

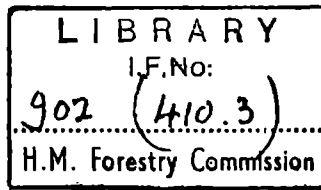
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HISTORY
OF
SLATTADALE

FOREST

N(S) CONSERVANCY



FORESTRY COMMISSION

HISTORY

of

SLATTADALE FOREST

1921 - 1951

NORTH (SCOTLAND) CONSERVANCY

History of Slattadale Forest

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HISTORY OF SLATTADALE FOREST

CHAIRMAN'S COMMENTS

Mr. Graham-Campbell has written a good and painstaking history of this difficult area.

Sir John Stirling Maxwell (Chairman), who was used to the treatment of difficult sites at Corroul remarked at his inspection in October 1928 that Slattadale was a much more difficult subject than he had previously thought, and that there was need for much more drainage.

The first inspection note of which I have a record is that made by Mr. Frank Scott following my visit of September 25th 1930. Under the heading "General Notes" he makes 10 points of which Nos. 3. (Drainage), 6 (Use of Scots pine) and 7 (Restraint in beating up spruce areas) seem most important when viewed in retrospect.

Nevertheless the procedure seems to have been the extensive application of beating up in a way which suggests perhaps more determination than intelligence.

Following a visit in 1943 I minuted the Inspection Report as follows:

"Slattadale has always been regarded as one of our most difficult areas. The state of our knowledge at the time of acquisition was unequal to the task of afforesting much of the ground and consequently there was waste and disappointment. On the other hand growth on the remaining ground has been excellent."

That, I believe, epitomises the broad lesson to be learned, viz. the necessity of restricting large-scale work on poor ground to well-proved methods.

Slattadale will continue to be of special interest for a number of years in respect of the further development or retrogression of the areas which are still backward.

R.

Feb. 29th, 1952.

HISTORY OF SLATTADALE FOREST

GENERAL DESCRIPTION OF THE FOREST

Situation

Watson in his "Place Names of Ross and Cromarty" gives the information noted below.

Slattadale; G. Sleiteadal; N. Slettr-dalr, Evendale.

The forest derives its name from the former sheep farm of Slattadale, which extended over approximately the same area as the existing forest.

Slattadale Forest is situated in the County of Ross and Parish of Gairloch, and it extends for three miles along the main road from Kinlochewe to Gairloch, on the southern shores of Loch Maree. It is nine miles from Gairloch and twenty miles from Achnasheen by road. The nearest railway station is at Achnasheen. Included in the forest is the Eilean Rhuairidh Mor, which lies in Loch Maree about three quarters of a mile north-north-east from the shore at Slattadale.

The land was feued from Sir Kenneth J. Mackenzie of Gairloch in 1921, and included in the agreement was the right to float timber through Loch Maree and the River Ewe, at all times except during July, August and September, which is the fishing season.

Area and Utilisation

TABLE I

From (Owner)	By	Date	Plant- at- ions ac- quir- ed	Plant- able excl. Col. 4	Nur- ser- ies	Agri- cult- ural	F.W.H and Hous- ing Sites	Un- plant- able excl. Col. 4	Other Land		Total
									Desc- ript- ion	Acre- age	
Sir Kenneth J. Mackenzie of Gairloch	Feu	9.11.21	71.0	632.3	-	3.6	15.1	432.0	-	-	1154.0

TABLE II
Area as at 30.9.51

(a) <u>Plantations</u>		
Acquired	71.0	
Formed by F.C.	<u>623.1.</u>	694.1. acres
(b) <u>In hand, awaiting planting</u>		
Blanks after felling	-	
Burnt Areas	9.2	
Other Land	<u>-</u>	9.2 acres
(c) <u>Nurseries</u>		-
(d) <u>Agriculture</u>		3.6 acres
(e) <u>F.W.H.</u> Number 1		14.5 acres
(f) <u>Unplantable Land in hand</u>		432.0 acres
(g) <u>Other Land</u>		
New Housing Site	.4	
Forester's House	<u>.2</u>	<u>.6</u> acres
TOTAL		<u>1154.0</u> acres

The acquired plantation is on Eilean Ruairidh Mor, and is an uneven aged stand of natural Scots pine of fair quality.

The Commission started planting in 1922, and the work was mainly completed by 1932. In 1938, 245 acres were written off and this land was classed as unsuitable for planting. 9.2 acres were burned in 1948. As a result of a re-survey in 1951, a further slight adjustment of areas was made. Of the 432 acres shown in Table II as unplantable, it is probable that small patches will be planted experimentally in future years. At the same time, there are still areas of P.27 and P.31 not yet established, where a write off may be necessary. The total area planted is, therefore, unlikely to vary a great deal in future.

The nursery was reduced from 3.0 acres to .5 acres after the main plantings had been completed, and was closed in 1948.

The agricultural land now consists of part of the old nursery, together with the field round the new housing site. These areas are used as grazings for the horse, and as stacking sites.

Utilisation of land is not affected by agricultural or sporting tenancies. The fishing rights have been retained by Sir Kenneth Mackenzie, but all other rights were transferred with the feu, and all buildings, existing timber and minerals, became the property of the Commission.

