to 8 tonnes and some have steel tracks or wheels. At present, most of these machines are single-grip harvesters.

In small multi-function machines, the reach of the crane is limited to 6 to 7m, so light harvesters normally have to open an additional passage, a so-called ghost rack, in between the racks to reach all the trees. Thanks to

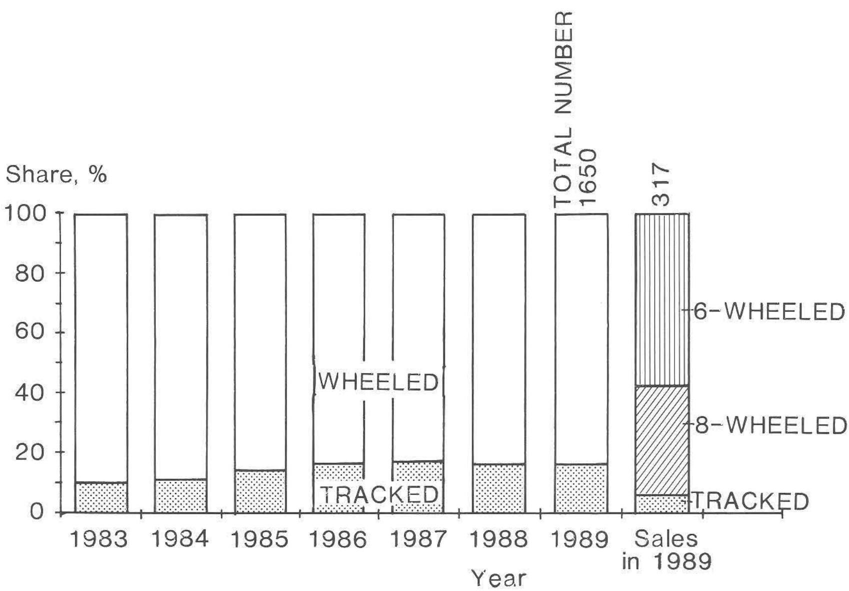

Figure 5: Forwarder fleet in Finland in 1983-89 (excl. machines older than 6 years) and forwarder sales in 1989 (Metsäkoneiden, 1989).

the small dimensions of the machines, the ghost rack can be narrow and winding, thus allowing removal of the lowest possible number of trees.

The price of light harvesters varies from 700,000 to 900,000 FIM. According to Sirén (1989), the smallest harvesters with rubber-tracked base carriers may produce 4 to 5m^3 timber per operating hour under difficult conditions of early thinnings with an average stem size of 0.04m^3. The optimum stem size was found to be between 0.05 and 0.15m^3. In 1989, this machine type accounted for about 9% of the cutting machine sales in Finland (Metsäkoneiden, 1989).

The combination of small size, low mass and rubber track running gear tends to limit the durability of a forest machine. However, when working as harvesters these small machines seem to have better chances to survive. Some organisatorial requirements are set, since these machines can compete with bigger ones only in early thinnings.

2.3 Off-road transportation

The dominating machine in off-road transportation is the wheeled forwarder. The development of forwarders began in the early 1960s in Sweden, and from the Nordic point of view their present level is quite satisfactory in terms of productivity, ergonomics and environmental aspects.

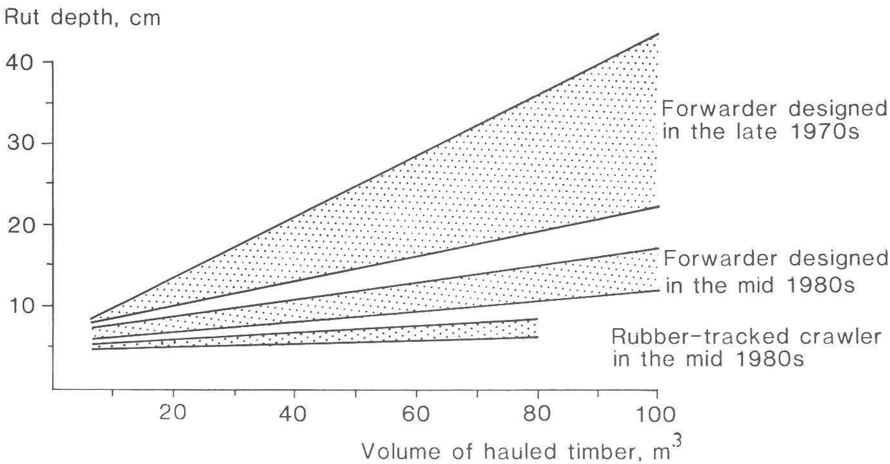

Figure 6: Rutting as a function of hauled timber volume and carrier type in an experiment on soft agricultural peat land (Sirén et. al., 1987).

In Finland, a typical forwarder purchased during the late 80s has six wheels, a net mass and load capacity of 10 to 12 tonnes and a crane reach of 10m. A forwarder of this size class is considered medium-sized. In Sweden, the variety is greater: there are more light and big units and also more eight-wheeled ones. Also in Finland the number of eight-wheeled forwarders is increasing mainly for their better flotation on poorly-bearing soils; about 40% of the forwarders sold in 1989 had eight wheels (Metsäkoneiden, 1989) (Fig. 5).

The weight of the models on the market varies from 8 to 22 tonnes, and prices accordingly vary from 750,000 to 1,500,000 FIM. Depending on the haul distance, terrain, site conditions, type of equipment and the skill of the driver the output in Finland varies generally from 8 to 15m^3 per operating hour, and with 2,000 annual operating hours the output of a medium-sized forwarder is between 15,000 and 20,000m^3 (Hakkila, 1989). In a Finnish follow-up study by Kahala and Kuitto (1986) the average productivity of a mid-sized forwarder was 10.3m^3 per effective machine hour, and the mechanical availability 93%.

On poorly-bearing soils and in snowy conditions the mobility of wheeled forwarders is improved by the use of steel tracks and chains. The state of the stand after mechanised logging is usually very acceptable. In various studies the percentage of damaged trees after cutting and forwarding has been found to be less than 5% and in many cases the size of the machinery did not affect the damage percentage, due to the differences in work methods. In the 1980s special attention was paid to reducing the damage that forwarders cause to the soil, yet a lot still remains to be done (Fig. 6). Some attempts have been made to equip a mid-sized wheeled forwarder with rubber tracks. So far the durability of the tracks has not been satisfactory, although at the moment the new Valmet system is still under investigation.

A farm tractor, when used for off-road haulage, is usually equipped with a bogie trailer. Loading is done with a simple cable-operated boom loader, with a hydraulic crane or, in case of small wood, even manually. A little under 30% of the total annual cut in Finland is delivered to the road side by self-employed forest owners working usually with chainsaw and farm tractor (Örn, 1990). In Denmark and Norway the farm tractor has an important role in off-road transportation.

The mobility and reliability of the best modern four wheel-drive farm tractors are also sufficient for contracting work when equipped with a powered trailer and an hydraulic crane. In permanent contracting the productivity is 6-7m^3 per effective hour for larger units, but considerably less, about 4-5m^3 per effective hour, for smaller ones (Mikkonen, 1984). In temporary operations of self-employed farmers, the productivity is lower. For example, for a unit with an unpowered trailer and a combination of winch and mechanical boom loader, the productivitiy is 2-5m^3 per effective hour over a haulage distance of 200m (Mäkelä, 1987).

Farm tractors are also frequently equipped with a skidding winch, the use of which allows wide spacing of racks. The productivity of skidding stems or logs over a distance of 200m is 1.5-3.0m^3 per effective hour (Ryynänen, 1986; Mäkelä, 1987).

Light tracked forwarders were developed for early thinnings and poorly bearing sites. A common feature of these machines is a rubber track running gear, one model with steel tracks being an exception. These machines have been developed over the years and generally they have grown in size and mass. Their mobility on poorly bearing sites is good and the damage to the soil minimum (Fig. 6). So far, the durability of rubber tracks, especially on mineral soils, has been a problem. Preferably these machines should be used on peatlands. This may be difficult to arrange, since usually the landing sites are located on mineral soils, and thus maybe only a minor part of the haulage is performed on peatland.

The weight of the present models varies from 2 to 8 tonnes, and prices vary accordingly from 200,000 to 500,000 FIM. In the follow-up study by Eeronheimo and Heikka (1987) the productivity of a mid-sized unit in first thinning conditions with easy terrain over a haulage distance of 340m

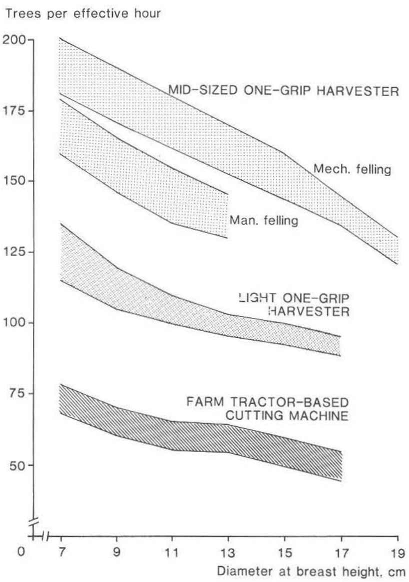

Figure 7: The productivity of different harvester types, pine (Mäkelä 1989a).

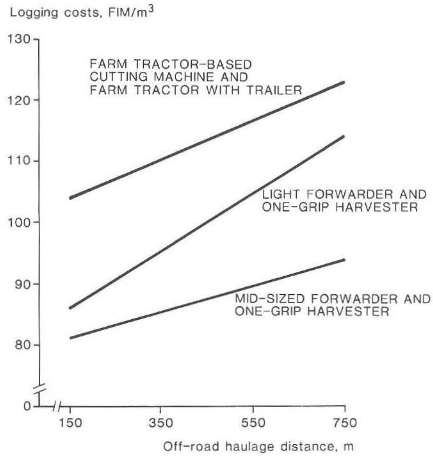

Figure 8: Logging costs of the studied machine combinations (Mäkelä 1989a) (1 FIM=0.16 Irish £).

Table 2: The relative productivity of the studied forwarders (Mäkelä 1989a).

	Relative productivity, %			
Haulage dist., m	Mid-sized forwarder (wheeled)	Light forwarder (tracked)	Light forwarder (wheeled)	Farm tractor
50	100	65-80	85-90	60
350	100	55-65	60-65	60
750	100	50-60	50	60

was 4.1m^3 per effective hour. In 1989, these machines had a 6% share of forwarder sales in Finland.

The tracked mini skidders, which do not carry the operator, were aimed for the use of the self-employed forest owner. In Sweden, they have had some commercial success, but in Finland, not more than 250 units have been sold to date, of which only 20 or 30 are used at least partly in logging. The average load size in first thinnings is about 0.5m^3 and productivity between 0.5 and 1.1m^3 per effective hour (Ryynänen, 1990).

3. Some Recent Studies of Mechanised Logging

3.1 Early thinning in pine and spruce stands

Mäkelä (1989a, 1989b) conducted a series of studies to determine the technical and economical feasibility of different harvesters and forwarders in first thinning pine and spruce stands.

In the pine stands, the machinery studied can be divided into three groups consisting of (1) mid-sized machines: five different wheeled, single-grip harvesters and two wheeled forwarders, (2) light machines: three tracked, single-grip harvesters (1 steel-tracked, 2 rubber-tracked), and three light forwarders (steel-tracked, rubber-tracked, wheeled) and (3) farm tractor-mounted processor with felling head or alternatively with trailer.

The average density of the stands was 1,780 stems per ha, the number of trees to be removed 580 per ha and the average size of thinnings 0.05m^3. Rack distance was 30m for group 1, 15m for group 2 and 25m for group 3. For groups 1 and 3 the trees outside the reach of the machine were felled manually. Main study results are presented in Figs. 7 and 8, and in Table 2.

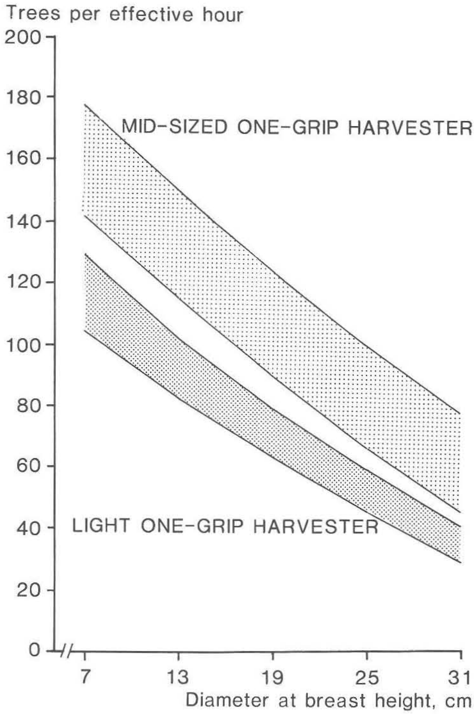

Figure 9: The productivity of different harvester types, spruce (Mäkelä 1989b).

In the spruce stands, the machine groups were: (1) mid-sized machines: four different wheeled single-grip harvesters and two wheeled forwarders and (2) light machines: three tracked harvesters (1 steel, 2 rubber) and two tracked forwarders (1 steel, 1 rubber).

The average density of the stands varied from 1,100 to 1,800 stems per ha, the number of trees to be removed from 400 to 900 per ha, and the average size of thinnings from 0.13 to 0.24m^3. Rack spacing was 20m for group 1 and 30m for group 2. No trees were felled manually, since the light harvesters used additional racks. Main study results are presented in Figs. 9, 10 and 11.

The percentage of damaged trees was low for all machine combinations in both pine and spruce stands, 3.7% in the worst case.

Brunberg and Nilsson (1988) studied the FMG 0470 harvester, a wheeled machine weighing 4.6 tonnes and able to operate on ghost racks in early thinnings. Productivity was found to be strongly dependent on the difficulty of the terrain and properties of the stand. In the ecological sense the harvesting result was good, yet in the difficult terrain, the amount of damage to the remaining trees tended to increase. Only in early thinnings with easy

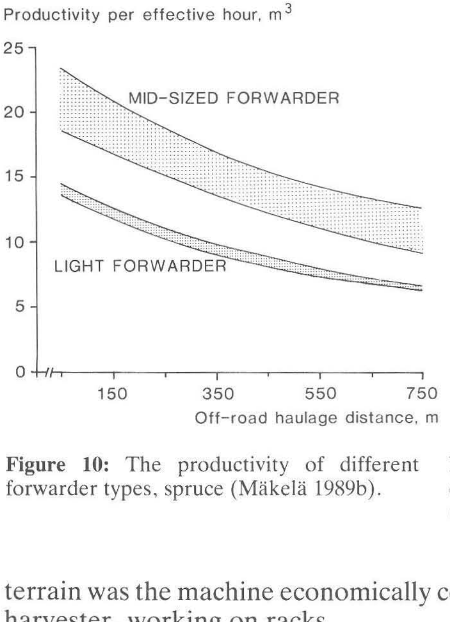

Figure 10: The productivity of different forwarder types, spruce (Mäkelä 1989b).

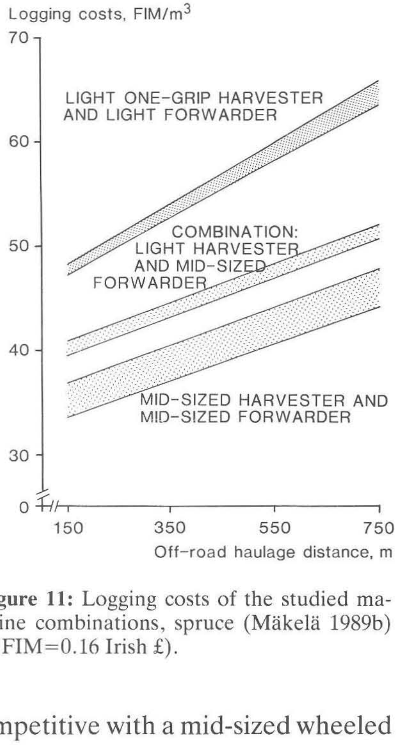

Figure 11: Logging costs of the studied machine combinations, spruce (Mäkelä 1989b) (1 FIM=0.16 Irish £).

terrain was the machine economically competitive with a mid-sized wheeled harvester, working on racks.

