

ROYAL SCOTTISH FORESTRY SOCIETY  
100th ANNUAL EXCURSION  
Northern Region  
Sunday, 11th May - Thursday, 15th May  
1997

**Christie-Elite Nurseries, Forres**

**Monday 12th May, 1997**

**Introduction**

The theme for the visit is the relationship between nursery practice and post-planting survival and growth, demonstrating the factors taken into account, their relative importance to forest success and the techniques employed to achieve this. After describing these factors, the notes provide a commentary on the demonstrations for the nursery walk.

The factors influencing forest success can be summarised under three headings:  
Plant Genetics, Handling and Form - (in essence "Nature and Nurture")

**1) Genetics (Plant Species and Origins)**

Although of less importance in terms of initial survival, only if the species and origin is appropriate for the site can a forest be expected to develop successfully. Species and origin selection is the most critical decision influencing silvicultural success and financial returns. For example, on an upland site where Sitka Spruce would produce YC16, the use of Pine or Larch would reduce nett revenue by around £3000 per ha over the rotation. By contrast, a new generation of "Elite" Sitka would increase revenue by around £3000.

Strategic planning, trying to foresee industry requirements 3-4 years in advance, is a major preoccupation of nurserymen. Increasingly, partnerships with estates with known planting or restocking programmes allows seed sourcing and plant production to specific requirements. This provides the comfort to foresters that regardless of the vagaries of the market their required stock will be to hand.

**2) Handling**

The old saw that there is no such thing as bad planting, only bad handling, like all such sayings has more than a grain of truth. While there is indisputably bad planting, this has more bearing on future root development and plant stability than survival. In terms of plant health and growth potential the cumulative effect of plant treatment between lifting and planting is paramount.

Good practice requires that the plants are not physically stressed, whether by rough handling, extremes of temperature or exposed to drying conditions. Bare-rooted stock should only be moved when dormant giving a planting season from November to March .or to the end of May if cold-stored. Cell-grown stock can be planted at any time but we recommend avoiding the period of full flush from April through to the end of June.

The introduction of the co-extruded thermal bags has greatly enhanced the quality of plant handling.

These bags reflect and discharge heat maintaining the plants in a cool sealed environment where moisture is retained and recycled. Depending on the season and provided they are not insecticide dipped, plants can be safely kept for many weeks in sealed bags, spread out singly and upright in shaded open space, typically under tree cover (canopy storage). This is very much better than in sheughs.

The use of Root Electrolytic Leakage (REL) and Root Growth Potential (RGP) tests are a valuable measure of plant health. Routine testing on plants leaving the nursery provides a check on nursery practice and a degree of guarantee to the woodland owner that the plants will survive and as importantly, thrive. Until our own laboratory is built we will rely on the FC to provide such tests.

### **3) Plant Form**

Regardless of whether raised from seed or cuttings, shoots should be sturdy with fibrous roots of high proportion to total plant mass. This is achieved by correctly spacing seedlings to give adequate girth and shoot development and at the same time controlling roots by a combination of pruning and ground disturbance. For larger plants, although precision sowing and precise root pruning can produce acceptable results, transplanting usually produces the best root structure and root/shoot ratios. The roots should also be evenly spread without pronounced bend in the main stem below the root collar. This feature is the result of inaccurate settings on the lining-out machine.

After planting cell-grown stock the roots can be disinclined to extend from the root plug into the surrounding soil. To overcome this we encourage the maximum number of growing tips around the root plug using trays with side slits, recently developed in Sweden, and which we now use as standard.

Although root form is important, shoots also need to be healthy, well nourished and with strong terminal buds. For many species most of the subsequent years growth after planting is dictated by the reserves laid down in the bud. This can be enhanced by techniques to induce early dormancy in the summer prior to planting out. We refer to such plants as Physiologically Well-programmed Plants (a fact sheet is available).

### **Christie-Elite Nurseries: The Nursery Walk**

Follow the route identified by the coloured ribbon. Proceed at your own pace but please aim to be back in the large shed by 1pm for lunch. At 1.30pm the President will mark the occasion by planting a Scots Pine at the main nursery entrance.

#### **Stop 1**

(a) Conifer seed is broadcast on prepared sterilised beds at a density calculated to give about 300 seedlings per sq. metre

(b) covered with lime-free grit

(c) and rolled to retain moisture. Irrigation is essential for the period immediately after sowing in dry weather

(d) To bring stock more quickly to a usable size the beds may be covered in fleece. This helps to compensate for our northern location when competing with continental or southern nurseries. After the initial boost the fleece is removed and the benefits of the hardy northern stock are still applicable.