Physiography

The plantations lie along the slopes bordering the south west shore of Loch Maree, on both sides of the main road, at elevations of from 50 ft. to 650 ft. above sea level. The general aspect is north easterly, and the slopes are moderate to steep. Exposure to the north and east is severe, but the topography provides a considerable degree of shelter to the west, except in the area of the Allt a Chaise burn. The Garbhaig burn in the south east of the area, with the spectacular "Victoria Falls" near the main road, forms an impassable barrier in the forest.

Geology and Soils

The main geological formation is Lewisian Gneiss, with orthogneiss predominating. At the north west end of the forest, in the valley of the Allt a Chaise burn, there is an area of Torridonian Sandstone of the Diabeg group. On the lower slopes, and particularly at the north west end of the forest near the shores of Loch Maree, morainic drifts form small knolls. Torridonian Sandstone boulders are widely scattered over the area. Rock outcrops are frequent to the north west of the Allt a Chaise burn, and also at the east end, where the gneiss forms a prominent line of escarpments running parallel to the main road. The formation on Eilean Ruairidh Mor is Torridonian Sandstone.

Over the greater part of the area, the soil is composed of peat, varying in thickness from 6 in. to 3 ft. over glacial drift. On the steeper slopes, where drainage is free, a peaty loam predominates.

In the south east corner, peat has formed in the hollows, but on the slopes which are steep a sandy loam up to 18 in. deep overlies the drift. On the southern half of P.22 and P.23, there is peat up to 3 ft. in depth over the drift. A deep Molinia peat is found on the flat and the lower slopes, changing to a poorer Scirpus peat further up the hill. Over the remainder of P.22 and in P.25, there is an area of peaty loam along the steep slope running parallel to the main road, with again deep peat on

the lower slopes, and a poorer type of Scirpus peat along the boundary. There is a small area of sandy mineral soil in Compartment 22. In P.26 and P.29 there is a poor tough peat from 6 in. - 3 ft. in depth, overlying the drift, with frequent rock outcrops. There is a small area of sandy loam in P.24 above Doire. Compartments 55, 67, 68 and 69, along the shores of Loch Maree, have a friable, peaty loam up to 4 ft. in depth.

Vegetation

At the time of the acquisition, there was a crop of natural Scots pine covering about one third of the island, of fairly good quality on the better sites. 5858 trees were estimated to contain 43,914 cu.ft. and 1,490 trees to contain 1,650 cu.ft.

A larch plantation (on the present P.23 Japanese larch area) had been felled, but was said to have produced 7,000 cu.ft. per acre at 80 years.

There was in addition scrub birch of poor quality covering about 51 acres near the Loch Maree Hotel, and another block at Slattadale, covering about 56 acres.

The Acquisition Report describes the vegetation as "mainly heather and ferns. Fine hill grasses on slopes with Molinia in the peat bogs. Vaccinium and bog myrtle are also abundant. Birch, rowan, aspen and saugh are the natural trees of the neighbourhood."

At the present time, the natural Scots pine wood on the island remains untouched. The birch has almost all been felled or ringed, although seedlings remain in some of the rides and along the roadside.

Over a great part of the area, the spruce and Douglas fir plantations have killed out the other vegetation, except where they are in check. Under the larch areas there is the normal Holcus, Hylocomium, Thuidium, Oxalis, community. Vaccinium is the main species under the Scots pine on the island.

In the checked areas, the growth of heathers and grasses is now rank. In the P.22 and P.23 areas, Calluna predominates on the flat, but gives way to Molinia on the lower slopes, with an increasing proportion of Scirpus at the higher levels. There is some Erica and Myrica. In the areas written off or still in check in the P.24, P.27 and P.28 areas, the vegetation consists of Scirpus, Molinia, Erica, Calluna, Narthecium, Juncus

squarrosus, and occasional Myrica and Eriophorum.

Meteorology

The climate is mild and wet. The annual rainfall has been given variously as 50 in. which is the local version, and 70 in. according to Dixon in his book "Gairloch and Loch Maree." 70 in. is probably more correct. April and May are usually the driest months. Frosts are not severe, and snow does not lie long on the area. The prevailing wind is south west, from which all the forest except P.28 and P.29 is well sheltered. Occasional severe gales are experienced from the south east, and most of the forest is exposed to all winds from the east or north.

Risks

(a) Fire

The risk of fire in this unit is moderate. The most likely causes are from adjacent muirburning, from cigarettes thrown out of passing lorries or cars, or from the activities of hikers or picnickers in the area. A hill fire could enter the forest through the top boundary at almost any point. The danger of fires starting from the main road is considerable opposite the Forest Worker's Holding in P.22, and from Compartment 26 in P.25 to the forest boundary at the west end. The old road along the shores of Loch Maree, which is used by hikers, passes through some inflammable ground, mainly in P.24.

There have been four fires at this unit:-

In F.Y. 37, .5 acres of P.29 were burnt on 7.4.37 and
1.75 acres " P.29 " " " 16.4.37

In F.Y. 41, .025 acres " P.28 " " " 2.5.41

In F.Y. 48, 7.6 acres " P.23 " " " 17.4.48. In this instance the cause was a hill fire which got out of control.

The shepherd responsible was fined £2. and his employers, the Kinlochewe Hotel Company, paid £81. 7. 0. in settlement of the damage.