3.2 Multi-tree processing with cutting machines

Processing more than one tree at a time is an attractive possibility in early thinnings, where the tree size is small and a large share of the cycle time is spent on other work phases than delimbing and bucking, resulting in low productivity. To do multi-tree processing a harvester must be able to activate the feeding rollers and delimbing knives independently, so that a new tree can be grabbed and felled while the others are held between the rollers. If a processor is used for multi-tree processing, the trees are felled into piles beforehand.

As an example of the results of the various studies, the dependence of cycle time of a Valmet 892/955 harvester (Brunberg et. al., 1989) and the dependence of productivity of a Pika 45 processor (Lilleberg, 1987) on the number of trees processed at a time is presented in Figs. 12 and 13.

Generally, the trees to be processed at the same time should preferably be

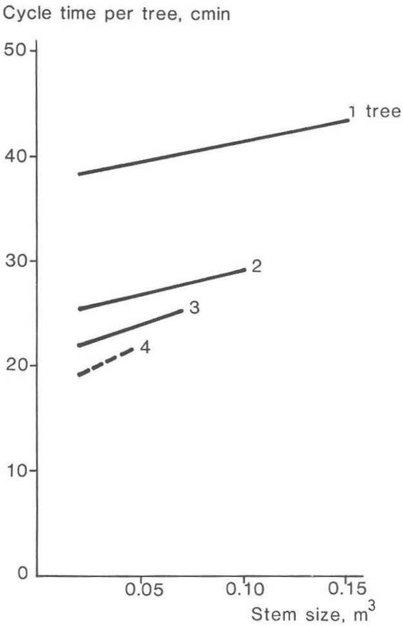

Figure 12: Cycle time per tree in multi-tree processing with Valmet 892/955 harvester (Brunberg, et. al. 1989).

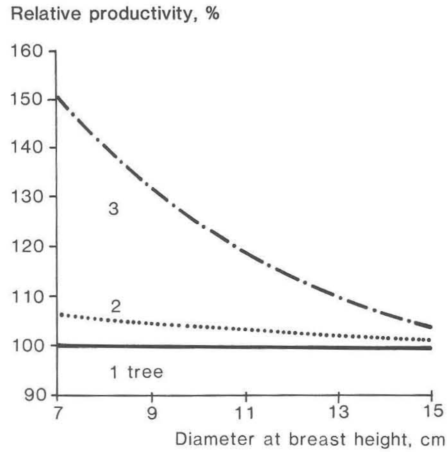

Figure 13: Productivity of Pika 45 processor in multi-tree processing (based on data of Lilleberg, 1987).

similar in terms of branchiness and size. The quality of delimbing is naturally lower than normally obtained, yet usually good enough.

Designing the feeding and delimbing devices especially for multi-tree processing will improve the results.

3.3 A combined harvester/forwarder

In the combined harvester/forwarder concept the same base machine is used for both harvesting and forwarding. The idea is to cut down machine transferring costs, when the individual stands to be harvested are small and the distances between the stands long. There are two variations of the theme. In the first, some machine elements, for example the grapple and the harvesting head, are interchangeable, and some are stripped off when not needed. The second alternative is to design the machine so that it can be used for both tasks without any modifications.

Lilleberg (1988) studied the Ponsse combine unit based on a standard forwarder chassis with interchangeable grapple/harvesting head and removable stakes. The productivity was 10-21% lower than the productivity of the standard single-grip harvester from the same manufacturer. This was due to the shorter reach of the crane and a limited working sector.

According to Andersson (1989) the productivity of the combine machine FMG 250 forwarder with IW-35 harvesting head, which is capable of doing both harvesting and forwarding without modifications, was 20-25% lower, than that of a conventional single-grip harvester. With a 15km distance between each stand, the cost of logging per m^3 was lower with the combine machine than with a single-grip harvester plus a forwarder, if volume removal was less than 125m^3. With the distance of 5 and 25km, the breakeven point was respectively 100 and 150m^3.

Valmet has recently introduced a combine machine, which can be equipped with a grapple saw or a harvesting head. The machine has a rotating cab and no modifications are needed when changing the type of work.

4. Future trends in harvesting

In the near future early thinnings with low productivity in mechanised harvesting and high costs in motor-manual harvesting will be the main question to be solved in the field of harvesting. The development of light machinery and multi-tree processing technology is therefore likely to take a remarkable step forward.

The present increasing trend in the degree of mechanisation will continue. Future harvesters will be more reliable, better suited for their task, easier to operate and more automated. Modern electronics and data based systems offer interesting possibilities. Concrete examples, which may be reality in the near future, are the single-lever to control the movement of the boom tip along straight lines in the horizontal and vertical planes (Löfgren, 1989), and go-home functions of the boom. The timber scaling devices of cutting machines are undergoing a rapid development and in Finland the measuring of timber will probably soon be largely based on them.

Environmental aspects also have a strong influence in machine development. The design of present-day forwarders are still based on very conservative concepts, although in the average site conditions in the Nordic countries they are environmentally very acceptable.

Bruun recently introduced a forwarder with steerable wheels on the front axle of the front bogie and on the rear axle of the rear bogie. The design reduces turning radius, and soil shear and motion resistance in curves. It is quite possible, that the future forwarders will have individual slip and torque control and active suspension of each wheel, and in addition to articulated frame-steering, the wheels will be steered in relation to the frames.

Unconventional vehicle running gear designs, such as the pneumatic mattress track (PMT) (Burmeister, 1989), would facilitate almost damage-free harvesting, as far as damage caused by the running gear is concerned. The PMT vehicle runs on tracks consisting of air-filled fabric bags joined one after another. The bags are pressurised only under the vehicle, which enables the track to "swallow" obstacles. Also, the application of light-weight structures could give interesting possibilities in developing forest machinery.

As a whole, the technology of harvesting certainly is far from the final stage of development, if anything like that even exists. The forest is, however, a harsh environment, so the machinery, besides being technically advanced, must, as well, be robust. This still today, tends to clip the wings of the wildest ideas.

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Effects of Drainage Intensity and Planting Position on the Growth and Nutrition of Second Rotation Sitka Spruce on Shallow Peat

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Summary

Results are presented from a restocking experiment on shallow peat investigating the effects of intensity of drainage and planting position on growth and foliar nutrient levels of Sitka spruce *(Picea sitchensis (Bong.) Carr.)*. The previous crop of Sitka spruce had been felled prematurely after 36 years. Growth was significantly enhanced by drainage at 10m and 5m intervals, compared to an undrained control treatment, and by planting on mounds of spoil compared with planting directly into uncultivated soil. Foliar nitrogen concentration was significantly lower in undrained plots 16 years after planting. The physical or nutritional condition of the peat does not appear to have improved by the first rotation crop.

1. Introduction

Soils with an organic surface horizon comprise 64% of the total area (approximately 58,000 ha) afforested by the Northern Ireland Forest Service. Organic soils include peaty gleys, with 5-50cm of organic matter overlaying gleyed mineral material, shallow peats, with 50cm-1m of organic matter, and deep peats, with more than 1m of organic matter. Three-quarters of forests in this category are less than 30 years old. Consequently although the area of felling and replanting of these soil types is small at present, it will increase substantially in the coming decades (Savill and McEwen, 1978).

This paper presents results from an experiment which was laid down following clearfelling in Cam Forest, Co. Londonderry, in 1972. The object was to investigate the effects of drainage at different intensities, and mounding, before replanting on the growth of Sitka spruce on shallow peat. The previous crop of Sitka spruce, which was planted in 1936 on hand spaced turves, was growing more slowly in the experimental site than in other parts of the compartment where the peat layer was less deep; it was felled prematurely with the rest of the compartment.

2. **Site and Experimental Layout**

The experiment was laid down on a gently sloping site at an elevation of 250m. Mean annual rainfall (1941-1970) is 1200mm per annum. The experiment occupies a small area of shallow peat, overlying a gleyed soil derived from fine textured basaltic glacial till. The area was planted with Sitka spruce transplants of QCI origin.

The following experimental treatments were applied to plots of 0.16 ha in spring 1972:

1. Existing drains at 40m spacing cleaned out, with trees planted directly into uncultivated soil at 2.0m spacing.

2. Drains 1m deep installed by tracked excavator at 10m spacing, with spoil placed beside drains. Four rows of trees were directly planted between drains, avoiding the spoil taken from drains, resulting in an average spacing of 2.2m.

3. As above, but with trees planted on heaps of spoil placed in between drains (mound planting).

4. Drains installed at approximately 5m spacing, with 2 rows of trees planted between drains on heaps of spoil, resulting in an average spacing of 2.4m.

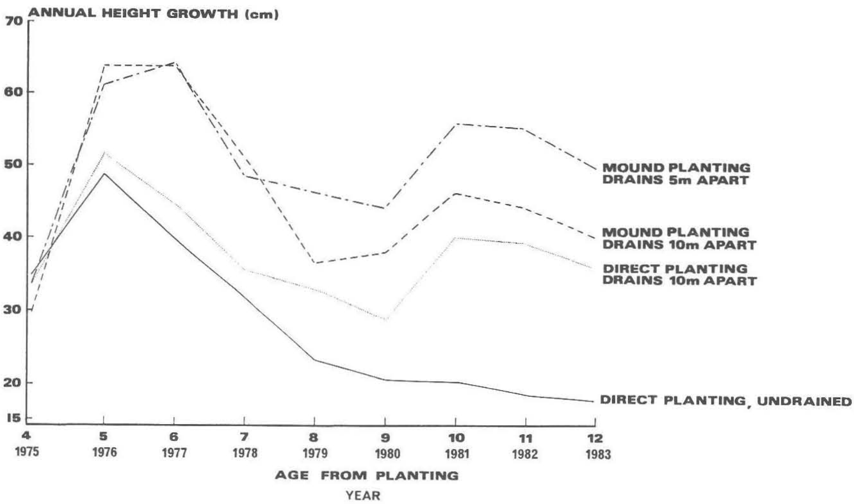

Figure 1: Effect of Planting Position & Drainage Intensity on Height Growth.

Table 1: Relative effects of planting position and drainage intensity on height growth.

Treatment	Mean annual height growth (cm) 1976-1979	1980-1983	Mean height in 1983 (m)
Direct planting	41	36	4.3
Mound planting	53	42	5.0
Planting beside drains	45	39	4.5
Planting between drains	49	39	4.8
Standard error of means:			
Planting position	2.6**	1.2**	0.16*
Proximity to drain	2.6 NS	1.2NS	0.16 NS
Mounds and drains interaction	3.7 NS	1.6 NS	0.22 NS

***, **, * significant at the 0.1%, 1% and 5% level respectively.
NS – non significant.

The treatments were replicated in three randomised blocks. There was no application of fertiliser at time of replanting or subsequently.

3. **Assessments and Results**

Annual height growth was assessed from 1972 until 1983 in rectangular plots containing 24 trees (6 x 4) within each treatment plot. In 1987 and 1988 the diameter at breast height (DBH) of trees in measurement plots and dominant height (the mean height of the five largest DBH stems per plot) were recorded; plot areas were measured and basal area per hectare determined. Top whorl foliage was sampled and analysed for major plant nutrient concentrations in 1981, 1983 and 1987.

3.1 Effects of treatment on tree growth

Annual height growth of trees 4 to 12 years from planting in each treatment is shown in figure 1. Growth was significantly increased by additional drainage and providing a raised planting position; growth differences between the treatments were statistically significant (at $p=0.001$) from year 6 (1977) onwards. The initial growth response is clearly related to planting on mounds of spoil; subsequently growth in undrained plots declines steadily while in drained plots it is maintained. From year 9 (1980) onwards significant differences (at $p=0.05$) in annual height growth between drained plots are apparent, with growth increasing with intensity of drainage. The

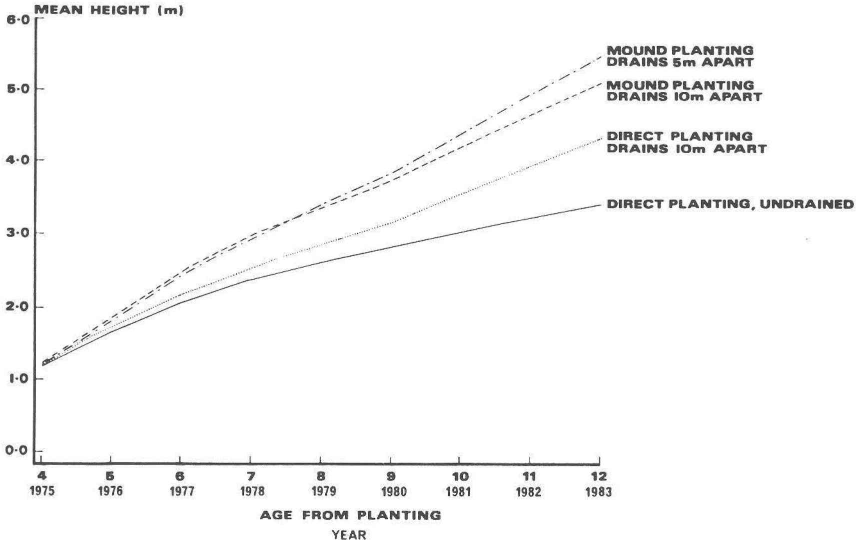

Figure 2: Effect of Planting Position & Drainage Intensity on Mean Height.

annual variation in growth in drained plots may be ascribed to fluctuations in climate and, possibly, aphid defoliation.

The effect of treatment on mean height up to year 12 (1983) is shown in figure 2. From 1980 growth of trees in each treatment appears to be represented by a different curve, reflecting consistent differences in growth response between the experimental treatments.

The relative effects of proximity to drains and planting position were investigated in plots which had drains installed at 10m intervals, and are shown in Table 1. Growth of the 12 trees growing beside drains on the outside rows of measurement plots was compared with growth of the 12 trees growing on the inside rows. Mound planting significantly increased mean annual height growth, compared with direct planting. Irrespective of planting position, planting beside drains had a slightly depressing effect on growth compared to planting between drains, although it was not statistically significant. This suggests that the effects of providing a raised planting position were initially more important for tree growth than locally intensive drainage. The interactions between planting position and proximity to drains were not significant.

Assessment of height and basal area 17 years from planting (i.e. at the end of the 1988 growing season) showed that differences accruing from drainage and raised planting were maintained (Table 2). Basal area does

Table 2: Effects of treatment on dominant height and basal area 17 years from planting (1988) and increment 1987-88.

Treatment	Dominant height (m)		Basal area m^2/ha	
	1988	Increment 1987-88	1988	Increment 1987-88
Direct planting, no drains	6.5	0.27	12.4	1.05
Direct planting, drains at 10m	7.7	0.37	17.0	1.23
Mound planting, drains at 10m	8.5	0.37	23.4	2.12
Mound planting, drains at 5m	9.3	0.53	26.5	2.44
Standard error of means	0.25***	0.14 NS	2.47*	0.23*

not fully represent the growth response to the imposed treatments because of differences in initial spacing between treatments. However, basal area in the undrained treatment is less than half of that in the most effective treatment (planting on mounds between drains at 5m intervals). The same is true for dominant height and basal area increment 1987-88.

3.2 Effect of treatment on foliar nutrient concentration

The effects of treatment on the concentration of N, P and K in top whorl foliage at the end of the 1981, 1983 and 1987 growing seasons are shown in Table 3. In 1981 values of P and K were marginally deficient in all treatments and foliar N concentrations were very low, ranging from 0.76% DM in the undrained direct planted treatment to 1.07% DM where the trees had been planted on mounds in the plots drained at 10m intervals. By 1983 when canopy had closed, the concentrations of N and P had increased slightly but K values remained virtually unchanged. Treatment had no significant effect on nutrient concentration in either year. By 1987, foliar K concentrations were very low in all treatments but were not significantly affected by treatment. Foliar P concentration ranged from 0.12% DM in the undrained direct planted treatment to 0.15% DM in the most intensively drained treatment, but treatment differences were not statistically significant. There was a significant effect of treatment on foliar N concentration in 1987; values ranged from a deficient 1.04% DM in the direct planted control plots to 1.24% DM in the direct planted plots drained at 10m spacing and to a more satisfactory value of 1.55% N in the most intensively drained, mound planted treatment. The concentrations of

Table 3: Effect of drainage and planting position on foliar N, P & K concentrations in 1981, 1983 and 1987.