### ***Cross Railway Line***

## **Stop 2**

- (a) After one year an undercutter is used to prune and encourage root development and check shoot growth. This helps achieve the correct balance between shoot and root. After 2 years the seedlings can be used for forest planting as 2yr undercuts (1ul) or even kept for a third year when they are 3yr undercuts
- (b) The seedlings are lifted by hand after passing an angled, vibrating blade under the beds to loosen them. Some are sold and a proportion provide the transplanting stock.

## **Stop 3**

- (a) Seedlings are lined out to produce transplants. Each lining-out machine needs five persons and a driver and plants about 50,000 seedlings per day. Careful monitoring of the machine settings and placement in the planting wheels is essential to avoid root or stem distortion
- (b) After lining-out a weed-control spray is applied and irrigation and feeding maintained as required. After one year, or sometimes two years, the finished stock (2+1) or (2+2) respectively is lifted
- (c) sometimes by machine such as this Famo lifter
- (d) graded and packed for delivery or cold storage

## ***Re-Cross Railway Line***

## **Stop 4**

Cell-grown stock provides an alternative format for foresters. It has advantages for species which are difficult to establish bare-rooted, provides planting opportunities at other times of year and can shorten the nursery production cycle. The controlled environment maximises the yield for scarce seed and enables plant pre-programming for faster establishment.

- (a) A range of tray types are used. We use as standard the Swedish cells with side-slits
- (b) Plant cells are filled by machine,
- (c) Large seeded species are sown by hand,
- (d) Small seeded species are broadcast in trays and pricked-out by hand,
- (e) Uniform seed (most conifers) is sown by machine, usually 2 or more seed per cell
- (f) These require to be singled by hand

## **Stop 5**

This heated tunnel is full of Native Pine raised from seed collected in the Spring '97 and scheduled for planting later this year. Trays are raised off the ground to provide air pruning of the roots.

## **Stop 6**

The vegetative propagation of the next generation of "Elite" Sitka.

- (a) Seed is produced by controlled pollination between proven clones by the FC Research Branch
- (b) Stock Plants are grown
- (c) These provide the cuttings
- (d) Cuttings are struck into mini-plugs and rooted in a controlled environment

- (e) After 3 months or so the cuttings are sufficiently rooted to be lined out as per normal seedlings
- (f) The finished transplant ready for forest use

The benefits these “Super Elite” confer on the grower are displayed at the lunch stop.

### **1.00 pm**

Lunch in the big shed where the grading system, nursery equipment and cold store can be viewed plus an information board describing the progress of the genetically improved Sitka programme and the “Super Elite Sitka, The Next Generation”.

### **1.30 pm**

The President will plant a Scots Pine at the nursery entrance

### **1.45pm**

Board the buses for departure

### **Forestry Commission Research Branch.**

The aim of the FC Research Branch is to increase the sustainable benefits from trees and woodlands by providing authoritative advice based on sound research. The two main Research Stations (Alice Holt, Hampshire, and Northern Research Station, Roslin) are supported by a network of 12 Field Stations covering Britain’s environmental and ecological conditions. Members may choose one of the following four sites to visit:

#### **Dava Moor (Braemora): Creation of New Native Woodlands.**

The Forestry Authority are encouraging planting of new native pinewoods in the Highlands. Forest operations should cause minimal site disturbance during the establishment phase. Experiments on Braemora Estate, involve low intensity cultivation and fertilisation with phosphate.

#### **Elchies (Bruntlands): Tree Improvement of Sitka spruce.**

A 13 year old full-sib Sitka progeny test will be visited. This demonstrates the gains available from the next generation of breeding.

#### **Teindland Forest: Limiting factors to tree growth on heathlands**

Research began in the early 1980’s into the use of sewage as a forest fertiliser. The Forestry Commission are co-operating in this work with the Water Research Centre and the Macaulay Land Use Research Institute. A number of experimental sites now demonstrate the growth responses that can be achieved under different application regimes. Two experiments will be visited. The first shows the use of liquid sludge on mineral heathland which has allowed a Sitka spruce crop to be established without the need for additional inputs. The second shows the use of granulated sewage to release a crop of Sitka spruce from severe check.

#### **Munloch (Black Isle): Short Rotation Coppice Energy Woodlands.**

Members will have the opportunity to inspect these clonal experiments with willow and poplar, which are

part of the UK wide series of experiments designed to test representative clones on a range of sites for their potential as future breeding stock for Short Rotation Coppice Energy Production. Energy coppice employs clones which are disease resistant and vigorous. Breeding programmes continually develop new clones, and it is unlikely that those recommended today will still be the same as those recommended in 5 years time. These experiments will help to predict the performance of future clones.