(b) Deer

Both roe and red deer enter the forest, but not in great numbers. The red deer come in for shelter in hard weather along the main road at the

west end, which has never been fenced. The roe deer cause most damage, by peeling young trees and browsing. In 1927, it was found necessary to put sheep netting on the P.24 fence to give protection from the north. On the Island, red deer have browsed the seedling pines, and have prevented effective regeneration. A part-time trapper is employed.

(c) Rabbits

These were troublesome initially and caused considerable damage to the early plantations. From 1924 to 1927, the numbers killed were 120, 250, 215 and 85. In 1927 rabbit netting was erected on the temporary east boundary fence, and later was put on the P.30 boundary. By 1935, little damage was occurring, although a few were still present in P.30. To-day there are virtually no rabbits in the area.

(d) Sheep

Before acquisition, there was a stock of 369 sheep on Slattadale. As the road was never fenced at the west end, a few of these sheep and their progeny have continued to come into the forest right up to the present time. The damage caused is slight.

(e) Voles

There have been two outbreaks causing damage by voles. In 1929, 500 voles were killed in P.28 and P.29, and in 1930 36 were killed. In 1933 a second incursion was reported, and in 1934 considerable damage was caused on the P.34 grey alder. Thereafter, numbers again declined, and no more serious damage occurred.

(f) Insects and Fungi

There has been no serious damage from this source so far. Among others, Chermes was common on spruces in 1935, and Hylobius and Myelophilus have been reported in the old Scots pine on the island. Chermes was seen in the over-wintering stage in the bark of Japanese larch in F.Y.49.

Pinus contorta suffered severely from attack by Pine Sawfly in F.Y.42, both bark and needles being attacked. Small Sitka spruce plants close by also suffered.

Apart from canker on the P.22 European larch, fungal damage is negligible. Honey fungus was present in the P.25 area at the time of planting, but no damage has resulted to date.

(g) Windblow

The forest is exposed to easterly gales, and occasionally these occur with great severity in the district. The Douglas fir areas, and also smaller larch patches, because they have grown much more quickly than the surrounding spruces, are liable to damage. 408 trees were blown in a south-east gale from 3rd to 5th November, 1951, but these were mainly isolated trees or very small groups.

Roads

The main road from Achnasheen to Gairloch passes right through the forest. This is a single track road with passing places.

A private road leads off the main road to the forester's house, and this was extended in F.Y.50 to the new housing site, and in F.Y.51 to the Allt a' Chaise burn.

Apart from a few very rough drag tracks, and the footpath which leads from Slattadale to the north boundary through P.24, there are no other roads in the forest.

Some roads to assist in extraction work are now required urgently.

Labour

From 1922 - 1935, there were 6 - 12 men on regular employment, and up to 30 men for short periods on unemployment relief schemes in the late 'twenties. A bothy to hold 5 men and one Forest Worker's Holding were made. From 1935 - 1948 the number dropped to between 3 and 4, and in 1947 it had fallen to 2 men. Two new temporary houses were built in 1950, and the squad now stands at 6.

Over all, the squad has been adequate for the work in hand, although during the war and in 1947 it was too small. To-day it is barely adequate for the work in hand, as the heaviest part of the thinning programme is being tackled.

SILVICULTURE

Preparation of Ground

(a) Fencing

The area was not fenced in one operation, but the fences were erected one or two years ahead of the planting. The erection was completed in 1929. All were deer fences, and the posts were made of birch, which was peeled and dried, and the bottom 2 ft. 6 in. was creosoted. Some of these posts are said to have lasted for 15 years.

There was no rabbit netting or sheep netting on the fences, except in certain particularly bad areas. In 1927, rabbit netting was put on the temporary east boundary fence, and was subsequently put on the P.30 boundary, and in 1927 too it was found necessary to put sheep netting on the P.24 north boundary fence, to keep out roe deer.

The sides of the main road were not fenced, except at the east end, but at the west end the deer fence was run back along both sides of the road for about 100 yards. This is, however, no obstacle to deer, as in the winter of 1951 a stag was actually met on the road going through this corridor about mid-day, obviously making for shelter before an impending snow storm. Sheep also come and go through this gap.

(b) Treatment of Birch Areas

The prescriptions of the 1922 Working Plan were :-

"The birch on the area will be cut or girdled a year ahead of planting. The best poles will be reserved for temporary fencing posts. A scattering of the smaller trees will be left where possible to act as nurses."

The two main birch areas were in P.25 and P.30, and there were also some in P.24.

The P.24 birch was girdled in F.Y. 23.

The P.25 birch was thinned and the lop and top burned in 1923. In 1926 more of the birch was cut and burned, and between 1926 and 1930 the remaining trees were girdled. In 1930 many stems were seen to be still alive, through incomplete girdling, and this was then rectified.

In the P.30 area, the birch was mostly clear felled. This operation commenced in 1926 and was almost completed before planting. A few old trees, however, remained until 1942, when they were cut back.

(c) Heather Burning and Bracken Cutting

The 1922 Working Plan prescribed the burning of rank heather, the switching of bracken and the cutting back of bog myrtle, prior to planting. Heather burning was undertaken in P.24 area in 1923, and in P.25 in 1924. Bracken cutting was done on the same areas. Heather burning was also undertaken on the island in 1924.