Treatment	Foliar nutrient concentration % dry matter								
	1981			1983			1987		
	N	P	K	N	P	K	N	P	K
Minimal drainage, direct planting	0.76	0.12	0.52	1.25	0.14	0.47	1.04	0.12	0.39
Drains at 10m intervals direct planting	1.03	0.12	0.44	1.18	0.14	0.44	1.24	0.13	0.39
Drains at 10m intervals mound planting	1.07	0.11	0.51	1.34	0.15	0.50	1.28	0.14	0.42
Drains at 5m intervals mound planting	1.01	0.13	0.47	1.44	0.13	0.49	1.55	0.15	0.41
Standard error of means	0.071	0.010	0.041	0.080	0.012	0.045	0.087	0.016	0.040
Significance	NS	NS	NS	NS	NS	NS	*	NS	NS

Ca, Mg, Fe and Mn were determined only in the 1987 samples. The values of these elements were in the "normal" range and were not significantly affected by treatment; they are not reported.

4. Discussion

The range of options for cultivating a clear felled (or windblown) site prior to restocking is limited by (a) cost, (b) the presence of stumps and roots of the previous crop and (c) the presence of harvesting debris (brash) on the ground. Until recently in Northern Ireland, ground preparation for restocking on deep or shallow peat sites has been restricted to cleaning out existing main drains with an excavator and planting directly into the peat. Most of these plantations already restocked were originally planted on hand spaced turves and the intensity of main drains was generally high. With the introduction of open ploughing for planting during the 1950s there was a tendency to instal fewer main drains. In both cases there is uncertainty as to whether simply restoring the original drainage system will provide adequate drainage for the second rotation crop. The present experiment was designed to address this uncertainty in the case of older crops established without the advantages and disadvantages of deep ploughing.

In large measure it appears that simply restoring the original drainage system will not provide conditions conducive to satisfactory growth of the next crop. At age 17, the top height of the directly planted crop with drains cleaned out at the original 40m spacing corresponds to general yield class 12 (Hamilton and Christie, 1971). Increasing the drain intensity to 10m spacing increases the indicated yield class to 16. Planting on mounds between 10m and 5m spaced drains further increases the indicated yield class to 18 and 20 respectively. Assessment of basal area indicates that the growth differences between the experimental treatments are even greater than shown by top height assessment. Comparison of current basal areas in treatment plots with yield models for unthinned Sitka spruce (Edwards and Christie, 1981) at the appropriate planting spacing shows that the local yield classes corresponding with the general yield classes of 12, 16, 18 and 20 are, respectively, 6-8, 12, 14-16 and 20. This reflects uneven establishment and growth in direct planted treatments. If these differences are maintained until maturity the financial implications are obvious (Busby and Grayson, 1981).

The original crop did not receive any fertiliser at planting in 1936. It could be argued that growth of the second rotation in the experiment would have benefited from the application of fertiliser. This is borne out by the result of the foliar analysis presented in Table 3; 10 years after planting (1981) levels of N and particularly P in the foliage from all treatments were below the deficiency level suggested by Binns et. al. (1980). Potassium bordered on the deficiency level. Foliar nutrient levels had increased slightly by 1983 but treatment did not significantly affect values and all were below the optimal levels quoted by Binns et. al. (op. cit.). Treatment significantly increased foliar N concentration in 1987, with values ranging from 1.04% DM in the direct planted undrained treatment to 1.55% DM in the most intensively drained and mound planted treatment. This difference is almost certainly caused by an increase in the rate of mineralisation of the soil organic matter. Although the effect is not statistically significant, there also appears to have been increased mineralisation of P in the closely drained treatment, where foliar P concentration is 0.15% DM compared with 0.12% DM in the undrained treatment. If this increase in mineralisation is maintained it would be expected that relative growth differences will be maintained or increased.

Unfortunately it is not possible to assess separately the effects of drainage, and the spreading of spoil as a result of drainage operations, on growth and nutrient uptake. Digging drains at 5m compared with 10m intervals doubles the volume of additional material available for exploitation by tree roots, even though the mounds provided for planting may have been of similar size. Indeed, Fig. 1 shows that the initial growth response to raised planting is similar at either drain spacing. It is possible that the increased intensity of drainage has lowered the water table within plots, increasing the volume of soil available to roots, and giving deeper roots a greater chance of surviving each winter. This would reduce the annual demand placed on trees in replacing root biomass allowing greater above ground increment. Experiments investigating the effects of drain spacing and depth on deep peat in the first rotation in Northern Ireland show that growth responses to drainage are slow to become apparent. In many of the experiments, which were laid down between 1964 and 1968, the response is now striking. Earlier work (Savill et. al., 1974) suggested that early responses were predominantly brought about by increased nitrogen availability in the peat spread above the original ground surface from drains. This implies that the presence of spoil has a greater effect on growth than drainage intensity per se. However, in practice, the relative effects of spoil addition and drainage intensity are inseparable since there is a direct relationship between the two.

The most effective treatment in terms of growth increment involved digging 1m deep drains at 5m spacing and planting in the resultant spoil. However this treatment has distinct practical disadvantages. Apart from economic considerations, such a system would create immense difficulties for harvesting and any other operations within the crop. Drainage at 10m intervals and planting on the spread mounds is a commercially feasible operation. In this treatment the trees are currently (age 17) growing at a rate corresponding to yield class 18. This represents a considerable improvement compared with the average yield class of 14 of Sitka spruce on similar sites in Co. Londonderry (Schaible and Kilpatrick, 1989). Spacing drains more widely than 10m would have the practical advantages of allowing more regular plant spacing and facilitating later harvesting operations. Since growth response is positively related to drain spacing these advantages would have to be weighed against a probable decrease in production.

Growth in the undrained, directly planted treatment is probably no better than in the previous rotation. This suggests that the first rotation crop has caused no irreversible changes in the physical or nutritional nature of the peat on which it was growing. Although no details of the previous crop are available, the trees were 36 years old when felled and examination of the remaining stumps indicated that the crop was at least moderately vigorous. Examination of the peat has not revealed any 'cracking' and subsequent irreversible drying of the kind reported in pseudofibrous peat under lodgepole pine in Northern Scotland and elseqhere by Pyatt (1987). Whether this is because of differences in species, climate or type of peat is not known.

The results of this experiment have shown that intensive drainage and planting on mounds at restocking on a shallow peat site allows successful establishment and good growth of Sitka spruce at least over the first 17 years of the rotation. In view of the apparent increase in the rate of N (and possibly P) mineralisation, the prospects for future growth are encouraging, even though height increment in the current year (1989) has been poorer than predicted. This may be connected with a severe aphid infestation in the previous 2 years.

Acknowledgements

The foresight of W. T. Wilson and P. S. Savill in initiating this experiment is acknowledged. The authors also wish to acknowledge the efforts of S. A. Mawhinney, R. T. Matthews and D. S. Ridge, who made the growth assessments and collected foliar samples.

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Forestry, the 1990s and Beyond

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Summary

The creation of large-scale conifer plantations by both public and private forestry organisations has attracted much public criticism during the past decade.

Foresters should seek to improve their image and actively influence the forestry debate so that commercial forestry may be seen as contributing a positive role to countryside conservation.

Introduction

The year 1992 is likely to hold some significance in the lives of inhabitants of the European Community and may serve to concentrate the mind on future pathways for us all. What should the forester expect of the 90s and beyond? How will his work, lifestyle and expectations require to be adjusted in order to cope with a world that has become super-sensitive to environmental issues and to satisfy a public that paradoxically, are critical of our man-made forests, yet concerned at the lack of Ireland's tree cover?

The Forestry Industry

Because of its long-term growth pattern, forestry is exposed to many changes both in public attitudes and values during the course of a single crop rotation. Past failures may be viewed as successes in the future, as each generation of people come to regard themselves as being more enlightened than their predecessors. Unfortunately management decisions have often to be made in the light of short-term expediency, sometimes as a reaction to prevailing political forces or strong attacks by pressure groups. Current concern with the conservation of our environment is a typical example and just one of the forces acting on the industry at the present time. Forestry, therefore, is constantly under review, influenced perhaps too frequently by the all-powerful media, creating a chain reaction of public opinion and eventual governmental decision-making. One thing seems certain, however – the production of timber is likely to remain a priority and the North American Sitka spruce the main provider of raw material for the steadily expanding sawmilling and wood processing industries.

IRISH FORESTRY, 1990, Vol. 47 (1): 28-31

The fundamental issue of the 21st century is more likely to be how we go about the job of timber growing rather than whether we should not afforest land. Public discussion and eventual governmental decision-making are likely to continue to be media dominated. It behoves our industry, therefore to get its act together, presenting a package of multiple land use, embracing recreation, conservation, sport, all the many compatible uses of land while it is growing a timber crop in an environmentally sensitive manner. None of the minority uses need be seen to detract in any way from the fundamental objective of growing wood. Forestry during the next century and in the last decade of the present one must be accepted for its social value in addition to its commercial role if it is not to be sacrificed on the altar of public opinion.

Presenting an image

The average citizen of the British Isles is largely uninformed and perhaps uninterested in forestry as we know it. They seldom have had the opportunity of seeing, let alone comprehending, what takes place within the forest gate. Tales of mega-millionaires salting away surplus money in the Flow Country of Caithness and of blanket bogs in Ireland being afforested in the interests of personal and corporate gain, do little to enhance our image. Foresters must first of all believe in the social and environmental value of their forests, move away from defensive positions and adopt a pro-active strategy to combat a poor public conception. They should seek to become identified with good environmental management and not its destruction.

All, however, is not gloom in our industry. There has been much good publicity from our forest parks, forest nature reserves and wildlife. Unfortunately, these aspects are not necessarily linked with commercial timber production in peoples' minds. They are seen as functions in their own right and it is not immediately obvious that they are entirely dependent upon the forest for their existence. The public image that we must seek to project is one of a vibrant, broadly-based industry that may be sub-divided into many functions, yet retains the fundamental purpose of wood production. The "march of the conifers" and the "coniferisation" of our hillsides must be seen to be an enhancement of the environment and a positive social asset by ensuring on the one hand, that we carry out sound plantation design principles and on the other hand seek to inform, consult and co-operate with our potential critics. The media will not be found wanting in this respect, it will largely be our own fault if we do not get to their door first with our good news.

The Forester

Foresters tend to be an introverted race of people. Their everyday work is specialised, its location isolated and their efforts not always understood by the layman. Dealing with the successes and failures of a past generation of colleagues and creating forests of the future requires a special mixture of dedication, faith, tenacity and unlimited patience with a general public who have suddenly become ecologists! Exhorted to replace the trees consumed during the war years, the forester set to with skill and dedication. Today, he views his creations of the 50s with some degree of pride as the forests begin to feed the increasingly hungry wood factories. To his consternation, however, in the light of current public opinion he is being censured for having produced ecological deserts, blots on the landscape, acidifying watercourses and is being viewed as some sort of environmental pariah!

The forester of the 90s and beyond must actively seek to broaden the forestry debate on a local basis. He has a number of important weapons at his disposal – locally he is seen as a landlord, an employer of people and a manger of resources. In addition to his silvicultural skills he must add those of the public relations arena. Communities must be involved in decision-making and communications constantly maintained with the formulators of opinion. A two-way flow of information will result in better forests, fulfilling local needs and a better understanding of what timber growing entails and the problem that it has to face. Forestry has become a multiple land use, the forester must react accordingly and adjust his profile from that of backroom boffin to one of public benefactor. The volume of timber production is unlikely to be reduced as a result and let's face it, life might just be that more interesting!

Some suggestions for image enhancement

1. Get to know the editor and staff of the local newspaper(s). Journalists welcome suggestions, particularly of a "green" nature and ideas discussed over a pint or a cup of coffee will invariably be rewarding.

2. Presenters of wildlife and countryside programmes on radio and television are delighted to receive suggestions for potential features. It makes their work easier and personal contact will open many doors.

3. Become a member of the local Naturalist Society or Field Club. These groups have great influence both locally and nationally. Membership allows a two-way flow of information and many a potential confrontation may be settled "in house" free from the glare of media attention.

4. Maintain a close liaison with the staff of local schools. They will always require material for nature tables, forest walks and assistance with projects. It is time-consuming but rewarding in the long-term.

The day of the forest classroom has arrived and as yet teachers lack confidence in its interpretation. Assistance will always be much appreciated.

5. Accept every opportunity of speaking to local organisations such as Young Farmers' Clubs, Rotary, Round Table and Farming discussion groups.

When doing so remember some important points:

Avoid, speaking in forestry jargon. P. Years, P.B.R., provenances and re-spacing may convey little or nothing to the layman.

Never, underestimate one's audience. Be sure of facts and if possible do some research into who may be present. The little old lady in the corner or the grey-haired gentleman dozing in the back row may either or both hold Ph.Ds in ecology.

Never, talk "down" to an audience from an assumed position of superior knowledge. An overtly superior approach is the hallmark of a fool and encourages audience hostility.

Lastly, in a confrontation situation, the Willow is invariably less prone to windthrow than the Oak.!

PUBLIC INVOLVEMENT: Forest District Conservation Committee meeting in action, Co. Down, 1989. Representatives of voluntary, statutory and local countryside interests meet to advise forest management.

A Bog Flow at Bellacorrick Forest, Co. Mayo

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Summary

A bog flow occurred in mid-July, 1988 at Sheskin property, Bellacorrick forest which affected an area of 2.4ha of blanket peat planted with lodgepole pine. Over much of the area the bog was completely removed down to a basal, greasy peat layer. The lower, softer layers flowed over this material and carried the upper, firmer layers downslope. This pattern is very similar to other bog flows which have occurred in the same region.

It is suggested that the exceptional weather of May, June and July contributed to the flow together with the lack of collector drains which left the peat soft and saturated. These factors, together with a topography which predisposed the bog to movement, initiated the flow.

Collector drains placed at sufficient depth and intensity should be sufficient to prevent similar occurrences.

Keywords: Bog flow, blanket peat, ploughing, peat strength.

1. BACKGROUND

Bog flows and slides have been recorded on a number of occasions in Britain and Ireland (Carling, 1986; Tomlinson, 1981). Bog flows refer to slides where peat from lower, softer layers becomes semi-liquid and flows out from under the overlying firmer, less humified top layer. Bog slides occur where intact blocks of peat move down slope with no outflowing of softer peat. Both types have been recorded in Ireland (Tomlinson and Gardiner, 1982).

The most widely known bog flow in Ireland occurred on the 29th December 1896 near Killarney, Co. Kerry (Praeger and Sollas, 1897) and resulted in large scale damage.