**Tuesday 13th May 1997**

**Glenmore Forest Park (Forest Enterprise).**

**Background:** Glenmore Forest Park lies between Abernethy and Rothiemurchus Forests in Strathspey. The Forestry Commission acquired the area in 1923. Only scattered remnants of the Caledonian forest amounting to some 80 ha in small groups and individual trees remained. During the next 50 years 1500 ha were planted with Scots pine, Sitka spruce and Lodgepole pine. In 1948, the Forest Park was designated and has become a very popular with around 800,000 visitors each year.

**Staff:**

David Jardine	<i>Forest District Manager</i>		
Ken Sinclair	<i>District Forester (Harvesting)</i>		
Alasdair MacLeod	<i>District Forester (Forest Management and Recreation,)</i>		
Roddy MacLeod	<i>Beat Forester</i>	Jim Gillies	<i>Recreation Forester</i>

**Detailed Description of Tour:**

**Stop 1: Coire na Ciste Car Park (NH 998 074) Introduction to Glenmore**

Geographic and environmental setting; History and development of Forest Park; Caledonian Forest Initiative; Management and Forest Design Plan Objectives; Partnerships

**Discussion Point:** Is the balance in objectives right?

**Stop 2: Harvesting of introduced conifers (Compartment 3100)**

Forest Enterprise declared 1000 ha of the Park a Caledonian Forest Reserve in 1992. Since then 400 ha of non-native crops have been removed.

Crops:	Caledonian Scots pine	dating from c. 1800	
	Scotspine	p.1928	YC2- 4
	Sitka spruce	p.1928	YC 4- 8
	Lodgepole pine	p.1967	YC 6

View harvesting; Felling by Direct Contractor using JCB/Silvatec 445 or new Daewoo/Silvatec 555 harvester; Extraction (FE machine) by Valmet 840 forwarder; Clearance of check by motor manual contractor.

**Discussion Points:** Choice of harvesting system  
Retention / management of planted Scots pine?

**Stop 3: Development of restored areas (Compartment 3075)**

Caledonian Scots pine dating from c. 1800; Clearance of non-native conifers (p.31 Western Hemlock, Norway and Sitka spruce) in 1992; Monitoring regeneration.

**Discussion Points:** Treatment of regeneration  
Deer management

## Monitoring of ecological change

### **Stop 4: Visitor Management and education (Glenmore Visitor Centre)**

Opened in 1991; Refurbished in 1996/7 using ERDF money in partnership with 4 other organisations; Overview of recreation strategy for Glenmore; Tour of new exhibits.

**Discussion Points:** Measurement of success in interpretation / visitor management  
Scope for development of additional messages?

**Tuesday 13th May 1997**

### **Abernethy Forest Nature Reserve (Royal Society for the Protection of Birds)**

**Background:** The RSPB Reserve comprises 12,795 hectares, entirely owned by the RSPB. Acquired by seven separate purchases since 1975 at a cost of over £3.8 million, the estate includes most of the Abernethy Forest with 3265 ha of woodland of which 1935 ha are native pinewood. The rest are pine plantations from 10 to 100 years old. To the South of the forest are extensive areas of heather moorland rising to the montane plateaux of Bynack More, Cairngorm and Ben Macdui. Within the reserve there are three National Nature Reserves (NNR) managed by agreement with Scottish Natural Heritage (SNH).

Most of the reserve is of exceptional importance for nature conservation with a wide range of interests. These include the geological / geomorphological interest of the high ground, the montane plant and bird communities, and the extensive native pine forest with its special birds, plants and insects. The area is also of very high landscape value and is enjoyed by substantial numbers of visitors. On the high ground these are mainly hill walkers, climbers and cross country skiers, while in the forest, visitors tend to be walkers and naturalists, apart from the general cross section of people who come to see the ospreys on Loch Garten. Ospreys first returned to nest in Scotland in 1958 after an absence of 40 years. Operation Osprey is a protection scheme involving staff and volunteers which allows the general public access to an observation hide situated at a safe distance from the nest. In a good year approximately 50,000 visitors come in the period May - August, and the ospreys are a significant tourist attraction to the area. The Scottish Osprey population has built up to over 100 pairs.