(d) Drainage and Turfing

The 1922 Prescriptions laid down that drains were to be dug if possible two years ahead of planting, and this was in fact often achieved. As in other units, early draining was very inadequate, and initially either the drains were too few or there were none at all, on ground which needed intensive treatment. The need for more intensive draining was stressed in the 1927 Notes on the Revision of the 1922 Working Plan, and by Sir John Stirling Maxwell in 1928. In P.27, P.28 and P.29, small areas of peat were intensively drained and turfed for the initial planting; these are the first recorded instances of turf planting at Slattadale, though subsequently it was to become the standard practice in the extensive reconstruction work which was undertaken.

Choice of Species

Appendix III shows the areas of each species at the end of the planting period, compared with the areas which exist to-day. In reading the table it must be remembered that 245 acres were written off in 1938, and that the 1950 figures have been obtained from a re-survey.

Considering the total areas planted, it becomes apparent that:-

(1) The European larch, Douglas fir and Scots pine areas remained relatively constant. (The difference in the Douglas fir figures is attributed mainly to re-survey). This indicates that these species had become well established by 1934.

(2) There was an increase in the Japanese larch area, because this species was used in reconstruction work.

(3) There was a drop in the spruce areas, particularly of Norway spruce, the area of which fell by 75%. Part of this area is now included in the "mixed column", as a result of reconstruction work, but the unsuitability of the species is clearly indicated.

(4) The "mixed" area has apparently dropped. This is misleading, but what in fact has happened is that the areas containing alder and originally classed as mixtures have now been reclassified as pure areas, as few of the alder remain. This loss has been only partly made up by reconstruction work, forming new mixtures.

Considering the percentage area figures, it appears that, although there was a drop in the total Sitka spruce area, this species now covers a larger percentage of the forest than formerly. In addition, the Pinus contorta, which appears as covering only .1% of the forest, is present in many of the mixtures. Mountain pine, Abies nobilis and some alder are also present in mixture.

The following summarised table is of interest.

Percentage Area Covered by Different Species

<u>Species</u>	<u>Forecast in 1922</u> <u>Working Plan</u>	<u>1934</u>	<u>1950</u>
Larches	10%	8.5%	14%
Douglas fir	30%	12 %	18.5%
Spruces	55%	45 %	33 %
Pines	5%	2.5%	4 %
Mixtures	-	<u>32 %</u>	<u>30.5%</u>
	<u>100%</u>	<u>100%</u>	<u>100%</u>

In the past, some species have been wrongly chosen at Slattadale:-

- (1) Norway spruce was planted extensively on ground which was not sufficiently good for it.
- (2) To a lesser extent, European larch has been planted on ground more suited to Sitka spruce. With a few exceptions, the European larch is generally of poor form, and suffering damage from canker. With successive thinnings, however, its appearance is improving.
- (3) Too much Sitka spruce and not enough pine was originally planted, though this has to some extent been rectified in the reconstruction operations. In 1942, Mr. Gosling said that Sitka spruce should never be planted pure on peat at Slattadale, but pines should be added.
- (4) Mountain pine was planted on ground which was virtually unplantable, and large acreages had to be written off.

Prior to 1934, there had been extensive beating up, but usually with the same species as the original planting. In 1930, however, it was decided to replace Douglas fir with Sitka spruce in wet patches in P.25. From 1935 to 1940, the main species used for beating up was Sitka spruce, with some Japanese larch, and Oregon and grey alder. From 1940 onwards, Japanese larch, Pinus contorta and mountain pine, usually in mixture with Sitka spruce, became the main species for reconstruction work. (The details of this may be seen in Appendix IV).

To conclude, it should be mentioned that Slattadale has been recognised as a difficult subject from 1928 onwards, and the problems it presents have by no means yet all been solved.

Planting

(a) Spacing

The spacing prescribed in the 1922 Plan of Operations was almost the same as that in use to-day, and was as follows:-

Douglas fir	6 ft.	x	6 ft.
Japanese larch	6 ft.	x	6 ft.
European larch	5 ft. 6 in.	x	5 ft. 6 in.
Sitka spruce	5 ft. 6 in.	x	5 ft. 6 in.
Norway spruce	5 ft.	x	5 ft.
Pines	4 ft. 6 in.	x	4 ft. 6 in.

(b) Type of Plants Used and Source of Supply

There is not a great deal of information about this in the early stages of formation, but a high proportion of the plants used came from the home nursery. At that time, plants of odd sizes were used fairly frequently, e. g.

P.22	Sitka spruce	3 + 2
	Norway spruce	3 + 2 + 1
P.24	Norway spruce	3 + 2 + 1, 2 + 1 + 1
	Japanese larch	2 + 1 + 1
	Sitka spruce	3 + 2
	Douglas fir	2 + 1 + 1

P.25	Norway spruce	2 + 1 + 1, 2 + 3
	Sitka spruce	2 + 1 + 2, 3 + 2
	Scots pine	2 + 1 + 2
	Douglas fir	2 + 1 + 1

From 1932 onwards, plants of normal size were generally used, details of which are given in Appendix IV. Again, most of the plants came from the home nursery, and some came from Inchnacardoch. Small lots were received from nearly every nursery in the Conservancy, but, in addition, alder was received from Craibstone in 1934, and Altonside in 1936, Pinus contorta from Delmere in 1943, Japanese larch from Newton in 1942, and Howden of Inverness supplied beech in 1933.