Bog flows have been recorded in North-West Mayo on a number of occasions. In 1931 a flow occurred at Glencullin near Glenturk (Delap et al., 1932) which resulted in some damage to property and loss of livestock. More recently, in 1985, a flow occurred at a site 8 miles east of Belmullet which caused damage to a county road (Shevlin, 1988). Both flows occurred on unplanted ground. Other flows have very likely occurred

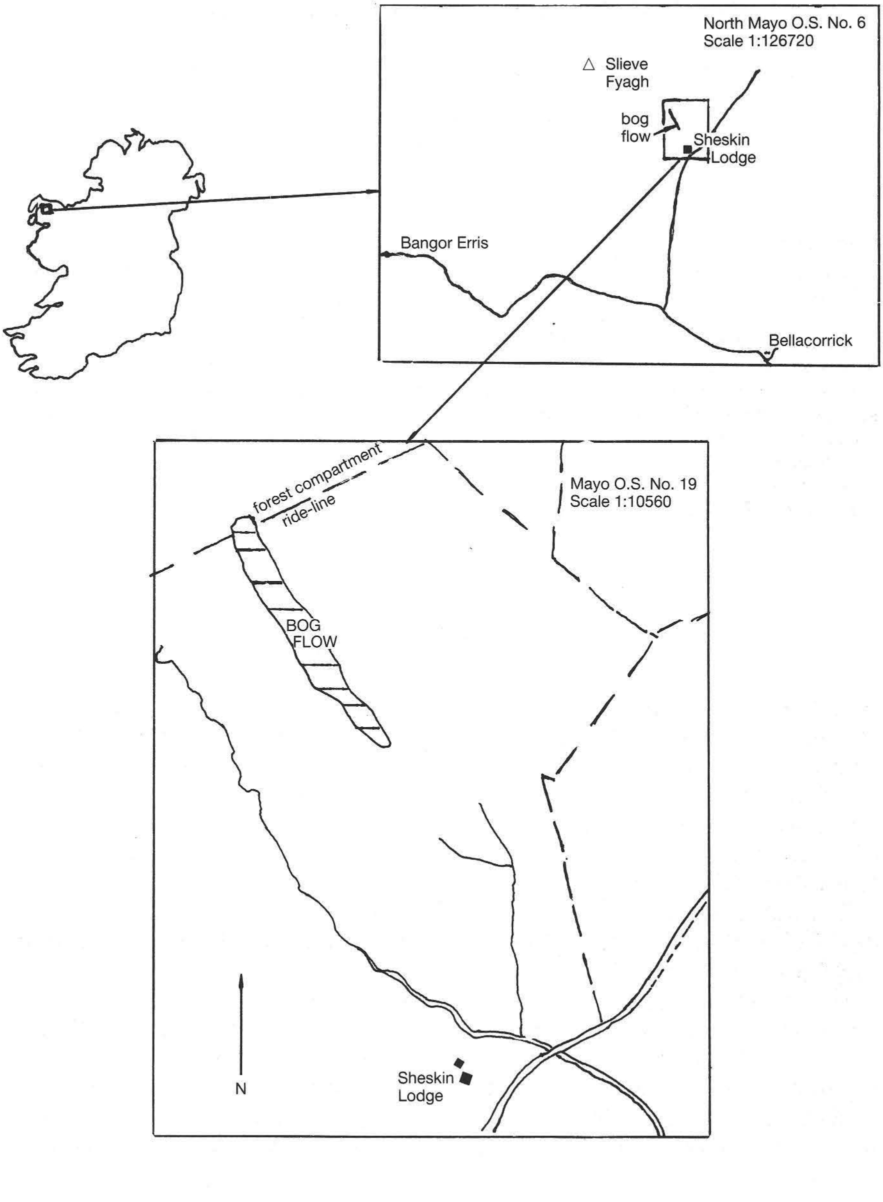

Figure 1: Flow location and extent

in the years between the two recorded. Two further flows have occurred on lands owned by Coillte Teoranta in the same region in recent years. One was at Glenlossera property, Ballycastle forest in December 1986 and the other at Sheskin property, Bellacorrick forest in July 1988. This paper refers to the latter event.

2. SITE

2.1 Location:

The bog flow occurred at Sheskin property, Bellacorrick forest about 1200 m north-east of Sheskin Lodge (national grid reference F 94 27). While it was largely confined to compartment 81617U, a small portion of the head extended into compartment 81614M (Figure 1).

2.2 Extent

The flow extended for 340 and 270 m above and below the forest road as shown in Figure 1. It had an average width of 45 m and altogether an area of about 2.4 ha was affected (Figure 2).

2.3 Topography:

The site slopes to the south-east at an angle of 3°, apart from two discontinuities where the slope increases to 7° (Figure 3). A 1500 to 2000 mm deep layer of blanket peat covered the site before the flow (Figure 4). The basal peat layer is about 100 mm thick and is firm and greasy.

Figure 2: General view of the flow area, looking southeastwards from the head of the flow.

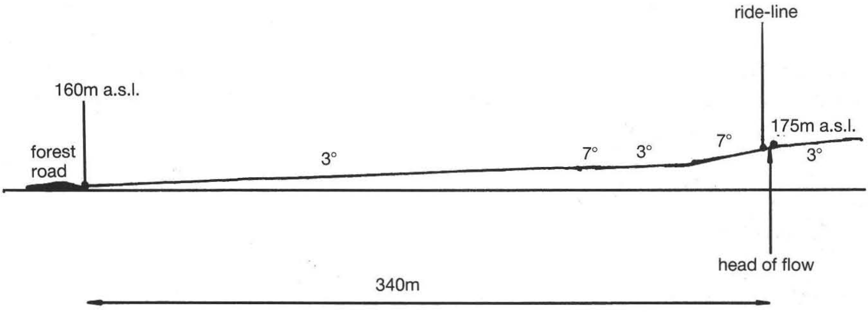

Figure 3: Diagrammatic cross section of area of flow *above* forest road.

2.4 Establishment methods, crop and vegetation:

Tunnel ploughing, running in the direction of maximum slope, was used in compartment 81617U where most of the flow occurred, which was planted in 1980. Double mouldboard ploughing (DMB), running in the same direction, was used in compartment 81614M, which was planted in 1982 (Figure 6). The bottom of the tunnels are from 80-90 cm deep.

Figure 4: Peat depth about 1.7m (near forest road) – rod is 1.5m high and is resting on bog floor.

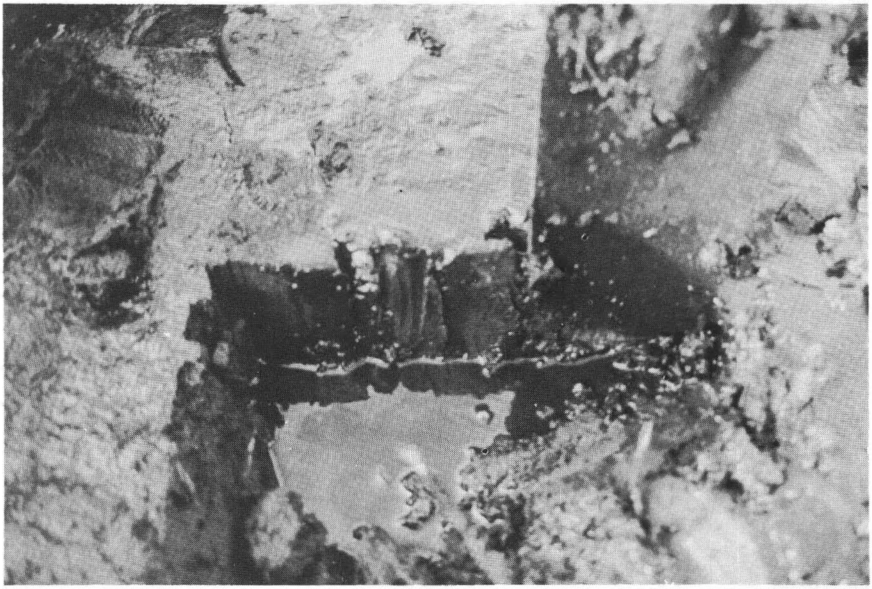

Figure 5: Basal 'greasy' peat layer over which flow moved (about 100mm deep), the object at the top right is a spade.

Both compartments were planted with lodgepole pine which had reached a height of about 2.5 m. The vegetation consisted of a dense sward of *Molinia caerulea.*

3. FLOW DESCRIPTION

The flow occurred sometime between the 15th and 22nd of July 1988. The head of the flow is located in compartment 81614M. As the head of the flow is almost always the point of initiation (Rodgers, 1988), it can be reasonably concluded that the flow began at this point and continued downslope. At the head of the flow lateral and longitudinal tears can be seen in the double mouldboard furrow bottoms (Figure 7). The head of the flow coincides with the 40m long break in slope shown in Figure 3.

As the peat moved down slope the more amorphous, less cohesive peat below a depth of 600-700 mm flowed out from under the fibrous top layer, which broke into large blocks from 500 to 3000mm in diameter. The flow continued downslope to the forest road where its momentum must have been checked as the affected area below the road is depositional only and no peat has been removed. This pattern of movement is very similar to that described by Delap et al. for the 1931 flow at Glencullin.

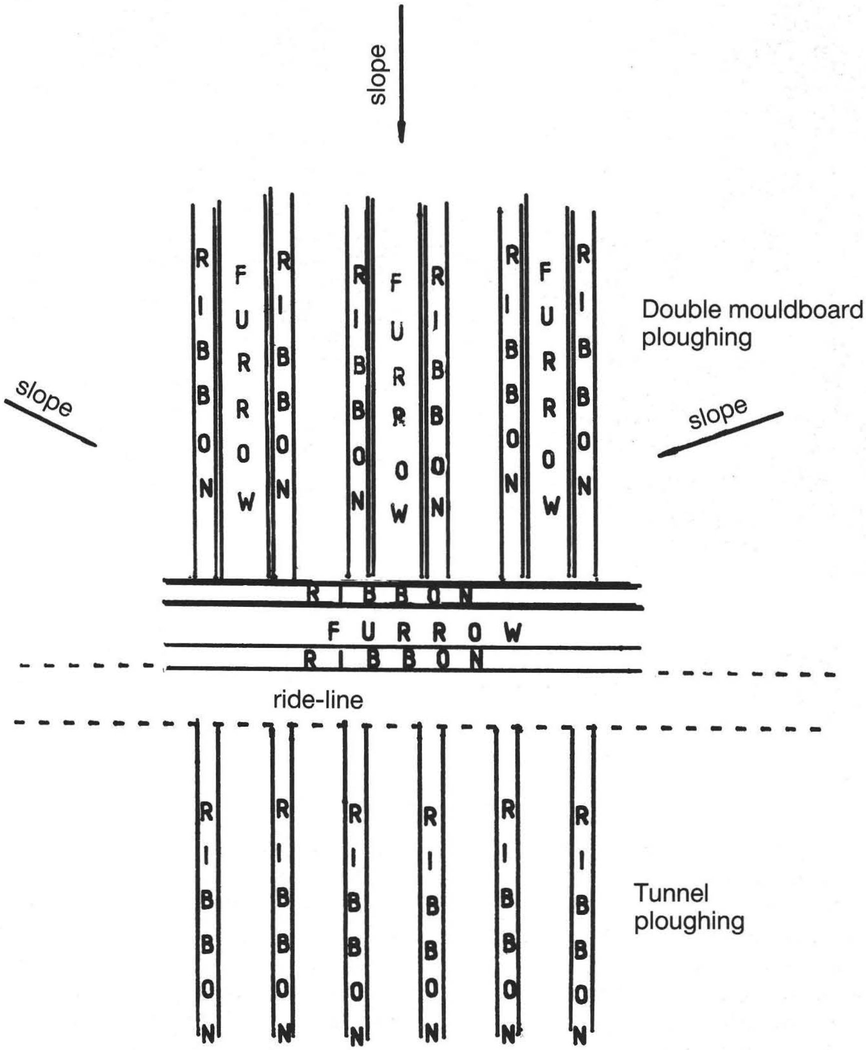

Figure 6: Ploughing layout at head of flow.

Figure 7: Lateral tears in bottom of DMB furrow immediately above head of flow.

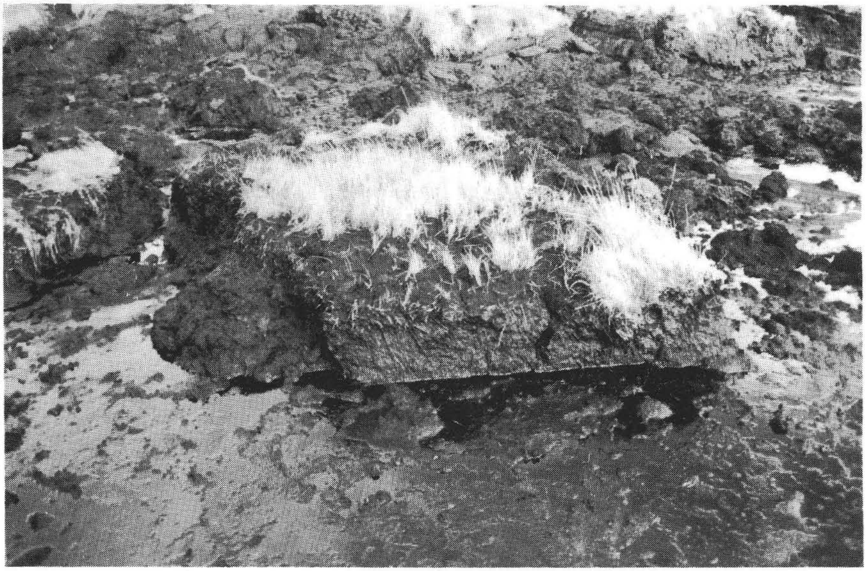

Figure 8: Blocks of solid peat resting on semi-liquid peat.

Above the forest road all of the peat has been removed above the firm greasy basal layer. The latter was very slippery and difficult to traverse. In places the peat was redeposited with solid blocks of peat resting on soft semi-liquid material (Figure 8).

In the tunnel ploughing area 2000mm wide blocks of peat, coinciding with the tunnel runs, were sheared off and moved down-slope. This explains the straight edges of the flow shown in Figure 1. The loose peat material moved downslope with considerable force as blocks of peat were uplifted at several points along the western edge of the flow (Figure 9).

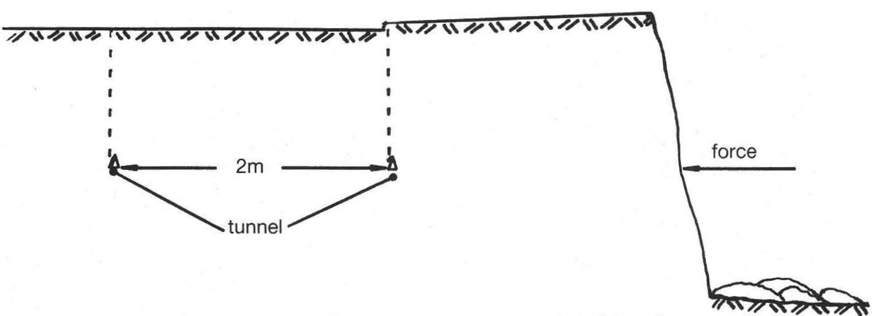

Figure 9: Thrust-faulted block of peat at western extremity of bog flow.

Water was flowing from the head of the flow on the 10th November, 1988 even though a cutoff drain had been installed above the head after the flow had occurred.

An area of 2.5ha was affected but only in the area above the forest road, 1.5ha, was peat removed. Given an average peat depth of 1750mm this represents a volume of 27,000m^3 or about 28,000 tonnes of wet peat. This amount of material could cause considerable damage to structures in its path.

4. CAUSES

4.1 Ploughing and drainage:

As stated above, the flow in all probability began in the double mouldboard ploughing area in compartment 81614M. The plough furrows, which run down-slope, carry considerable volumes of water as they are bare and free of vegetation, particularly near the break in slope which coincides with the rideline (Figure 2). These were not connected to any collector drain and ended at two double mouldboard furrows which ran across them at right angles. This resulted in ponding of water above the rideline and discharge across it following heavy rain.

The tunnel ploughed area was crossed by two collector drains. These were not deep enough to collect water coming downslope in the tunnels. In the area adjacent to the flow they were full of *Sphagnum* and tufts of *Molinia*. In effect these drains collect no water. During heavy rain it is probable that the tunnels became full of water and pore water pressures built up, as a result of the increased head of water. These pressures would increase with depth.

4.2 Weather:

Bog flows and slides are associated with periods of heavy rain or thunderstorms. Prior to flows that occurred in Antrim in 1981, 97 mm (4 inches) of rain fell in threequarters of an hour (Tomlinson and Gardiner, 1982). Carling (1986) reported on bog slides in the Pennines following a rainstorm of similar intensity.