The native pinewood is being left to develop naturally but the pine plantations are managed to create a more natural structure and mix of trees and shrubs, involving the removal of exotic conifers and progressive thinning of planted pines. Forest drains are blocked to restore natural water tables and to assist woodland grouse populations. Deer fences have been removed wherever feasible. Deer are being rigorously controlled to allow regeneration to succeed and to allow the pinewoods to extend back to their former range. The changes are being carefully monitored.

#### **Staff:**

Stewart Taylor	Reserve Manager
Desmond Dugan, Richard Thaxton, Andy Amphlett	Wardens
Robert Moncrieff	Assistant Warden
David Lambie	Stalker
Ross Campbell	Reserve Trainee (Skillseeker)

**Access Track Stop: A p.** 1972 Scots pine plantation, managed by heavy thinning to develop tree crowns and ground vegetation. The thinning is irregular, leaving clumps and widely spaced trees. All broadleaves and juniper are retained. Manual felling was undertaken, with Norcar forwarder type extraction. The brash has been left to die down, and there was no stump treatment.

**Stop 1:** Thinning plantation edges where juniper and broadleaves are present. There is a lack of deciduous woodland at Abernethy and this work encourages seed sources. The remainder of this part of the plantation will remain unthinned.

**Stop 2:** Semi-natural forest to one side, and plantations to the other, are managed for Capercaillie. Good canopy and ground vegetation, particularly Blaeberry, which is 12 times richer in Lepidoptera larvae than other vegetation types, is important. This provides adult and particularly young chick feeding habitat. The incidence of fence collisions by woodland grouse will be described.

**Stop 3:** Boglechynach Plantation (p.74-77 Local provenance Scots pine) can be viewed. Because of ploughing, good numbers of natural seedlings had become established. A crop of Christmas trees was taken in 1993 and planted pines felled in 1994, but not extracted. The aim is to have a natural forest developing without silvicultural intervention.

**Stop 4:** Rynettin Cottage provides holiday accommodation but was permanently lived in until 1960. The site has archeological importance, and excellent views to Cairngorm and the montane habitats.

The Deer Forest became part of the reserve in 1988, and carried 900 - 1000 animals. In 1989 a reduction of the population started. In 1996, counts revealed 200 - 300 animals. There is now ample evidence of woodland expansion by natural regeneration without the need for fences.

In 1994, a WGS application was approved, covering 5241 ha. with Special Management Grant paid over 1651 ha. 296 ha attract a regeneration grant and 212 ha were covered by an existing regeneration grant. This was the first major scheme to be accepted by the Forestry Authority without fencing.

Rynettin Hill, behind the house, shows how exotic conifers have been removed from a remote site, with attendant extraction problems. A track was created across fields for extraction and this has now been restored to grassland. The potential future tree line is visible, above the montane forest zone at 650 m.

**Stop 5:** The River Nethy is an important salmon spawning river with 100 - 300 fish in the stretch in RSPB ownership each November. Research has been undertaken recently into water quality, aquatic fauna and riparian vegetation. Monitoring is being undertaken to try to understand more about the effects of forest expansion on the river and its catchment.

**Stop 6:** Despite its small size (in world terms) Abernethy Forest has a wide range of age classes from recent regeneration to ancient stands over 300 years old. Deadwood is present throughout the forest and supports a range of dependent flora and fauna.

### **Wednesday 14th May 1997 Novar Estate.**

The Munro Ferguson family have owned Novar Estate since the late 18th Century, and have developed a forestry tradition from that time. The first formal working plan, covering 1500 hectares, was drawn up by Lord Novar in 1899. Much of the area has been managed using a shelterwood system which has resulted in the woodland developing its own distinctive character which the Estate intends to maintain using Continuous Cover Forestry techniques. In the 1960's large areas of hill ground and marginal farm land were planted, increasing the woodland area to 3,500 hectares. These areas are now productive, with first thinning and clearfelling being carried out.

**Outward Journey:** View continuous cover forest, with patches partially damaged by the 1989 storm. Consider regeneration efforts and deer damage; Admire views over Glen Glass; Note YC20 Sitka spruce and excellent Douglas fir contrasting with DF of unknown poor provenance, together with invasion of Hemlock.

After emerging from the forest, the coaches cross the grouse moor, with views of the higher elevation Scots pine, Lodgepole pine and Sitka spruce in the distance. The road has been built to allow construction crews to reach the site of the National Windfarms turbines at 500 m altitude. Once on the summit, Bob Nicholson, Resident Engineer, will describe the project.

Descent: Admire views of Boath and its upland forests; Re-enter Lodgepole and Sitka spruce pole stage crops at the foot of Meall an Tuirc, and descend to the public road, crossing to the waterfall site surrounded by well established forest. Note the hydro-electric scheme commissioned by Novar Estates.