(c) Methods of Planting

The Prescriptions of the 1922 Working Plan said that the usual method of planting would be that of vertical notching with the Schlich spade. In peaty and other areas, some pitting might be necessary, and on the steep slopes at the east end of the area the prevalence of rocks and boulders might necessitate the use of a mattock or iron dibble.

These were, in fact, the methods used for most of the initial plantings, although in P.27, P.28 and P.29, small areas of peaty ground were turf planted. From 1934 onwards, all the reconstruction work was carried out by planting on turves.

(d) The Annual Rate of Planting

The rate of planting laid down in the 1922 Working Plan was 100 acres a year from 1922 - 1927 (inclusive). In 1927 it was decided that planting should be completed during the next five years, but it was recommended that no new planting be undertaken in 1928 or 1929 owing to the large amount of drainage thought to be necessary for P.28, and the arrears of beating up work in previous years' plantations. These recommendations were not, however, adopted, and the actual acreage originally planted was as follows:-

<u>P. Year</u>	<u>Acreage</u>
22	120
23	100
24	80
25	100
26	100
27	145
28	50
29	52
30	60
31	36
32	8
34	5.5
51	4.5

(e) Manuring

The use of manures started on a small scale in the 1929 plantations where strips of European larch, Norway spruce and Abies nobilis, planted on turves, were treated with 2 - 3 ounces of basic slag per plant, at the time of planting. This was part of a trial carried out also at Achnashellach, North and South Strome and Glenshiel. In 1931, the results were assessed. The best results were obtained where slag had been placed under the turf, but application anywhere on the turf was found to be markedly beneficial. As a result of this, slagging came into use from 1932 onwards.

The worst areas of P.31 and P.32 were slagged in 1932. From 1932 onwards, slag was applied generally to all backward and beat up areas, where turves were used:-

<u>Year of Working</u>	<u>P. Years to which slag applied</u>
1929	29
1932	22, 25, 31, 32
1933	25, 26, 27
1934	23, 24, 26, 28, 29, 30, 31

The species originally slagged were Norway spruce, Sitka spruce, Pinus contorta, Scots pine, European larch, Abies nobilis.

The policy of slagging all plants, including Japanese larch and Tsuga, was continued during the reconstruction period. In 1943, however, superphosphates were used in the P.29 area beaten up with Pinus contorta and hybrid larch, and in the P.26 area beaten up with Pinus contorta, hybrid larch, Japanese larch and Sitka spruce. In 1951, the P.51 area of Sitka spruce, Pinus contorta and mountain pine, was treated with ground mineral phosphate.

In 1942, Mr. Gosling commented that he did not think that the

tendency to check after the first effect of the original slagging had worn off, was likely to be prolonged except on the worst sites, but he thought a second slagging should be tried. Accordingly, in 1943, small areas of checked spruces in P.27 and P.28, which had been turf planted, and slagged previously, were treated with superphosphates.

(f) Success of Establishment

Details of this by P. Years can be found in Appendix V. A summary reads as follows:-

	<u>1935</u>	<u>1938</u>	<u>1947</u>
Area Established	89.5	299	541.0
Area not Established	767.0	558.5	37.0

245 acres were written off in 1938.

Progress was initially slow, and over parts of the area has only been obtained at great cost. The reason for the slowness was that part of the original plantings failed, and part had to be completely reconstructed between 1934 and 1945. The amount of beating up was tremendous, but the success of the work is apparent from the recent rapid increase in establishment. (See Appendix IV for details of P. Years beaten up during the reconstruction period).

At the present time, there still remain some unestablished areas where success is doubtful, particularly in P.27 and P.31.

Ploughing

As a result of the Chairman's visit of inspection in 1945, in which he expressed a desire to see the plough tried out at Slattadale, 4.5 acres of the P.27 and P.25 areas were experimentally ploughed in F.Y.50, and planted in F.Y.51, with a mixture of Sitka spruce, Pinus contorta and mountain pine. The ground was deep ploughed with a Cuthbertson double-furrow plough, at 10 ft. intervals. The plants were notched into the furrow. The plants used were Sitka spruce 2 + 2, Pinus contorta 2 + 0, and mountain pine 2 + 0. 2 ozs. of ground mineral phosphates were applied to each plant. Results so far are promising and other similar areas could be treated in the future.

Beating Up

This has been done on a very extensive scale at Slattadale. A list of P. Years treated since 1932 can be seen in Appendix IV. The work falls into two categories :-

- (1) That which was done up to 1934, in which there was little change in species or methods of planting.
- (2) Subsequent reconstruction work, in which new methods were applied, and new species introduced.

From 1924 - 1934, about 100 acres a year were treated, starting as follows :-

<u>Year of Working</u>	<u>Acres Beaten Up</u>	<u>P. Years</u>
1924	130 acres	P.22 and P.23
1925	48 acres	P.23
1926	(22 acres (100 acres	P.23 P.24
1927	100 acres	P.25
1928	45 acres 45 acres 15 acres 25 acres 100 acres 9 acres	P.22 P.23 P.24 P.25 P.26 P.27

This continued until 1934, when a general beat up was given to P.22, P.25, P.26, P.29, P.30 and P.32, the work being confined in this year to the more hopeful areas of Molinia flushes.

This early beat up was given to all species, and no major changes were introduced. The worst losses had been suffered by Norway spruce, Sitka spruce and European larch. The causes for the failures were:-

- (1) Insufficient drainage.
- (2) Wrong choice of species for poor ground.
- (3) Attack by voles, rabbits, sheep and deer.