Rainfall data for May, June and July are presented below for the two nearest Meteorological Service stations at Belmullet and Glenamoy (Table 1). May and June were particularly dry months at both stations. At Glenamoy, for instance, during June there was a 26 day period from the 4th to the 29th when only 13.5mm (½ inch) of rain fell. Only 46.5mm fell in the full month (58% of average). Such a long dry spell during May and June would result in considerable drying of the surface peat. This could have opened cracks in the furrows where water could move rapidly to the soft lower peat, particularly at breaks in slope. In relation to the Pennines slides, Carling states that there was a 28 day antecedent period with only 15.8 mm of rain.

Table 1: Rainfall amounts for Belmullet and Glenamoy, May-July 1988.

	MONTH					
	MAY		JUNE		JULY	
DATE	B*	G*	B	G	B	G
			mm			
1	4.6	1.4	1.2	2.3	7.6	4.5
2	1.0	0.1	1.7	4.5	9.0	8.5
3	–	–	5.6	5.5	–	1.5
4	0.1	0.6	0.1	–	2.8	4.0
5	0.1	–	0.4	–	12.7	14.5
6	–	–	5.1	5.0	2.0	7.3
7	–	–	–	–	7.1	6.6
8	–	0.1	–	–	1.8	0.5
9	2.3	1.7	–	–	10.7	19.7
10	4.8	0.8	–	–	8.1	6.5
11	–	4.1	–	–	1.4	1.4
12	3.2	4.5	–	–	11.6	10.2
13	0.5	0.1	–	–	–	0.9
14	–	–	–	–	0.1	0.2
15	–	–	–	–	0.7	0.2
16	–	–	0.1	–	2.0	3.0
17	–	0.5	–	–	0.2	–
18	1.1	4.5	–	–	3.1	5.5
19	1.6	0.1	–	–	0.3	–
20	0.1	–	2.9	4.0	3.3	6.0
21	–	–	0.5	–	5.3	4.0
22	–	–	–	–	0.4	–
23	7.1	5.2	–	–	7.9	5.0
24	13.2	8.8	0.2	–	14.9	18.0
25	9.4	2.5	1.1	1.2	8.6	13.0
26	2.1	2.8	0.2	–	1.6	3.0
27	5.0	11.0	–	–	0.6	2.1
28	2.9	8.6	–	–	3.0	3.8
29	2.3	–	5.2	3.3	3.8	4.3
30	5.1	5.0	16.9	19.3	2.0	1.0
31	0.5	0.9	–	–	–	–
TOTAL	67.0	63.0	41.2	46.5	132.6	156.3

* B = Belmullet Meteorological Service Station
* G = Glenamoy Meteorological Service Station

From the 30th of June until the 12th of July there was rain on all days at both stations (apart from the 3rd at Belmullet). Over the country as a whole, July 1988 was the wettest for 30 years (T. Keane, 1988). At Belmullet and Glenamoy the July rainfall was 184% and 176% of average respectively (1951 – 1980 average for period). While examination of the July rainfall at Belmullet shows no exceptional rainstorms this constant heavy rain would have brought the water table back to the surface of the peat (Table 2).

Table 2: Simplified water balance for peat at bog flow area assuming Belmullet rainfall, evapotranspiration of 4 mm/day and drainable pore space of 10%.

Date	Water Table Depth mm	Evapotranspiration (E) mm	Rainfall (R) mm	R - E mm
29/6	–400	4	5	1
30/6	–390	4	17	13
1/7	–260	4	8	4
2/7	–220	4	9	5
3/7	–170	4	0	–4
4/7	–210	4	3	–1
5/7	–220	4	13	9
6/7	–130	4	2	–2
7/7	–150	4	7	3
8/7	–120	4	2	–2
9/7	–140	4	11	7
10/7	– 70	4	8	4
11/7	– 30	4	2	–2
12/7	– 50	4	12	8
13/7	+ 30 (overland flow)			

4.3 Slope:

As shown in Figure 2 above, there are two breaks in slope in the area above the forest road. Flows are almost always associated with breaks in slope (Carling 1986, Tomlinson and Gardiner, 1982). Calculations on the effects of slope can be made (Appendix) but the safety factors are dependent upon the value for soil cohesion.

5. DISCUSSION

5.1 Probable sequence of events prior to and during flow

The exceptionally dry months of May and June initiated drying and cracking of the surface peat. This was followed by prolonged heavy rain in July. Rainfall moved down slope and accumulated at the end of the plough furrows at the head of the flow. The weight of this water and the saturated nature of the peat encouraged the lower peat layers to begin to flow over the basal greasy peat layer at the break in slope, where the peat had the poorest hold. Downslope the peat in the tunnel ploughed area was also saturated owing to the absence of proper collector drains. This allowed the flow to continue down-slope. The flow was further facilitated as the surface peat readily sheared longitudinally along the 2000 mm wide cuts made by the tunnel plough.

When the flow reached the forest road its momentum was checked owing to the damning of the flow by the road formation. Effectively the *in situ* bog ceased to flow at this point. However, the material that had flowed downslope continued over the road and was deposited on the lower side of the road.

5.2 Implication for tunnel ploughing:

Tunnel ploughing, if properly drained, should reduce the probability of bog flows. Tunnel ploughing has been shown to lower the water-table to a greater extent than double mouldboard ploughing (O'Carroll et. al. 1981). This lowering will result in lower pore water pressures, increased peat strength and higher factors of safety (Appendix).

6. RECOMMENDED PRACTICE

1. All ploughing sites on peat should have collector drains installed at a minimum intensity of 100m/ha. These should be sufficiently deep to intercept flow in furrows and tunnels and have a sufficient bottom gradient to remove water rapidly from the site without causing erosion (a 2-3° gradient is sufficient on sloping ground).
2. Drains should be installed above distinct breaks in slope to prevent water seeping to vulnerable slope faces.
3. Planted blanket peat areas which adjoin public roads, dwellings and reservoirs should be critically examined to ensure that they have sufficient collector drains to remove **storm** rainfalls. This would be particularly important in the case of areas which have slopes exceeding 6°.

7. Acknowledgements

Thanks are due to Mr. Michael Rodgers, Civil Engineering Department, University College, Galway and Mr. Tom Keane, Meteorological Service for helpful discussion during the preparation of this paper. Thanks are also due to Mr. Joe Fenton, Research Forester, Coillte Teoranta and Mr. J. Martin forester-in-charge Bellacorrick Forest for help during fieldwork and Mr. Niall Brooks, Meteorological Service for supplying the data for Table 1. Finally, thanks are extended to Dr. R. McCarthy for a critical reading of an earlier draft and Ms. E. Khan for typing this paper.

APPENDIX

Calculation of factor of safety for Bellacorrick site.

$$F = \text{factor of safety} = \frac{\text{sum of resisting forces}}{\text{sum of driving forces}}$$

(F>1 safe slope; F<1 unsafe slope).

$$F = \left[1 - \left(\frac{\gamma w}{\gamma s} \times \frac{Dw}{D} \right) \right] \times \frac{\tan \varnothing^1}{\tan \propto} + \frac{2\,C^1}{\gamma s\, D \sin 2\propto}$$

Where:

γw	=	unit weight of water	= $9.81 kN/m^3$
γs	=	unit weight of wet peat	= $10.24 kN/m^3$
Dw	=	depth of peat below water table	= 1.5m
D	=	depth of peat	= 1.5m
$\varnothing^1$	=	angle of internal friction	= 14.45°
$\propto$	=	slope	= 7°
C^1	=	residual cohesion	= $1 kNm^{-2}$

Substituting these values gives an F value of 0.6. Lowering the water table to 60cm below the surface increases the factor of safety to 1.4.

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Notes

A NEW LARCH CULTIVAR[1]

Chris Kelly

John F. Kennedy Arboretum, New Ross, Co. Wexford.

[1] Extracted from Moorea Vol. 8 (1989) with kind permission of the editor.

Larix kaempferi (Lambert) Carriere 'Hanan'

Deciduous coniferous tree, differing from the typical form in its weeping habit; branches pendulous; leaves flat, to c. 20mm long; <1mm broad, with two stomatic bands beneath. Voucher specimen: DBN-cult. Kennedy Arboretum,

Figure 1: Larix kaempferi cv. Hanan – the original tree photographed in autumn 1986.

New Ross, *Chris Kelly*, 1988, 10.00.

Larix kaempferi 'Hanan' has been selected in the John F. Kennedy Arboretum, New Ross, County Wexford. The original tree (Figure 1) is in cultivation in the Arboretum (immediately adjacent to the collection of *Potentilla fruticosa* (Rosaceae) collection), and young plants are in the National Botanic Gardens, Glasnevin.

Seeds of *Larix kaempferi* were obtained by the Irish State Forest Service in 1956 from Nagano, Japan, and were sown at the Camolin Forest Nursery, County Wexford. In 1965 a batch of seedlings was transferred to the Kennedy Park for planting in a shelter belt. Within a few years one seedling differed markedly from the others. This unique seedling has a slim habit and markedly pendulous branches. It has been named after Anthony M. S. Hanan, the first director of the John F. Kennedy Aboretum who for eight years, until his untimely death, shaped this area of farmland into an arboretum of international standing.

L. kaempferi 'Hanan' is to be registered with the International Registration Authority. One other weeping cultivar of *L. kaempferi* recorded – ''Pendula' is described as having particularly drooping branchlet systems, but Rushforth (1987) dismisses it as being only 'quite interesting but often no improvement on a normal seedling'. Grafting of 'Pendula' can produce a tree with branchlets a little more pendulous than usual, if a leader develops. In 'Hanan' the branches are pendulous, not the branchlets, so the whole habit of the tree is distinctive.

FOREST DESTRUCTION ACCELERATES

Raymond M. Keogh

Statistics relating to deforestation in the tropics are inevitably unpleasant but they have performed a role in spurring initiatives against further destruction of the earth's forests.

In 1980 the Food and Agriculture Organisation (FAO) of the United Nations informed that 11.3 million hectares of forest were being cleared per year. Put in an Irish context, this represented a denuding of an area the size of the Phoenix Park every 30 minutes.

Since 1980 a large volume of scientific and popular books and articles have been produced, outlining the causes and consequences of forest destruction. There has been a constant reminder of the forest problem in the press, on radio and television. Concern has led to the establishment, in 1985, of a forum composed of most of the agencies which provide funding to forestry in the developing world. This is known as the Tropical Forestry Action Programme. Concern about the mining of tropical timbers gave rise to an international organisation which had a slow and painful birth in the mid 1980s; its aim is to encourage tropical timber suppliers to obtain raw material from areas under sustained management. This organisation, of which Ireland is a member, operates under the title: International Tropical Timber Organisation.

In addition to the establishment of corporate bodies to redress the situation, governments have expressed concern: of special interest is the Declaration on the Environment by the European Council of the EC at the Dublin Summit in June 1990 during Ireland's 'Green Presidency'. It states: *We are Gravely Concerned at the Continuing and Rapid Destruction of Tropical Forests'.*

It could be assumed that the collective energy directed to redress a major global problem would, by now, begin to have an impact where it matters: in the countryside of affected nations. *Nothing Could be Further from the Truth.* FAO is undertaking a reassessment of the tropical forests using the most up-to-date technology available, including satellite remote sensing. The interim figures indicate continuing deforestation. Not alone this, the rate is accelerating. Now the annual rate of deforestation stands at 17 million hectares, equivalent to the cutting of an area the size of the Phoenix Park every 20 minutes.

Between the production of the two sets of FAO figures in 1980 and 1990 an area of 170 million hectares has disappeared; this is equivalent to 20 times the size of Ireland.

Clearly the battle for the tropical forests is being lost and lost quickly and the planet must suffer the consequences this entails. Scientists can only investigate what these consequences might be and then inform society; society must take action through its politicians. However, to redress the situation politicians cannot expect that expressions of concern will act like a magic wand; it is necessary to translate these expressions into action and action, unfortunately, needs financial support.

Note of interest: Gorta (the Freedom of Hunger Council of Ireland has reprinted a booklet entitled: "Time runs out for tropical forests". This may be obtained by writing to: Gorta, 12 Herbert Street, Dublin 2).

Forestry in the News

Crackdown on Black Economy in Construction and Forestry

The Minister for Social Welfare, Dr. Michael Woods TD has signed regulations which will require employers and others in the construction and forestry industry to notify his Department of sub-contractors hired by them. The sub-contractors will, in turn, be required to notify the Department of any person engaged to carry out that contract either with them or on their behalf.

The regulations, which came into force on 1 January, 1990, represent a major crackdown on the black economy in these two industries and are aimed at rooting out unscrupulous employers and sub-contractors who collude in social welfare fraud.

The regulations mean that an employer in either industry, who takes on sub-contractors or employees who are working and claiming, can be prosecuted for failure to make the required return. There will be no need for the Department to prove collusion. On the other hand, legitimate employers who make the return will help their industry in the fight against fraud.

UPTCS News, February 1990.

Hundreds Seek Redundancy in Coillte Upheaval

Four hundred and twenty workers employed at the state forestry agency, Coillte, have applied for the Government's voluntary redundancy package which was made available to all staff before Christmas, according to union sources. This represents almost one-fifth of the 2,300 workers employed at the agency.

In all 380 of those accepting the terms are industrial workers, while 20 in clerical and administration and a further 20 technical staff also took the package. It was not clear yet how many of these will be allowed to go though, a union spokesman claimed that some have already left.

Ironically at a meeting held before Christmas, between An Taoiseach and chief executives of all commercial state bodies, Coillte outlined job creation targets at between 1,050-1,450 by 1993.

The vast majority of these jobs are to be in contract or seasonal work. Specifically, 500-750 jobs are to be created in contract harvesting, transport and saw milling while there will be 400-500 seasonal jobs, i.e. 3-6 months duration, in the preparation and planting of trees following an expected increase in the amount of acres available for plantation.

In addition, the establishment of a new wood pulp factory with possible international involvement would create 100-150 jobs while expansion of the existing wood pulp plants in Ireland would create a further 50 jobs.

A spokesman from UPTCS which represents the 600 technical workers in Coillte expressed grave reservations at what he regarded as a state agency creating, not full-time jobs, but opportunities for sub-contractors to operate in the black economy.

Coillte, while admitting that it has extended its use of contractors in the past year, claimed its policy on the use of contractors was as laid down for the public sector i.e to use only contractors registered for tax and PRSI.

A Coillte spokesman explained the apparent disparity between the expected job creation targets over the next three years and the present redundancy programme saying the redundancy scheme was designed to correct what he termed a "mismatching" between the spread of work and the staff available.

SIPTU represents 1,500 industrial workers in Coillte. It fears extended use of contractors will not bring an expansion in the forestry industry, but may replace permanent industrial jobs in a total reorganisation of the state industry. They point out that 20 to 25 years ago there were about 5,000 workers employed in forestry and that this had dropped to 3,000 in 1984 and to 1,500 at the moment. The present redundancy scheme could see this drop further to just over 1,100.

The union claims that there is considerable scope for expansion in the forestry area with the potential of almost 2,000 jobs as opposed to the 500 identified in the Programme for National Recovery. But the union claims that such employment potential must be realised through the creation of secure full-time jobs – not the further expansion of contract work.

Irish Independent, January 1990.

Forestry Option for Farmers

Tree planting has at last become a very attractive option for farmers on wet mineral soils that give poor returns from other enterprises. For many years farmers have tended to resist the blandishments of the foresters, as they regarded woodland as wasteland that would be better grazing cattle or sheep, but now they are being offered an income with less strings attached, and it will be better than rearing store cattle at low stocking rates.

The recently-announced premiums of £47 a year for 15 years on the first 20 acres planted, and £35 for every acre after that up to a maximum of 164 acres, are not going to make the average farmer on drumlin soils in Co. Clare or Leitrim rich overnight, but it gives him or her an income per acre for those interim years while the trees are growing big enough to take the first thinnings, that is better than the gross margin from rearing calves to stores on that kind of land, even in better times than we are going through now.

The net cash income per acre by the end of 35 years is £133 an acre per year, or thereabouts.

What is particularly attractive, and should result in a lot more planting, is the concessions that the combined off-farm income of the landowner and spouse can amount to £11,000 a year before disqualification.