**Lunch:** Examine restructuring, with Scots pine replaced by Sitka spruce before departing for the Black Rock Gorge.

**Afternoon Stroll:** Alight, and descend on foot to some very tall Douglas fir, Larch and Grand fir. There will be a height measuring contest of the tallest tree. Continue along the walk to the gorge, crossing the River Glass footbridge, and passing through the continuous cover, multi-benefit Evanton Wood, stocked with Scots pine, Sitka spruce, Larch, Douglas fir and broadleaves. There will be opportunities to discuss the funding of continuous cover forestry, silvicultural treatments, selection of over-storey, regeneration takes, timber quality, removal of Western Hemlock and the provision of public access.

Arrive at the Evanton Caravan Park to view a site where the main crop of Western Hemlock has been completely removed. The Estate has been pleasantly surprised to find a reasonable stocking of Scots, Sitka and Douglas of good form. There has been excellent regeneration of all species with Hemlock being retained for 10 years as a nurse before respacing is undertaken.

**Annual General Meetings** will be held in the Courtyard, to conclude the day at Novar.

## **Thursday 15th May 1997**

### **The Scottish School of Forestry (a part of the Inverness College).**

Established in 1975, the School has its own 10 hectare site, six miles from the centre of Inverness. The School has 10 staff qualified in forestry and also calls on the services of other college faculty staff for their expertise.

The School provides a comprehensive range of courses to the forest industry. Full time courses are the Certificate in Forestry, the Higher National Certificate in Forestry, the Higher National Diploma in Forestry and the BSc. in Forestry and Conservation; part time attendance for these qualifications is possible. The School provides Scottish Vocational Qualification (SVQ) courses and short training courses either at Inverness or at the workplace. Such courses include operator training, supervisor and management courses.

## **Highland Birchwoods Display and Demonstration at the Scottish School of Forestry.**

Highland Birchwoods is a charitable company working through partnerships to pioneer the multi-purpose management and use of native woodlands in the Scottish Highlands.

The display features current aspects of work on the processing, utilisation and promotion of native timbers, including a working demonstration of the Blossom mobile double-slabber saw. This tractor mounted saw is designed to enable economic primary processing of short lengths of small diameter hardwood timber. Billets are cut to standard specifications currently in demand for a variety of high value end uses, such as flooring, panelling, furniture and turnery.

**Saw Specification:** The mobile double slabber consists of two parallel circular saw blades which are adjustable and powered by tractor PTO. Tractor hydraulics operate the log feed which has variable feed speeds. The saw is transported to site on a standard 8' x 5' trailer and is unloaded and operated using a tractor three point linkage. The saw performs three main operations: Converting small diameter round logs into squared timber (cants); Edging the slabwood; Resawing the cants and slabwood into boards.

The double-slabber is very efficient at the initial conversion and edging operation, but because of a wide kerf it should only be used for resawing if a separate resaw is not available. The saw is robustly manufactured to withstand continuous, heavy use in farm and forestry conditions. Because the saw is mobile, the logs can just as easily be processed at the woodland edge as in the farm or estate yard, enabling the woodland manager to retain more of the added value.

The double -slabber has been developed by Colin Robbins, of Bryn Mawr Farm Timber, with support from Coed Cynru. FC Technical Development Branch have also provided invaluable technical advice and will be publishing a report later in 1997.

The machine has been purchased as part of Highland Birchwoods Demonstration Woodlands Programme with support from the Millennium Forest for Scotland Trust, Ross and Cromarty Enterprise and Cromarty District Council. The saw is available for hire anywhere in northern Scotland. Those interested in purchasing a machine should contact the manufacturers, Blossom Design (01559 384303).

### **ROYAL SCOTTISH FORESTRY SOCIETY 100TH EXCURSION**

#### **The Cawdor Estate**

**OWNER:** THE DOWAGER COUNTESS CAWDOR.

**FACTOR:** MR GORDON ROBERTSON

**FOREST MANAGER:** MR STEPHEN CONOLLY

**FOREST FOREMAN:** MR WILLIAM GRANT

**FOREST WORKER:** MR ALAN BREATHE

**TREE BOTANIST:** MR JAMES PATERSON.

## **THE VISIT:**

Your time on Cawdor estate is limited and to ensure that the time is well spent the choices of activities are;

Guided walks through the Big Wood.  
Cawdor Castle tour (not guided)

Please let Mr Robertson know what you would like to do when you arrive. It will be possible to do both activities so long as the estate knows on arrival.