In spite of this work, the 1935 working plan stated that the following areas required additional treatment:-

P.22	68.5 acres
P.23	41.5 "
P.24	24.0 "
P.25	73.5 "
P.26	40.0 "
P.27	45.0 "
P.28	19.0 "
P.29	30.0 "
P.30	51.0 "
P.31	32.0 "
P.32	8.0 "
P.34	5.5 "

In short, beating up work had had little effect.

In 1935, however, a new technique had been tested and found successful, namely intensive draining, turf planting, and slagging. From 1934 - 1943, a new reconstruction programme was carried through, using an average of 30,000 - 35,000 thousand plants a year, which ran to a peak of 46,000 plants in 1942. This period also saw increasing use made of Japanese larch, Pinus contorta and mountain pine as nurses for Sitka spruce on poor ground, and mixtures of these species were commonly formed.

A considerable proportion of this work took the form of interplanting a checked species, usually Sitka spruce or Norway spruce. A good instance of this was in the P.23 area, planted initially with Norway spruce, and not drained. In 1932, Pinus contorta at 10 ft. intervals was introduced, and a very few drains were put in, the hope being that the Pinus contorta would eventually drain the Norway spruce. The Pinus contorta grew, but the Norway spruce remained in check, and in 1941 the lower part of the Pinus contorta and Norway spruce area was intensively drained and slagged, and a few Japanese larch were introduced. The Norway spruce have now started to grow.

Beech was used to interplant 4 acres of the P.25 European larch in 1927. The results have been disappointing, as deer have prevented good development of the beech.

In 1944, on the Chairman's instructions, 2 acres of poor Sitka spruce in P.31 Compartment 66 were interplanted at approximately 10 ft. apart with Pinus contorta and Scots pine, 1 acre being used for each species. The beat up plants were slagged.

Possibly only about 5% of the Scots pine remain in the acre planted with Scots pine. Survivors show little growth. On the acre planted with contorta, almost all survive. The average height is 3 ft. and the annual growth increment varies from 6 in. to 1 ft. These have suffered considerable damage from deer and sawfly.

In neither plot has there been any effect on the Sitka. The Pinus contorta has been put in at about 10 ft. intervals, and the growth is now sufficiently rapid to make it appear that there will be a replant of parts of P.22 where the Pinus contorta have left the Sitka too far behind.

In the same year, small patches of checked Sitka spruce were interplanted with Pinus contorta in P.23 and P.26

Between 1934 and 1941, alder was interplanted in European larch and Sitka spruce in P.22, P.23, P.26, P.27, P.28 and P.30 mainly in the wetter areas. Not many remain, although a few survive, mainly as bushes in P.22.

This reconstruction work indicates the nature of the new technique in beating up, namely, intensive draining, turfing and slagging of all plants, and the introduction of pines and Japanese larch into checked spruce areas. Results are generally promising.

Weeding

Weed growth was not a major problem at this forest, but there were some areas of strong bracken growth, particularly at Slattadale and Doire, and the birch at Slattadale and the east end made scrub cutting necessary. Heather covered a large part of the forest originally, but there were also some areas of grasses where weeding had to be done. It is of interest to record that the bracken switching in the early days was carried out with sharpened birch sticks.

The prescriptions of the 1922 Working Plan laid down that weeding was to be regularly carried out. In only a few places was bracken strong enough to require switching more than once a year. Stool shoots were not to be allowed to endanger the crop.

The annual rate of weeding during the early formation years averaged 100 acres. In a few places, it was carried out for up to four successive years after planting. In the reconstruction work, when turf planting was adopted, very little weeding was necessary. Weed growth did not affect the establishment of the forest.

Mixtures

In the original plantings, as far as can be ascertained, there were very few mixtures. By 1934, however, 32% of the plantations were classed as mixtures (including the alder mixtures), and in 1950 30% were mixtures (excluding the alder mixtures, which had by then, for all practical purposes, reverted to pure conifer crops). The many and various mixtures which now cover a third of the forest are, therefore, mainly the result of beating up and reconstruction work.

Notes on the most interesting of these mixtures are given below:-

- (1) Pinus contorta, Norway spruce, Sitka spruce, Scots pine
P.23 Compartment 10.

The original species was Norway spruce on Calluna and Molinia peat. The area was beaten up each year from 1924 to 1931 with Norway spruce, Pinus contorta, Scots pine and some Sitka spruce. All backward plants were slagged in 1934. A fair proportion of the original Norway spruce still survive. To date, the pines are the most vigorous in growth, but the spruces are being nursed up. The mixture is now developing satisfactorily, and patches have reached the cleaning stage.

- (2) Pinus contorta, Norway spruce, Japanese larch
P.23 Compartments 11 and 12.

The original species was Norway spruce, notch planted with very little draining. In 1932, Pinus contorta at 10 ft. intervals was introduced, and a very few drains were put in, as it was hoped that the Pinus contorta would eventually drain the ground for the Norway spruce. The Pinus contorta grew, but the Norway spruce remained in check. In 1941, the lower part of the ground was intensively drained and slagged, and a few Japanese larch were introduced. The Norway spruce started to grow in 1943, and the treated area is now developing satisfactorily. Cleaning will be necessary within the next few years to relieve the Norway spruce.