There are many part-time farmers who are earning the average industrial wage and getting very little off the farm who can now start planting trees for a rotation that will give them a modest income up to the time of the first clear felling and a good lump of money then, perhaps at the time or retiring from the regular job, or at the time of handing over to an heir.

These premiums, financed by the EC, form part of the policy for rural society. They replace the payments for forestry which were based on the livestock headage payments in the disadvantaged areas and they are also available all over the country. They are specifically designed to keep people living on the land as part of the EC policy on rural society, so it is a condition of eligibility that the owner must live within a reasonable distance of the plantation and they are not just investment aids for absentee landowners.

Irish Times, 17th February 1990.

Limerick Gets 25 p.c. of Trees Planted

One quarter of the trees planted this year by the Irish Forestry Board – Coillte – will be planted by the organisation's Limerick division.

The division embraces counties Limerick, Clare, Kerry and North Tipperary. Coillte held its first Limerick Division Conference in the Woodlands Hotel recently.

Division Manager, Jim Dillon told the Conference: "The expansion of the Coillte programme is making a major impact to the economy of the region, through increased planting and harvesting ability.

Investment

"1990 will see an investment in excess of £8 million coming into the division through wages and salaries, local contracting and machine hire."

The conference was addressed by Mr. Martin Lowery, Chief Executive of Coillte. He confirmed the important role of the south-west area, and said he was confident that forestry could make an even bigger contribution to the economy and to job creation in future years.

In the Limerick Division alone, Coillte will plant 1,900 hectares and produce 250,000 tonnes of timber. 250 people are employed in the area and Coillte expects to employ up to 120 additional staff on a seasonal or contract basis.

Mr. Dillon confirmed that Coillte was actively seeking land in the division to enable further expansion. Coillte, he said, would pay "competitive prices" for land and deal with all offers "promptly and in strictest confidence".

Limerick Leader,
14th April 1990.

Environment Impact Protection Under Forestry Plan Inadequate

Commenting on the announcement recently by Minister Bobby Molloy of the Forestry Operational Programme, the Chairman of the IFA's Rural Development Committee, Mr. Padraic Divilly, welcomed the scheme as one that would provide real incentives to farmers to become involved in the development of Irish forestry.

"The provision of an annual income has always been a major part of IFA's policy in getting farmers interested in planting parts of their land, particularly as the payback period for thinnings and clearfell is too long" he said.

Mr. Divilly expressed concern however that the recently announced Environmental Impact Assessment (EIA) for forestry plantation which is mandatory in excess of 480 acres (200 hectares) provided inadequate protection for farm families whom he said could suffer social and physical isolation in many parts of rural Ireland from large-scale forestry development.

Mr. Divilly called on the Minister for the Environment to reconsider the regulations governing the EIA and to lower the mandatory threshold of 480 acres to 120 acres (50 hectares) which he described as being much more in keeping with the scale of Irish farming.

Enniscorthy Echo,
2nd March 1990.

Private Forests 'Destroying' Irish Bogland

Areas of ecological importance around the country are being destroyed by private afforestation companies funded by the EC, according to An Taisce and the Irish Peatland Conservation Council.

Blanket bogs and moorland, especially in the west of Ireland, are being bought, drained and planted by commercial developers, largely grant-aided by an EC funding scheme, known as the Western Package.

Special legislation, which was introduced to protect these bogland areas, is inadequate, according to the conservation bodies. The new Environmental Impact Development Assessment Directive only requires that planning permission be obtained for areas that cover over 200 hectares.

A growing number of farmers and members of the public, who want to stop certain developments in the west, have no real form of redress, according to David Hickey, Environment Officer with An Taisce.

An Taisce has been receiving an increasing number of public complaints in the last year. If the land in question is under the stated 200 hectarage, then planning permission for the proposed forest development is not required. Recent developments near Mulranny in Mayo and Portumna in Galway, are causing particular concern.

Over 8,600 hectares were grant-aided by the Forestry Service last year. The Western Package means that 85% of the initial costs incurred in establishing a forest will be given to individuals or farmers' co-ops, while 70% of the initial costs are given to companies.

This "fund-driven afforestation" is helping to damage wild habitats, particularly along the western seaboard, says David Hickey. Commonages are being increasingly broken up, especially for commercial forestry, he says.

An Taisce and the IPCC are also critical of Coillte, the semi-state forestry body, which has benefited from EC funding and which has recently been responsible for a number of ecological blunders.

Already, 35% of the original area of blanket bog in the west of Ireland has either been afforested or cut away, according to the Irish Peatland Conservation Council.

Sunday Tribune, 29th April 1990.

Big Tax Break for Forestry

The ICMSA claims to have negotiated a significant tax break for farmers undertaking forestry.

Following submissions from the association, it says, the Revenue Commissioners have ruled that all payments from the new Forestry Premium Scheme will be exempt from income tax.

This means, it says, that a farmer in the 53 p.c. tax band will get an annual income equivalent of £100 per acre before tax for 20 years for broadleaved trees.

The ICMSA points out that this ruling makes the Forestry Premium fundamentally different from headage payments, as headage payments are regarded as farming income and taxable accordingly.

Irish Independent, 1st May 1990.

Major Contract Awarded to University

The University of Limerick have been awarded a major contract to undertake an important feasibility study in the area of novel processing techniques for synthetic wood products.

The contract was awarded by 'Medite' of Europe Ltd., who complimented the university on its unique and comprehensive range of expertise which they say offers the greatest potential for the success of the project.

Welcoming the decision to locate the contract in Ireland, Minister for Science and Technology, Michael Smith TD said that having expressed concern on many occasions about the graduate brain-drain from the country he was especially pleased that this contract would not similarly be leaving the country.

In the national context, forest and forest products are becoming increasingly important and this fact, said the Minister, is why we must encourage and welcome initiatives of this nature.

This contract will enable the University to extend its work area into synthetic wood products and novel processing techniques and this project will investigate the feasibility of producing a wood fibre composite product using specialised binder resins and process systems.

Following discussions with a number of universities, in Ireland and abroad, Medite Ltd. announced the contract with the University of Limerick this week.

Limerick Tribune, 21st April 1990

State's Forestry Assets Rise

Coillte, the forestry board, increased the value of its forest assets by £58 million in its first year in operation. It made a loss of £4.2 million on current operations before a £3.855 million exchequer grant, according to the company's 1989 annual report, but expects to be in profit by next year.

New planting valued at almost £32 million and growth in existing forest of £26.5 million led to a rise of nine per cent in the company's forestry holdings which stood at £618 million at the end of the year. Coillte planted 10,000 hectares of forestry in 1989 and plans to increase this to 12,000 hectares by next year. When Coillte was vested on 1st January 1989 it took over 396,000 hectares of land of which 348,000 was forested.

In its first year of trading Coillte registered a loss of £0.35 million on its current operations after grant-in-aid from the exchequer of £3.85 million. The company's chief executive, Mr. Martin Lowery said the loss was "considerably lower than expected" and predicted that Coillte would be making profits by 1991, with "a chance of a break-even" in the current year.

Last year revenue from timber sales increased by 22 per cent over the equivalent figure for 1988 by the Forestry Board. "This was due largely to better timber prices arising from buoyant market demand", the report says, with increased marketing and better segregation of timber also contributing. Cost saving measures were also introduced and staffing levels have dropped from 2,510 at the start of the year to 2,041 by December. Turnover for the year was almost £30 million.

The annual report says one of the key issues for the timber industry is the structure of the sawmilling industry. Mr. Lowery said that with Ireland likely to be self-sufficient in softwoods by 1993 the industry would have to increase its marketing and product development capability.

Irish Times,
6th June 1990.

£1m Wildlife Centre for Doneraile

A £1 million wildlife centre is to be developed within Doneraile Forest Park, which is already proving to be a major tourist attraction in the Blackwater Valley.

A £200,000 allocation for this year was included in the £25 million ERDF aid package, which Tourism and Transport Minister, Mr. Seamus Brennan, announced last week.

Cork East TD, Mr. Ned O'Keeffe, said the Office of Public Works has exciting plans for Doneraile over the next few years.

Special emphasis will be placed on native wildlife including badgers and foxes, while visitor facilities will be also provided.

"It will play an important role in educating children about wildlife and it should also prove to be a significant tourist attraction," he said.

The 400 acre park which was acquired by the State in 1969 was once part of the historic estate of the St. Legers, who provided successive Lords Doneraile.

It features sunken fences, fish ponds, a reformed lake with resident and migratory wildfowl, a deer herd, forest walks and picnic areas.

Doneraile Court, the former family seat of the St. Legers, was also acquired by the State in 1969 and later leased to the Georgian Society.

Major restoration work has since been carried out on the mansion beside the Forest Park and the Georgian Society plans to eventually open it to the public.

Deputy O'Keeffe said the development of the park and the house as major tourist attractions will prove to be a major economic boost for the area.

Complementing it will be a £1.6 million 450-pupil co-educational second level school which Education Minister, Mrs. Mary O'Rourke, recently approved for Doneraile, he said.

The school will, in fact, be located on a site across the road from the main entrance to the Forest and Wildlife Park.

Cork Examiner,
28th May 1990.

£20m Leisure Centre Planned for Lough Key

Coillte, the state-owned forestry board is to consider a proposal to build a hotel, golf course and theme park at the Lough Key forest park and bird sanctuary in Co. Roscommon. The proposal has come from a group of, as yet unknown, American investors who have commissioned a feasibility study and environmental impact assessment from Stokes Kennedy Crowley. Those studies, which are expected to be favourable to the proposed project, will be completed within the next couple of weeks.

Lough Key forest park has been described as the jewel of the crown of the forestry service. It comprises part of the old Rockingham Estate on the shores of Lough Key. It has been managed by the Department of Forestry and more recently by the newly-formed semi-state company, Coillte Teo, as an amenity area rather than as a commercial forest.

It attracts a large number of visitors, both day trippers and holiday-makers with its caravan park, boating, nature trails and restaurant.

Coillte had approved the project subject to a number of conditions. A spokesman for Coillte said that it would be anxious to take a substantial shareholding in any venture and would require that traditional local rights in the area were protected.

He stressed that widespread local support would be a condition of any project.

Details of the proposal are still sketchy. But the total investment being talked about is about £20m.

Evening Press, 7th June 1990.

It's Hard to See the Wood for the Trees

Coillte Teoranta, the state-owned forestry firm, has defended the methods used in compiling its accounts for last year, which show a loss before exchequer grants of £4.2 million.

Private sector forest products firms claim that the true level of losses is far higher, but that the loss level is being contained by the accounting policies used by joint auditors Price Waterhouse and Oliver Freaney.

The 348,000 hectares of state forests transferred to Coillte when it was set up in early 1989 were valued in the company's books at £1,650 per hectare. But figures issued with Coillte's latest financial statements show that it is costing closer to £2,500 to establish a hectare of immature forest, counting the cost of land acquisition and afforestation.

When Coillte harvests and sells wood from the state forests, however, it charges only the historic "value" of the forest used against the Coillte profit and loss account.

This means in effect that they are charging for the forest consumed at a rate of £1,650 per hectare. In the most recent year this depletion charge was just £7.45 million, whereas timber sales topped £27 million.

The total cost of running the Coillte forest products division is put at just under £26 million (including the £7 million depletion charge), leaving the division operating at a small surplus. However, administrative costs of £5.7 million and other "ancillary costs" leave the books showing a loss of over £4 million.

The selling price of a cubic metre of timber last year was around £18 but the depletion charge of £7.45 million suggests that the charge in the accounts for timber harvested and sold was around £5 per cubic metre. It is little wonder then that a profit is being reported.

The very low depletion charge derives directly from the very low value placed on the forests inherited by Coillte in the opening balance sheet. If for example, the auditors Price Waterhouse and Oliver Freaney had decided to value the inherited forest at closer to £1 billion, the depletion charge would be in excess of £12 million and a much bigger loss would have to be reported.

Private sector forestry firms also claim that whereas it is costing Coillte around £2,500 to create a new hectare of forestry, the market value of newly afforested land (net of EC grants) is around £1,400. Thus they argue that a loss of over £1,000 is being created for each hectare which is afforested.

A spokesman for Coillte confirmed that it was costing around £1,400 to plant a hectare of forest in addition to land acquisition costs of around £1,000.

But he said that to compare this sort of forestry with that which was inherited by Coillte was "like comparing apples and oranges". The yield on newly forested land was far higher than the average yield on the total stock of forestry.

Sunday Business Post, 24th June 1990.

Forestry Projects 'Ruining' Ancient Sites

Dozens of known archaeological sites throughout the country, including cairns, ring-forts and souterraines are being destroyed by the new wave of commercial forestry plantations, according to a preliminary report compiled by archaeologists in the Office of Public Works.

The report, which was drawn up by the Sites and Monuments Record Office, has been submitted to the Irish Association of Professional Archaeologists and the State forestry company, Coillte Teoranta, in the hope that new guidelines will be formulated to protect ancient sites threatened by afforestation.

The toll of destruction highlighted by the report includes an Iron Age hillfort and field system at Muckelty, Co. Sligo, which has been ploughed up and planted with trees, and a Bronze Age cairn in Cloghleagh townland, Co. Wicklow, which has also been "levelled and planted".

In Rathlackan, Co. Mayo, a court tomb dating from 3000 BC has been "badly damaged by forestry" and the adjoining field system and house sites "destroyed". In Tooreen, Co. Waterford, a Bronze Age complex, including stone circles, ceremonial enclosures and ancient cooking sites, has also been "badly damaged".

The preliminary report only covers the counties of Dublin, Kerry, Kilkenny, Leitrim, Mayo, Sligo, Waterford and Wicklow. However, Mr. Michael Gibbons and Ms. Geraldine Stout, of the Sites and Monuments Record Office, say it is likely that the rate of destruction is just as serious in other parts of the country.

Given the scale of the planting which is now taking place, the report recommends the establishment of an archaeological unit to assess forestry proposals so that the "rich heritage of historic and archaeological remains of national and international importance" is not unwittingly damaged.

Irish Times,
18th June 1990.

Firms Paying £700 for Forest Acres

Land suitable only for forestry continues to make high prices, with up to £700 per acre being paid in some parts of the country.

Competition is so fierce between the companies involved that they have been paying more than what is regarded as the marginal level for an economic return.

Practically all the deals involving the highest prices have been done by private treaty, and auctioneers are reluctant to go on the record about them, due to the confidential nature of a transaction in these circumstances.

But a number of agents – in the west, south and west-midlands – have spoken to us off the record to highlight the extraordinary demand for this sort of land, which up to a year or two ago had absolutely no value in its own right.

"Before this you couldn't sell the land that's now being bought for £600 and £700 an acre", said one. "In recent months we have had up to five different companies making offers for the same pieces of land."

Location is of prime importance in getting top price, according to the auctioneers. Closeness to a good road makes it easier to get planting equipment in and out, so this will add to its value.

Land that is very wet is less valuable because of the different conditions machinery would have to work in. Steep slopes on property also affect its value.

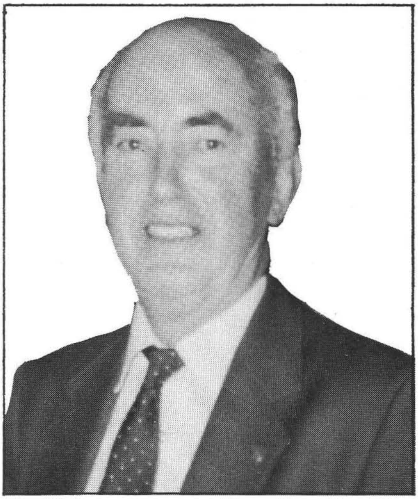
Up to recently, the only way this sort of land changed hands was when lumped in with other property as part of a larger holding. Now these holdings have become relatively hugely valuable in their own right. The general run of prices, however, is on average a lot less than £700 per acre. It can go as low as £300 – still an awful lot more than it was worth, say, five years ago.

This lower price would be for the larger acreages of poorish land with difficult access. Smaller acreages of the same quality appear to be making up to £450-£500.

Irish Independent,
26th June 1990.