The restaurant will be open and lunch can be obtained at your own expense, however, entry in to the Castle is free courtesy of the Dowager Countess Cawdor.

The Cawdor Estate lies with its northern boundary on the shores of the Moray Firth, and extends southwards to Carrbridge, comprising approximately 60,000 acres (24,282 hectares).

At its heart lies Cawdor Castle, which was built over 600 years ago. The Castle remains very much a family home, but for 5 months every summer it is open to the public, attracting 100,000 visitors to the Castle gardens and the ancient woodlands that surround it.

Cawdor is fortunate to be a truly diverse estate, with many separate enterprises, all of which are integrated in an overall business management plan. The area is one of a fairly low annual rainfall 30 inches per year (762 mm per year) with light soils near to the coast which become increasingly productive as one travels inland before reaching higher ground.

Arable crops such as Winter Wheat, Oil Seed Rape, Winter Barley grow well up to an altitude of 150 metres above sea level, at which point the land use changes to grazing pasture, forestry and above 250 metres, heather moorland.

## **Estate Enterprises**

### **Farming**

Thriving home farm comprising 1,500 acres (607 hectares) arable land. This area will double by 2002 as various short term lets come back in hand. A further 8,000 acres (3,238 hectares) are held for grazing by seasonal tenants The estate has no stock of its own.

### **Forestry**

There are approximately 5,000 hectares of woodland on the Estate, mainly productive commercial plantations, but also containing a 160 hectare S.S.S.I. oakwood, and a 200 hectare birch regeneration scheme. At the end of 1997 there will be an additional 1000 ha of new planting which will be designated as a New Native Pinewood. This woodland will cover an area which was previously used only for the occasional grouse shoot. Located just north of Carrbridge and close to the A9 it will enhance the landscape as well as reintroducing many wild life habitats that were previously present when Caledonian forest covered the area.

The plantations are managed to produce a sustainable long term flow of timber, whilst maintaining and enhancing their ecological and landscape value.

The native woodlands are managed purely for their conservation value.

### **Houses and Cottages**

The estate owns 100 houses and cottages, including most of the village of Cawdor, which is a conservation area. These are primarily let to local people but there are two furnished holiday cottages.

The maintenance department have the responsibility for the upkeep of the Castle and all dwellings upon the estate. There is a policy of inward investment, to safeguard the fabric of all dwellings and to improve the standard of accommodation.

### **Sporting**

#### **Salmon Fishing**

12 kms of River Findhorn. 4 Beats May to September. Also has fishing on the River Nairn.

#### **Roe Deer Stalking**

#### **Wild pheasant shoot**

25,000 acre Grouse Moor with Sporting Lodge. Grouse numbers very low but continued investment in moorland management hopefully will bring returns in the years to come.

7,000 white hare shot last year.

Estate encourage small business'. Will look at sensible alternative uses for redundant farm buildings.

### **Others**

Small caravan park.

Sand and Gravel Quarry.

## **CAWDOR BIG WOOD**

The Big Wood extends to 306 hectares lying between and on each side of the arms of an inverted 'Y' formed by the confluence of two burns flowing north in rocky gorges. The protected central area was mapped as forest as early as 1660 and it suggested that it may have been forest since the retreat of the ice cap about 11,000 years ago. Over the latter period the wood has been variously managed under regimes as diverse as group selection and shifting cultivation, because of, or despite this, the wood is now unique in north-east Scotland in its diversity of species and age classes.

Currently the estate is monitoring the amount regeneration which is occurring in different areas of the wood after different ground preparations. These include ground disturbance from natural wind blow, scarification, and no activity under the tree canopy. It is hoped to understand better the best way to regenerate the Oaks that are now beginning to show signs of degrade. Many factors are thought to be the cause of the poor regeneration rate including, thick ground vegetation, heavy shade, low squirrel counts and high numbers of deer present in the wood. The three plots being monitored are showing encouraging signs of regeneration having been deer fenced, however, the amount of light required will have an

influence in the coming years.