- (3) Sitka spruce, Pinus contorta - P.22 Compartments 6, 7 and 8.

The original species was Sitka spruce, planted directly on to deep Molinia peat, which failed in spite of being beaten up in 1924, 1928 and 1929. The area was again beaten up in 1931, 1932 and 1933 with Pinus contorta and Sitka spruce, after intensive draining and slagging. Turf planting was used in this beating up and the Pinus contorta was put in at about 10 ft. intervals. The Pinus contorta has grown well and is now drawing up the Sitka spruce. In places, the Sitka spruce is still in check, and is as much as 8 ft. shorter than the Pinus contorta. Some pruning of Pinus contorta branches has been done to relieve the Sitka spruce in accordance with the Chairman's instructions, and future development appears likely to be satisfactory.

- (4) Spruce and Larch Mixtures - P.22 Compartments 1 - 8

These have resulted where the original European larch crop was poor, and was beaten up during the early stages with Sitka spruce or

Norway spruce. The larch has tended to remain dominant over the spruces, especially on the steeper ground, where the spruce now has the appearance of an understorey. Near the road in Compartment 5 there is a more even mixture of European larch and Sitka spruce which is growing fairly well. This is, however, not satisfactory as a mixture, because ground suitable for Sitka spruce is not good for European larch, and vice versa, and either one species or the other has tended to become dominant.

(5) Japanese larch, Pinus contorta, Mountain pine, Sitka spruce
Norway spruce - P.26. Compartments 29 - 33 (above main road).

The original species was Norway spruce, beaten up in 1928 with the same species. From 1940 to 1944, reconstruction work was done on the area, introducing Pinus contorta, Japanese larch, Sitka spruce and a few hybrid larch and alder. Intensive draining, turf planting and slagging, was the method employed. The resulting crop is a more or less intimate mixture of all or most of these species. The larch and Pinus contorta have made the quickest start, but the spruces are now being drawn up. The mixture has been successful in establishing a crop on a difficult area.

(6) Japanese larch, European larch, Norway spruce, Pinus contorta
Abies nobilis - P.29 Compartments 61 - 63 (above main road).

This mixture includes the first trial area at Slattadale to be planted on turves and slagged at the time of planting. There is very little Pinus contorta in the area, and it was introduced at a later date. The resulting crop is a mixture of all these species in varying proportions. The Japanese larch has made the most consistent growth, and is now tending to suppress the spruce and also the Abies nobilis in places. However, a few of the Abies nobilis have grown clear of the Japanese larch, and are up to 3 ft. higher than the surrounding crop. Establishment has been obtained, and the cleaning stage has now been reached. In the cleaning operations, the Norway spruce and Abies nobilis will be freed where possible, in order to preserve the mixture.

Rates of Growth

A tabular statement is given in Appendix VI describing the growth and condition of the main species, in areas selected to show the best growth.

Some general comments on the main species are given below:-

European larch

This species has not done well on the area, due mainly to soil conditions which are too moist. Canker is present, and much of the crop is of poor form. However, with successive thinnings, the general appearance of the European larch stands is improving.

Japanese larch

The larch is doing well as a timber crop in P.23, and also useful as a nurse for spruce on some of the more difficult spruce sites. It is suffering from windblast in P.29, where the tops are deformed. The P.23 Japanese larch is of interest as it shows several distinct form types, typified by shape of needles and cones, and habit of branching.

Norway spruce

Originally extensively planted, it has not done well except on a few favoured localities, owing to unsuitable soil conditions. In P.29 and P.30, however, there are two good stands, which show rapid growth and good form. It survives in mixture over a considerable area of the forest, where it may yet feature in the final crop.

Sitka spruce

The Sitka is disappointing for a west coast forest. There is one excellent stand in P.31, but much of the remainder has been in check for considerable periods, from which it is only now starting to be freed by nurse species, draining and slagging. The reason for its failure is simply that the ground was unsuitable (i.e. deep peat, few drains, and heather) for notch planting of Sitka spruce in pure stands, which is what happened in the early days.

Scots pine

This species has not been extensively planted, but where it exists it is developing slowly to form a fair crop.

Pinus contorta

Contorta is proving to be a valuable nurse for Sitka spruce on the poorer peat ground, where it is showing relatively rapid growth.

Mountain pine

Mountain pine was originally planted direct on the poorest areas, where it has been a failure.

Some P.27 and P.28 mountain pine still survive as shrubs no more than a foot high. In P.27, where it was planted along the side rides in a Scots pine area, the Scots pine has partly failed, and the double lines of mountain pine running up the hill, still surviving, are an ugly feature of the landscape.

Douglas fir

This species is growing vigorously on the better ground, but tending to be rough in form. Its liability to windthrow is giving rise to some anxiety.

Abies nobilis

In the P.29 area, it has remained in check until quite recently, in mixture with Japanese larch. Some few trees have now started to grow with great vigour, and have in a few cases actually outstripped the larch. It appears to withstand the blast which is damaging the Japanese larch.

Broad-leaved Species

Beech, used to beat up European larch, has as usual been deformed and stunted by deer. Both grey and Oregon alder have been introduced into the forest at various times, but results are not apparently satisfactory. The younger surviving plants are bushy in habit, and only a few of the older ones remain. The Oregon alder in P.30 was devastated by voles. Populus trichocarpa was planted in P.23 in the Sitka spruce area, but failed.