Obituary

JOHN O'DRISCOLL
1937-1990



John and I first met as forest workers in Germany in 1958 and spent the summer in the forest of Zang, occupying a fairytale log cabin in the woods. He had by then completed a term as a forest worker in Glenealy, Co. Wicklow, an area and a county for which he retained a special place in his affections.

Graduating in 1960, he joined the Forest Service in the fledgling Research Section and shortly became responsible for genetics, which was to be a primary interest throughout his career. He was in due course invited to lecture forestry students at UCD on the subject and this he did with great enjoyment for twenty years.

John's work in provenance trials and plant breeding brought him recognition abroad as well as at home. He became Chairman of the IUFRO working party on Sitka spruce in 1972 and continued in his chairmanship until his untimely death.

He enjoyed travel and was a good ambassador for Ireland and for Irish forestry. He and his wife Fionnuala welcomed many visitors to their friendship and their home.

One of John's first tasks as research officer in charge of genetics was to investigate the provenances of lodgepole pine as a species of especial interest in Ireland. His knowledge of the species became renowned and he was far advanced with his intention to submit his work for a doctorate degree.

John's love for Wicklow reached full flowering when circumstances provided an area for a research nursery at Kilmacurragh in 1974 as part of the illustrious gardens. There he initiated the nursery and led its development with great joy. A great burden in his last illness was his frustration in not being able to get back to his beloved work.

From 1978 responsibility for the John F. Kennedy Park was added to his charge. His many contacts abroad were of value in expanding the collections and in making them more meaningful for this country.

With the establishment of Coillte Teo in 1989, John, as senior serving research officer bore the care of elucidating a role for research in the changing world of commercial emphasis. He was happy to have a real role acknowledged and his own dedication to research recognised.

John died at home on April 6th 1990 where he had been devotedly attended for several months by a brave Fionnuala and their children, of whom Eoin had already followed his father into forestry.

Fate ordained that John should die on a day when the Society of Irish Foresters was holding a day's symposium and it was to a hushed and saddened auditorium that the President Bill Wright announced his passing and paid touching tribute to him. In the normal way he would have been deeply involved in the symposium as he had been in the Society throughout his career. He served for four years as Secretary and was in turn Treasurer and he served two periods as Vice-President. He was honoured in becoming President in 1980 for a two-year period.

John's attitude to anything he did was wholehearted and, as became a good researcher, painstaking in attention to detail. He enjoyed woodwork, again very aptly, and his craftsmanship in everything from model-making to furniture and even to his precisely planned book racks were a joy to the eye.

His wife Fionnuala mourns a loving husband and Eoin, Conor, Roisin and Killian a devoted father. To them his untimely death has been a tragic loss and his wider family and his friends in forestry have lost a good man.

Ar dheis Dé a anam.

Jack Durand.

Book Reviews

Trees of Nigeria by R. W. J. Keay. Published by Clarendon Press, Oxford. 1989. 476 pp. £50. Hardback.
ISBN 0 19 854560 6

The book presents 86 Plant Families, 417 genera and 935 species of trees found in Nigeria. Savanna trees greater than five metres height, rainforest trees limited to eight metres and greater, and a selection of introduced trees known to regenerate freely in Nigeria, such as the genera Pinus, Casuarina, and Eucalyptus, are included. **Trees of Nigeria** is a revised and shortened version of **Nigerian Trees** (2 vols. 1960, 1964), also compiled by Dr. Keay with co-authors C. F. A. Onochie and D. F. Stanfield. In the present version, the author drew on the extensive data base of the former volumes whilst paying careful attention to recent taxonomic developments. It is interesting to note that since the 1960-64 period, 8 Plant Families, 24 Genera and 34 Species of trees can be added to the Nigerian Flora listing.

Identification keys, systematic descriptions and a broad range of up-dated information contribute to the quality and value of this book. Easily observable features based on the morphological features of leaf, flower and fruit, form the basis of the keys for Family, Genus and Species identification. They are maintained constantly except where special features are more appropriate e.g. latex present with a fleshy stem as in the Family Euphorbiaceae. There are only limited requirements for the use of a magnifying lens during the identification procedure, although careful measurements of leaf, stalk and fruit parts are essential when following the generic key. Illustrations (165) assist in species identification; 32 of these help to describe members of the large and often confusing Leguminosae Family. Flowering shoots, flowers, fruit and leaf parts are highlighted in these figures, with longitudinal and cross-sections of reproductive parts included for certain species. Fruits are often the most reliable means of identification for certain species and some genera. Of particular interest are the 8 species of the Genus Terminalia and a range of the Family Caesalpinaceae, distinguished graphically through a comparison of their seed-pods. The reliance on leaf, flower and fruit for identification places some limits on the application of this key however, as the absence of some or all of these parts at certain times of the year clearly inhibits identification or verification. This is particularly true perhaps in the case of the savanna group which can contain species of a deciduous or semi-deciduous nature.

Although this book refers specifically to trees in Nigeria, the information is readily applicable in other parts of Tropical West, Central and East Africa. A reference guide to eight other Tropical African Floras is incorporated into the text which facilitates further investigation for the less common trees. Family and generic name derivations are explained in a very interesting way. Authorities, early nomenclature and distinguishing traits of each genus are presented followed by a key to the most common species. Each species is similarly assigned to its authority and relevant Flora. A special feature of this work has been the inclusion of species vernacular names. This greatly enhances the value of the book particularly for in-country research and field application. Igbo, Ido, Hausa, and Yoruba are the most commonly used throughout, although twenty-nine other vernacular languages are also used, including Arabic. All are found with botanical names in vocabulary listings at the end of the text. Useful information regarding habitat and range of distribution is provided for each species, with comments on farm regeneration for some trees.

There is a lack of information provided relating to the timber characteristics of most trees. The uses of these trees and the range of products to be derived from them are without doubt immense. Unfortunately it is beyond the scope of this book, and perhaps understandably, as the subject is so diverse and variable within regions. Some comment regarding the deciduous or evergreen tendencies of the trees dealt with, could have been valuable. Because of the height limit (5m), imposed on savanna trees, suffrutix species are excluded, and as already mentioned, so are most of the understorey and shrub components of rainforest groups.

This book however succeeds in assembling and presenting descriptions and information relating to complex and diverse tropical ecosystems. It has a wide application area, both as a key and also as an excellent up-dated reference for workers not only in Nigeria, but also in many regions of sub-Saharan Africa.

Philomena Tuite

Silvicultural Systems by John D. Matthews. Clarendon Press, Oxford. 1989. 284 pp. Stg£32.50 Hardback. ISBN 0-19-859491-7

Faced with forest destruction over the centuries foresters in central Europe drew on their accumulated experience to design systems of silvicultural management for the purpose of sustention and renewal. These silvicultural systems have been described by many authors including R. S. Troup whose well known text, published in 1928 and revised in 1952, is long out of print. This book by Professor Matthews is the most recent on the subject and will be welcome by students and foresters looking for a comprehensive up-to-date text. The book is divided into two parts; Part I provides theoretical background and covers approximately one quarter of the text while Part II presents the silvicultural systems.

Part I, comprising Chapters 2 to 5, sets the scene for the readers study of silvicultural systems by providing an outline of the foundations on which the systems are based. Chapter 2 introduces the reader to forest ecology and genetics. The forest ecosystem is outlined and contrasted with clear felling which breaks the hydrological and nutrient cycles and interrupts the development of annual increment. The evolution of modern forestry in central Europe during the 18th century showed a tendency towards rigid methods of silviculture with regular crops of one species and rigid methods of management. Since the foresters task was to re-establish and expand a depleted resource these methods were appropriate for the time but it soon became apparent that there were conditions of terrain, soil, and climate unsuited to the growth of pure regular stands of one species. The 19th century saw foresters moving towards more flexible methods of silviculture and management, more regular forms of forest stands and a conviction that mixtures were desirable. This in turn led to the evolution of the 'natural' approach to forestry based on the ecology of natural indigenous stands. The author maintains that the basic concept of the forest as an ecosystem is not forgotten but the emphasis has shifted to the development of techniques that increase production of a specified raw material for industry.

The advantage of mixtures and irregular stands are explained and numerous examples cited to illustrate the benefits of mixtures including the nursing effect of Japanese larch on Sitka spruce in Ireland and the suppression by beech of epicormic branches in the oak/beech mixtures of the Spessart.

In Chapter 3 the author describes the protective functions of managed forests. In mountainous regions the role of forests in protecting against avalanches, landslips, erosion and floods is well recognised and silvicultural systems have evolved to cater for this purpose. Forests on water catchments have sometimes led to controversy because of the high level of evapo-transpiration from foliage. It is accepted that the water yield from a forested catchment is often reduced but compensatory features are regularity of supply, with peak flows lower and later than from grass and a much higher water quality, low in suspended solids, nutrients and pesticides leached from the soil.

Forests also play a role in the conservation of wild plants and animals. Even when the principal function of the forest is to produce timber, improvement of habitat for native wildlife is very often an associated function. The practice of sustained yield of timber provides a mosaic of stands, differing in area, age, height and canopy development which together form the ideal wildlife habitats. In regard to forests and the landscape the point is made that the visual impact of several silvicultural systems can be made more acceptable by considering the size, shape and arrangement of fellings. To the general public a clear cutting is usually regarded as forest destruction rather than a prelude to forest renewal.

Chapter 4 deals with the protection of forests against biotic and abiotic factors. Some good advice is proferred to help increase the resistance of forests to wind damage. Fellings that suddenly expose the interior of the stand to wind should be avoided as should large clearings and small scattered coupes within mature crops. As a general rule felling direction should be against the prevailing wind. Where snowfall is heavy an irregular crop will be less susceptible to snow damage than a regular crop. Protection agains fire is best achieved by a mosiac of small stands of different species.

Protection of the forest against disease, insects and animals is very much a matter of prevention through good management practices. This is especially the case in protecting against damage by deer and the author describes how winter feeding will minimise damage and provide a revenue from venison, stalking and the sale of live animals.

Protection against air pollution is treated very briefly. Apart from listing the most important gaseous pollutants and mentioning their effects on Norway spruce and Scots pine in Germany and Czechoslovakia there is little opportunity to develop the subject in a book on silvicultural systems.

In Chapter 5 the author summarises and comments on several topics in forest management from the viewpoint of silvicultural systems. The role of forest management is outlined and the reader is introduced to the division of the working plan area. The relationship between sustained yield and normal growing stock is explained in the context of yield regulation. Recognising that treatment of the growing stock is only a part of forest management the author moves on to describe harvesting systems and the planning and designing of forest road networks. This is followed by a short discourse on the influence of timber markets on silviculture, reminding the reader that the silvicultural treatment of managed forests depends greatly on the value in commerce of the timbers produced and on the specifications required by those who process and use the timbers. To quote Lord Bolton "no industry of any sort whatever can prosper if it consistently floods the market with second or third rate material. First quality timber can always command a fair price, while poor quality timber, except in times of great scarcity, is – and rightly so – a drug on the market". The Chapter concludes with guidelines on the design of forests and their social as distinct from their productive functions.

Part II (Chapters 6 to 20) deals with the silviculatural systems in practice, beginning with the simplest of all high forest systems, the clear cutting system. Clear cutting has been practised for many centuries, first with natural and then with artificial regeneration, but it was systematised in its present form only at the beginning of the 19th century. There are many variations of the system. The form most widely used in these islands, clear cutting followed by planting, is treated at length by the author. The attendant operations of slash treatment, ground cultivation and drainage, weed control and supplementary nutrition are also described. Another form of artificial regeneration is by direct seeding, particularly aerial seeding, a method used extensively in North America for pine and Douglas fir.

Artificial regeneration with the aid of field crops was quite common in Europe at one time but it is now virtually obsolete there. It has, however, grown greatly in importance in tropical countries as a form of shifting cultivation. The so-called *taungya* plantations in Burma is probably the best example of regeneration by this method.

Clear cutting may be followed by successful natural regeneration, either from seed on the ground or disseminated from adjoining stands. The best known example of the former is in the Maritime pine forests on the coastal dunes of the Landes in South-western France. There are many modifications of the system to encourage regeneration from seed disseminated from outside, notably patch felling, strip-like clear cuttings, progressive fellings and felling in alternate strips. Each is described in turn and the author then summarises the advantages and disadvantages of the system. Although the system produces even-aged stands, it is pointed out that clear-cutting does not demand the growing of pure crops, as is sometimes alleged.

The Shelterwood Systems are dealt

with in Chapters 7 to 12. The first of these chapters provides an overview of what a shelterwood system entails emphasising that, in general, the system aims at natural regeneration in contrast to the clear cutting system which usually relies on artificial regeneration. The Uniform System is described in detail using a typical young even-aged crop of oak or beech as an example. This is followed through the stages of its life until it reaches maturity and is removed to make way for a new crop. Heights at which cleaning, thinning and selection of 'main-crop' trees occur are provided making it easier to visualise what takes place. The author traces crop development through the 'education' stage to the seeding, secondary and final fellings and establishment of the young crop. The rule that the silviculturist should 'follow the regeneration' is emphasised, so for braodleaves secondary fellings should take place when the leaves are present. Pursuit of regeneration can sometimes conflict with yield and the interrelationship between the two is explained in the context of periodic blocks with given rotations and regeneration periods. A good example of application of the system is provided for the oak forest of Belleme where it was introduced in 1856 on a 200 year rotation and eight regeneration periods of 25 years. This has been adhered to ever since. It is interesting to note that although the original application of the system is associated with Germany it is now most widely used in France where it is applied to regenerate 90 per cent of the oak and beech forests.

Other shelterwood systems, notably the Irregular Shelterwood System and the various strip systems either draw on elements of the Uniform System or evolved directly from it. An experiment in the forest of Ae during the 1960s, when attempts were made to determine the applicability of the Group System to the regeneration of semi-mature Sitka spruce, makes interesting reading and illustrates the facility with which the species can regenerate. Foresters interested in the application of shelterwood systems over tracts of tropical moist forest will welcome the chapter on this topic which includes experiences in West Malaysia, Uganda and India. The system is based on the principles of the Uniform System in which the seeding felling consists of a general opening of the canopy by cutting climbers and progressively reducing the middle storey by felling, girdling or poisoning the unwanted trees.

The Selection System is largely confined to the mountains of the Vosges, Jura, Alps and the Black Forest range where it is highly regarded for its protective and visual amenity properties. Chapters 13 and 14 describe the single tree selection and group selection systems citing many examples of the latter system in Belgium and England where conversion from regular to irregular forest has taken place over the past few decades. Although the Selection System arose from a primitive form of selective cutting dating from early times it has evolved into a highly scientific method requiring a great deal of expertise.

Chapters 16 to 18 deal with the coppice systems. Simple coppice' is the oldest silvicultural system known and was widely practised up to the 19th century for fuelwood and small size material. Many countries have undertaken programmes of conversion to high forest but there are still extensive areas remaining as in France where there are 5 million ha. The reader is provided with information on the species most suited to coppice as well as the cutting method, the most suitable season, the rotation and method of working. Certain modifications of the 'Simple coppice' have taken place and some are described in great detail. The basket willow coppice, which is an agricultural rather than forest crop, is widely known. Another form, short rotation coppice for energy, became prominent during the 70s and its development is recorded. *Eucalyptus* coppice is treated as a separate form and it is estimated that most of the 4 million ha of *Eucalyptus* in the world is managed as coppice with a common cutting sequence of four crops in 22 years. Although the coppice system is out of favour in Europe it is being widely used in developing countries and its importance is increasing as populations continue to rise.

The Coppice Selection System has long been applied in certain parts of Europe, although it is now less common than it used to be. In principle the working of the system is similar to the Selection System in high forest. Coppice with Standards was the principal system applied to oak in Britain up to the middle of the 19th century. The standards were much in demand for shipbuilding and the coppice provided firewood. With industrial development, more extensive use of coal and the introduction of iron in shipbuilding, the system has been in decline and considerable areas have been converted to high forest.