### **Factors of locality**

Climate:	Cawdor is in the second coldest and within the lowest rainfall zone in Scotland.
Rainfall:	Mean annual rainfall at the castle gardens is 762mm and the lowest recent recording was 450mm for the year of 1972, which is very low indeed for the UK.
Frost:	Recorded on 50 + days a year, down to a recent minimum of -19C; frosts are by no means unusual in early June, to a damaging degree.
Exposure:	Gales of hurricane intensity have created havoc from various points of the compass, e.g. in 1953 (NE) and in 1961 (SW).
Topography & Aspect:	The ground rises gently to the North but the configuration is influenced by the glacial origin of the site and all aspects occur.
Geology & Soils	The main part of the Big Wood is Middle Old red Sandstone conglomerate: overlain with Fluvioglacial material, which has given rise to deep, freely drained soils of moderate fertility. The south part of the wood overlies less fertile schist and gneiss

### **Management**

In 1955 Professor Mark L Anderson of Edinburgh University prepared a management plan to convert the wood to the Group Selection System with a conversion period of 120 years. The area was divided into 6 equal sized blocks to be managed on a 6-year working circle, 1/120 of the area would be stocked or restocked each year in groups of 0.02 or 0.04 of an acre in extent, all operations being confined to one block in any year. Yield was strictly controlled by the "Check Method" involving 100% enumeration of a 6 - year cycle. The system was abandoned after Professor Anderson's death in 1961, however, much of the value was learnt from the experiment. A revised and less rigid management plan was mooted by the University but was never put into practice and from 1964 a flexible approach to management was adopted in which 86 hectares of poorly stocked, mixed woodland scrub at the south end of the wood were cleared and restocked with conifers. The balance of the wood is managed to maintain its mixed character.

In 1985 165.2 hectares were notified by the Nature Conservation Council as a Site of Special Scientific Interest (SSSI) and their successor Scottish Natural Heritage is responsible for the management of this area in consultation with the Estate.

Four separate areas are recognised:

The central oakwood or. "Core Area"

The Gorges - the precipitous slopes to the burns with their unique flora and semi-natural woodland.

The Pinewood - an area of Scots pine planted in 1792.

The Mixed Wood - mature oak and beech woodland with conifers, mainly European larch.



## **NATIONAL WIND POWER LIMITED**

### **NOVAR WINDFARM, NOVAR ESTATE THE DEVELOPMENT**

Novar Windfarm, which is currently under construction, will consist of thirty-four 500 kW wind turbines on the hills of Bendeallt (Beinn na Diollaide), Cnoc Gillie mo Bhrianaig and Meall an Tuirc on Novar Estate. Each turbine will be mounted on a tapered steel tower 35 metres tall (115ft), with a 3 bladed rotor of about 42 metres (138ft) diameter, giving a total height from ground to blade tip of about 56 metres (184ft). The turbines will be linked by a network of access tracks and underground cables to a substation in Glen Mor below Bendeallt. From here, the electricity will be carried by a new line to the local distribution system at Hydro-Electric's Alness sub-station. While most of the new line will be carried on wooden poles above ground, some sections will run underground, where environmental and/or technical criteria warrant the extra cost.

The total capacity of the windfarm is 17MW and the windfarm is expected to generate an average of 70 million kilowatt hours of electricity per year. This is equivalent to about 40% of the total electricity consumed each year in the Easter Ross grid (this is the grid which serves Evanton, Alness, Invergordon, Nigg, Tain, the seaboard villages and the rural areas in between). The cost of the development is approximately £17 million. The life of the windfarm is expected to be 25 years, at the end of which the turbines will be removed and the site reinstated.

### **ENVIRONMENTAL IMPACT ASSESSMENT & PLANNING PERMISSION**

To ensure that windfarm would not result in significant negative environmental impacts, National Wind Power carried out a detailed Environmental Impact Assessment at Novar. This began in 1994 using independent consultants and continued until early 1995. The information from the studies was combined with experience from windfarms which we had previously built, to produce a site design which ensures that ecologically sensitive areas are not disturbed by the development. The results of the assessment were written into an Environmental Statement, which was submitted to Highland Regional Council with the planning application in May 1995. The Statement was audited by the Institute of Environmental Assessment, who gave it a grading of B (only minor omissions and/or inadequacies). This high level of grading has been achieved at just one other windfarm, Windy Standard, which is a joint development by National Wind Power & Fred Olsen Limited.

The site was granted conditional planning permission in December 1995. The full permission was released on final agreement of conditions in October 1996.

## CONSTRUCTION

Construction began in the autumn of 1996 by upgrading existing estate tracks and building one new short section of track. In total it has been necessary to upgrade 13 km of existing estate tracks and build a further 13 km of new tracks (ongoing). Within constraints placed upon us by the planning process, wherever possible the tracks have been located in such a manner that they are also useful to Novar Estate. Stone for the tracks has been excavated on the estate from two separate locations, with a small amount of imported sand and stone used for specialist purposes. Tracks are 4.5 metres wide, with widening at passing places and bends and in some areas where poor ground conditions exist. Reinstatement of hill track verges is carried out immediately after construction, tracks on the lower ground will be reinstated during the course of 1997 (where it has not already been carried out). Where peat is thick, tracks are floated over the surface of the peat using geotextile laid directly on top of the vegetation.