The process of conversion from one silvicultural system to another is detailed in Chapter 19. The methodology is described and examples are given of different kinds of conversions which supplement those already provided in the chapters on clear cutting and group selection systems. Conversion usually follows forest degradation and is appropriate under certain conditions which are listed by the author. The main silvicultural techniques used in conversion are; improvement fellings, enrichment and replacement. The approach to each is explained particularly in relation to improvement and enrichment of tropical mixed forest.

The French 'conversion classique' approach will interest readers wishing to convert coppice with standards to uniform broadleaved high forest. Continuity of management over a long period is needed for success so it may be more applicable to State owned forests. A modification of the system involving conversion through intensive reservation is also an option.

The final Chapter provides an introduction to agro-forestry systems. Next to the chapter on coppice selection it is the shortest in the book and does little more than draw attention to the contribution that the silvicultural systems can make to agro-forestry systems. Two systems are mentioned; silvo-pastoral systems, of which the widely spaced Radiata pine system in New Zealand provides an example and agro-silvopastoral systems which is illustrated by a poplar growing undertaking at 8m spacing for 22 years.

The book provides one of the most comprehensive descriptions of silvicultural systems available in the English language. Although the systems are essentially central European in origin the underlying principles have been adapted to the practice of silviculture all over the world and the adaptations have been successfully captured by the author. The publication will therefore be welcomed worldwide by both forestry students and practitioners. Since Troup's text on the subject is of limited availability in libraries, this book will be particularly welcome to students. Its well structured chapters and lucid, flowing style complemented by indented highlighting of essentials make it the ideal textbook.

For practising foresters the book provides a timely reminder that systems other than even-aged monocultures are possible and may well be more suitable in the long-term. It can certainly be argued that just as continental foresters of the last century found it necessary to diversify so today's foresters dealing with first generation plantations should consider the introduction of mixtures and shelterwood systems in the second rotation. While this may mean some sacrifice of short-term gains it will eventually lead to a more stable ecosystem providing for continuity of supply for present and future generations. Foresters who wish to choose this course will find the book invaluable.

It is inevitable that readers will wish to draw comparisons between the book and Troup's text of the same title. There are indeed many similarities. The French and German terminology used by Troup has been maintained and Spanish has been added. The format and style are similar as are many of the figures depicting the various systems and the practice of summarising the advantages and disadvantages of each system has been maintained.

It is a tribute to the author that he has retained many of the excellent features of Troup but this book is much more than just an up-to-date edition of that text. Part I alone would stamp this book as a separate entity but there are many other features such as the addition of the Tropical Shelterwood System and the inclusion of the alternate strip method in the Clear Felling System which gives the book an identity of its own. Yet it shares with Troup's text the feature of being an eminently readable and essentially practical book and this should ensure its wide acceptance.

Padraic M. Joyce.

Society News

NEW LOGO FOR SOCIETY

The Council of the Society has approved a new logotype which is timely as the Society will celebrate its 50th Anniversary in 1992.

The logo will have a broad application including letterheads, brochures, journal, exhibition stands, membership application forms, educational certificates, etc.

The design uses a silvicultural theme incorporated in the acorn symbol to reflect the Society's main aim – to advance and spread the knowledge of forestry in all its aspects. While the Society continues to evolve and influence change in Irish forestry development, its educational role has remained consistent. In the process it has been able to attract a wide audience from the specialist to the general interest groups.

The designer of the logo is Society P.R.O. Donal Magner. His previous designs for the Society include Foresters/Educational Award Certificate, exhibition magazines and logos for Wood Ireland and Forestry '88 shows.

A former forester in Laragh he is now Communications Co-ordinator with Coillte.

Sincerest thanks are due to Donal for the time and effort he spent on the design and we must highly compliment him on the outcome.

ANNUAL GENERAL MEETING

Minutes of the 48th Annual General Meeting
Thursday 5th April, 1990
Agricultural Building, University College Dublin

The President, Mr. W. Wright in the chair.

Attendance

J. McLoughlin, F. Mulloy, E. P. Farrell, L. Furlong, A. J. van der Wel, A. Pfeifer, J. Fennessy, D. Magner, P. Breathnach, J. Durand, M. O'Brien, P. Doolan, G. Gallagher, N. O Carroll and E. Hendrick.

Apologies

K. Collins and R. Whelan.

Secretary's Business

The minutes of the Forty Seventh AGM were read. The sentence under Any Other Business: 'F. Mulloy stressed the need to issue Certificates to Coillte's Foresters before the EC reciprocal recognition of qualification in 1992' was amended to read: 'F. Mulloy stressed the need to seek to have Certificates issued to Coillte's Foresters before the EC recognition of qualifications in 1992'. The minutes were then signed.

Matters Arising from the Minutes

The President stated that the suggestion from the previous AGM that An Post should be approached to issue a stamp to commemorate the fiftieth anniversary of the Society was being pursued.

Following a suggestion at the previous AGM the Society has become affiliated to the Tree Council of Ireland. Alistair Pfeifer has been appointed the Society's representative on the Council.

The Foresters Certificates mentioned at the last AGM have been printed and were to be presented at the symposium.

Preliminary work has been done on the proposed Society Tour to North America and a number of organisations have been approached for sponsorship.

Council Report 1989

The report having been circulated to members was taken as read. F. Mulloy and N. O Carroll congratulated the council on organising the successful Wood Ireland Exhibition at Belfield in October and proposed and seconded the report.

Abstract Accounts

The Hon. Treasurer presented the Society's audited accounts for 1989. He informed the meeting that currently the accounts were in a healthy state, mainly as a result of the increased subscription rate from the beginning of 1990. Adoption of the accounts was proposed by J. Durand and seconded by G. Gallagher. At this point the President paid thanks to the outgoing council for their work during the year.

Confirmation of Elections

The meeting confirmed the 1989 Council Elections as follows: President, W. J. Wright; Vice-President, E. P. Farrell; Hon. Secretary, K. Collins; Hon. Treasurer, K. Hutchinson; Editor, A. Pfeifer; Business Editor, J. Gilliland; Public Relations Officer, D. Magner; Hon. Auditor, W. H. Jack; Technical Councillors, P. Breathnach, P. Doolan, J. Neilan; Associate Councillor, L. Furlong.

Motion

That the annual subscription rate for retired members, over the age of 65, be set at 50% of the rate for working members. The new retired members' rate being optional and to come into effect from 1st January 1991.
Proposed by C. Kilpatrick.
Seconded by M. O'Brien.

Following discussion an amended motion was put to the meeting: That the annual subscription rate for members over the age of 65 be set at half the current rate. The rate being optional and to come into effect from the 1st January 1991. The amended motion was passed unanimously.

Any Other Business

N. O Carroll suggested that the directions to authors in *Irish Forestry* should include the stipulation that material which has been published elsewhere should not be submitted for consideration by the editor of *Irish Forestry*.

E. Hendrick stated that the Society had made a submission to the Cutaway Bog Committee established by the Minister for Energy.

A new Society logotype, designed by Donal Magner, will appear on all Society material. The President paid thanks to D. Magner for his work.

The Editor, Alistair Pfeifer appealed to Society members for articles for *Irish Forestry*. He pointed out that these need not be of a research nature and articles on any topic will be considered.

There was discussion on the need for the Society to develop a voice in professional forestry matters. The President pointed out that a Constitution Committee had been convened under the previous council and it was anticipated that its work would be continued by the incoming council.

E. Hendrick (for K. Collins, Hon. Secretary).

EDUCATIONAL AWARD FUND
FOR YEAR ENDED 31st DECEMBER 1989

1988	*RECEIPTS*	*1989*	*1988*	*PAYMENTS*	*1989*
1,453.47	*To Balance from last account*	1,510.67	100.50	Awards	—
67.29	To Interest	109.79	1,510.67	By *Balance*	1,620.46
—	To Donation	—			
90.41	To DIRT Refund	—			
1,611.17		1,620.46	1,611.17		1,620.46

I have examined the above accounts, have compared with vouchers, and certify same to be correct, the balance to credit being IR£1,620.46 which is held in the Trustee Savings Bank Investment Account 30013591.

Signed: W. H. Jack, Hon. Auditor

SOCIETY OF IRISH FORESTERS – STATEMENT OF ACCOUNTS FOR YEAR ENDED 31st DECEMBER 1989

1988	*RECEIPTS*		*1989*
3,718.33	*To Balance from last account*		1,216.24
	To Subscriptions Received		
	Technical 1989	5,976.09	
	Technical 1988	444.80	
	Associate 1989	1,314.50	
	Associate 1988	199.00	
	Student 1989	130.00	
	Student 1988	35.00	
	Other Arrears	134.98	
	Advance Payments	1,267.43	
6,625.29			9,501.80
	To Interest on Investments		
	Savings at Ulster Bank	136.27	
222.73	Educational Building Society	7.48	143.75
2,888.42	*To Journal*		2,233.24
47.12	To Gains on Sterling		40.77
	To Wood Ireland Repayment		500.00
	To RTE Refund		57.50
25.66	To Donation		10.50
870.00	To Forest '88		718.50
14,397.55			14,422.30

1988	*PAYMENTS*		*1989*
237.50	By Stationery and Printing		136.30
3,448.50	By Printing of Journals		5,978.50
2,631.32	By Postage		1,304.29
610.00	By Expenses re Meetings		26.50
185.50	By Bank Charges		94.48
3,109.60	By Secretarial Expenses		1,468.90
823.56	By Value Added Tax		321.73
—	By Examination Expenses		57.55
—	By Miscellaneous		30.80
888.37	By Insurance Liability		888.38
177.46	By Affiliations		—
	By *Honoraria*		
	Secretary	50.00	
	Treasurer	50.00	
	Editor	50.00	
200.00	Business Editor	—	150.00
—	By Wood Ireland	500.00	
870.00	By Forest '88 Show	—	
	By *Balance*		
	Current Accounts	1,695.59	
	Savings Accounts	1,598.16	
1,216,24	Educational Building Society	171.62	3,465.37
14,397.55			14,422.30

I have examined the above accounts, have compared with vouchers, and certify same to be correct, the balance to credit being IR£3,465.37 which is held in current accounts at the Ulster Bank (IR£1,770.91 less IR£75.32 in uncashed cheques), Ulster Bank Savings Account 08778241 and the Educational Building Society Account 11304413. There is a holding of IR£100 Prize Bond Number R855061/080.

Signed: W. H. Jack, Hon. Auditor

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Improves the reliability of weed control,
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Effective against a wide range of weeds.

Atrazine Flowable 50%
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A highly effective selective **scrub and brushwood** herbicide.

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The new chemistry product for total weed control in Forestry.

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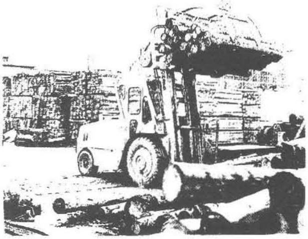

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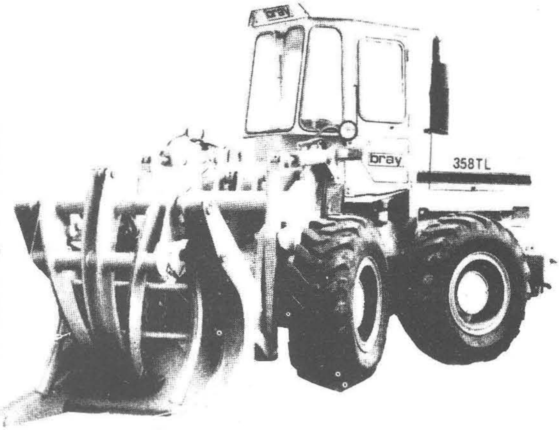

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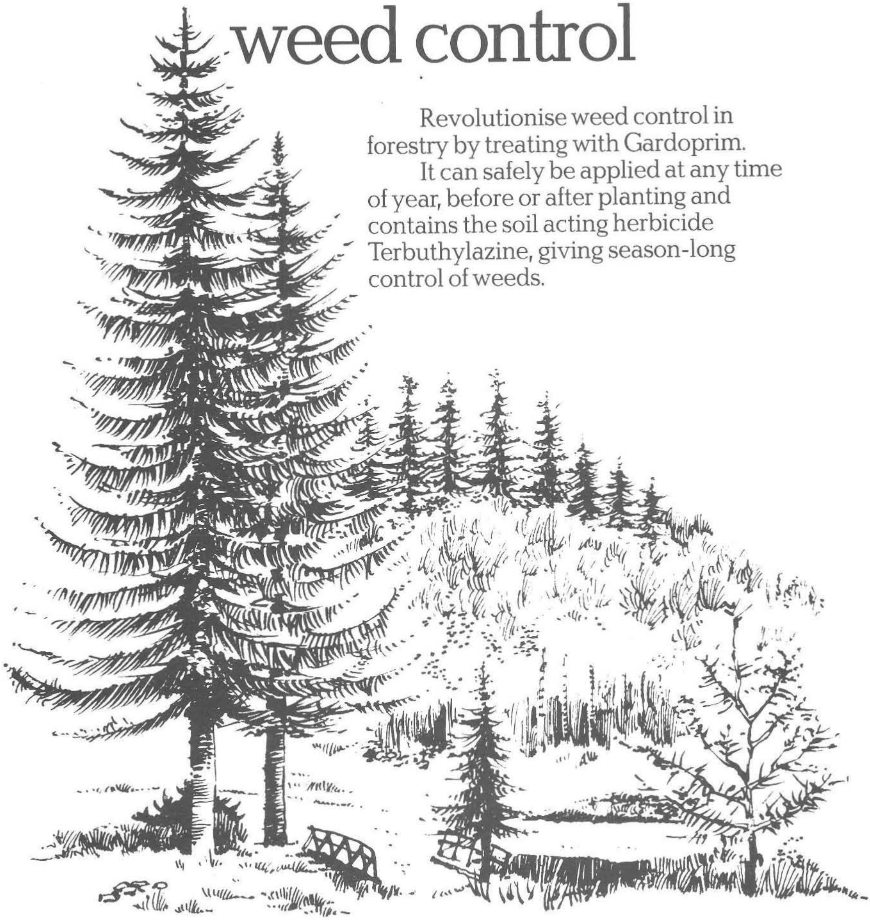

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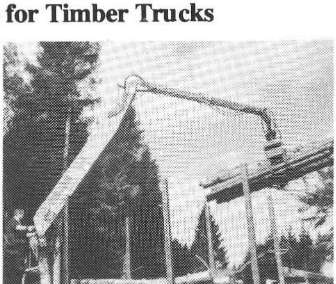

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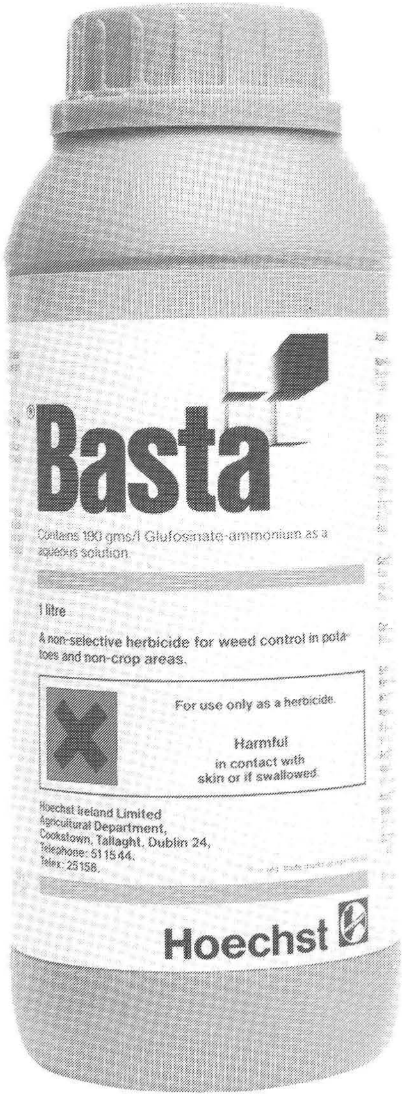

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IRISH FORESTRY

JOURNAL OF THE SOCIETY OF IRISH FORESTERS

Volume 47, No. 1, 1990

Published twice yearly, Price £6

In this issue:

Volume 47, No. 1, 1990
ISSN 0021 - 1192