At each turbine location, the peat is removed over an area 12m by 12m and the rock excavated to a depth of about 3 metres. A two-tier reinforced concrete foundation is then built in the excavation, of which only the smaller upper tier protrudes above ground level. Each foundation contains 116 cubic metres of concrete. Once the concrete has set, the void above the lower tier is backfilled with rock up to ground level and the peat is replaced. The turbine tower is then placed onto the upper tier and bolted down. The nacelle (which contains the gear-box and the generator) is placed on top of the tower and finally the rotor is lifted into place on the front of the nacelle.

The substation building and the power line are constructed in parallel with turbine erection. The windfarm will provide the equivalent of 35 man-years of employment during the construction phase.

## OPERATION

The windfarm will become operational in September 1997. It will provide work equivalent to two and a half full time jobs. Through rates, rental payments and wages it is expected to put about £150,000 into the local economy each year.

The turbines generate electricity at 630 volts, which is stepped up to 33,000 volts by a transformer located inside the base of each tower. The turbine operates fully automatically and is self starting when the wind speed reaches an average of 5 metres per second (m/s). The power increases in proportion with wind speed until its maximum output is reached at 15 m/s, at which point the power is regulated by aerodynamic stalling of the rotor. At wind speeds in excess of 25 m/s, the turbine is shut down through deployment of aerodynamic and mechanical brakes and the rotor is parked. The turbine re-starts itself when the wind speed drops below a pre-set restarting limit. At Novar, the wind speed range is such that there will

be very few days each year when electricity is not generated.

Peak production will be between October and April when demand for electricity is highest. Wind energy production tends to match electricity demand, as windy weather increases heat loss from buildings, which leads to higher electricity consumption. The efficient modern design of the turbines results in 99% availability. Annually, the capacity factor of the windfarm will be in the order of 48% (the largest power station in Scotland, the coal-fired station at Longannet, is currently run at a capacity factor of about 40%).

National Wind Power will monitor the site during the first five years of operation, in association with SNH and RSPB, to ensure any impacts on wildlife are accurately recorded. This information will be added to that gathered from existing windfarms to increase our knowledge and to enable us to further improve our designs.

## **DECOMMISSIONING**

At the end of the lease and planning permission in 25 years time, it may be that a future generation will wish to continue with a windfarm at Novar. However National Wind Power make full provision at all their windfarms to ensure that they can be decommissioned at the end of their life, i.e. that the turbines can be dismantled and removed. At Novar, National Wind Power have entered into a Section 50 agreement with Novar Estate and Highland Council, backed by funds which were placed in a secure account before construction began.

## **WHY NOVAR?**

To generate electricity efficiently the wind should have an average speed above 7.5 m/s (about 17 mph) and it should flow smoothly. This means that lowlands are generally unsuitable because the speed is too low, and mountains are unsuitable because the flow is too turbulent. The ideal site is a high hill of the type typically used for rough grazing. Although there are many sites like this in Scotland, they are usually in sparsely populated areas where the electricity grids tend to be weak. This constrains the development of wind energy in many areas. Upland areas, often because they are sparsely populated or because they are too windy for cultivation, or both, also tend to be environmentally sensitive, which places restrictions on the ability to develop them. The hills of Novar Estate have a high wind speed, the right landform and are close to a suitable connection point on the electricity network. The process of environmental impact assessment which we carried out ensured that we could identify and avoid sensitive areas.

## **NATIONAL WIND POWER LTD.**

National Wind Power Limited was established in August 1991 by National Power plc, British Aerospace Ltd. and Taylor Woodrow Construction Holdings Ltd. It was formed by combining the windfarming interests of these three, who had been involved in wind energy developments since the late 1970's. In April 1996, National Power Plc became the sole owner of National Wind Power.

Since being formed, National Wind Power has built eight windfarms in Britain. Novar and one other windfarm at Llyn Alaw, Anglesey are currently under construction and a further four are going through the planning process.

**FURTHER INFORMATION**

If you would like further information about Novar or any other National Wind Power development, please feel free to contact us at the addresses below.

The process of identification of new sites, with due regard for environmental, technical and economic suitability is ongoing, and we particularly welcome enquiries from landowners who are interested in having a windfarm on their land.

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