Past Treatment of Established Plantations.

Treatment of established plantations has followed normal practice.

Birch scrub had to be cut back in P.23, P.24, P.25, P.28, P.30, P.31 and P.32. This was carried out from 1940 - 1944. The worst of these areas were P.25 and P.30, where the former scrub stands were located. This work was normally done prior to pruning and thinning, but, where birch still remained when the thinning stage was reached, it was removed. There is very little birch scrub in the plantations to-day.

Brashing commenced in 1938 in the P.25 Douglas fir and the P.23 Japanese larch, and the area treated rose gradually to about 20 acres a year. It is now running at about 25 acres a year, and will remain at that level for some time to come. The intensity of brashing has varied slightly, the original practice being to brash all but the worst stems, and the present aim being to treat not more than 50% of the stems. Much of the Slattadale ground is steep, and if many stems are left unbrashed, marking,

felling and extraction work are made more costly and difficult. Generally speaking, a few stems remain unbrushed after the first thinning, and none after the second thinning.

Very little in the way of cleaning operations has been done at Slattadale, although the early thinnings might well have been placed in this category. What work has been done has followed on the brushing operations, and rough or diseased or dying stems have been cut out. The work has been done mainly on Douglas fir and larches. Cleaning operations will increase considerably in the immediate future, as the mixtures resulting from the reconstruction work become due for treatment. A start has already been made on this type of work in the pruning of Pinus contorta in P.25 to free the Sitka spruce which are still partly checked below them.

The annual summary of areas thinned can be seen in Appendix VII. Starting with 2 acres in 1939 in the P.23 Japanese larch, the area increased fairly steadily up to 1950 when 44 acres were treated, and then in 1951 the area rose again to 67 acres. For the next 5 years, the area requiring thinning will continue to rise, and will average about 75 acres a year.

The intensity of thinnings has followed general practice. Prior to 1946, they were very light, and the 1935 Working Plan laid down that only the dead and suppressed trees would be taken out. There was another reason for thinning lightly, and that was the difficulty of finding a market for the produce, especially when it was on such a small scale. Labour troubles also delayed the work. Since 1947, however, more intensive thinnings have been carried out, and the situation is at present reasonably well in hand. The forest is now being worked on a 3 year thinning cycle, and the grade may be judged from the Thinning Yield Plot data in Appendix VIII.

As Slattadale is an isolated unit, the disposal of the produce presents some difficulty. Up to 1939, the only production was of firewood and fencing material from the acquired birch scrub, and from 1939 to 1942 thinnings were used only as fencing material. From 1943 to 1950 some pit-wood was prepared at the unit, together with fencing material, firewood, some telegraph poles for the army in 1943 from the P.23 Japanese larch, and some pulpwood in 1946. In 1951 a new method of disposal was started - the sale in the length at roadside. This method conserves forest labour for forest operations, and has allowed an increased thinning programme to be undertaken.

As in other west coast units, extraction of produce is presenting a problem. The main road running through the unit and the road to the forester's house and new housing site, tap a good part of the forest, but P. 24 and parts of P. 22 and P. 23 are inaccessible. Thinnings have been left lying in P. 24 and on the steep slopes of P. 25. It is hoped to construct tracks through these areas in the course of the next few years.

RESEARCH

In November, 1951, three permanent sample plots Nos. 250, 251 and 252 in Sitka spruce, Douglas fir and Norway spruce respectively, were established in Compartment 67 at Slattadale.

These plots are in a sector of comparatively fast growth where in 21 years the Sitka spruce have attained a top height of 50½ ft. and thus are on the upper limit of Quality Class II. The Norway spruce with a top height of 42 ft. at 23 years of age are in Quality Class I but the Douglas fir, though reaching their top height of 53 ft. at 27 years, are down in Quality Class III of that species.

The Sitka spruce and Douglas fir have a total production to date of 3100 cu.ft. per acre quarter girth under bark compared with a total production of 2300 cu.ft. per acre by the Norway spruce.

All the plots still have a fairly dense maincrop, although the volume removed by Conservancy and plot establishment thinnings together gave 720 cu.ft. quarter girth under bark per acre in the Douglas fir, and 472 cu.ft. and 436 cu.ft. respectively in the Norway spruce and Sitka spruce.

The Douglas fir are inclined to be rough and coarsely branched, but the Sitka spruce and Norway spruce are excellent quality with straight stems and light branches.

(Sgd). Alex. M. MacKenzie.

22. 2. 52

Conclusions in the light of experience gained

This history reveals that the lessons learnt at Slattadale are not peculiar to the unit, but are common to all the forests which have been formed on the poorer ground in the north west of Scotland. The striking feature at Slattadale is that parts of the ground where afforestation has been essayed are so poor and so extensive that the lessons are shown up on a grand scale and with a certain degree of clarity. The main lessons are as follows:-

(1) Drainage and Turfing

On deep peat, intensive draining, with a minimum of 30 chains to the acre, and turf planting, are absolutely essential.

(2) Choice of Species

- (a) Norway spruce will not grow on Molinia or Calluna peat in pure stands.
- (b) European larch is generally unsuited to most of the area.
- (c) Sitka spruce should not be planted pure on peat at Slattadale.
- (d) Pinus contorta and Japanese larch and, to a lesser extent, Scots pine, are useful nurses for spruce.
- (e) Alder is of doubtful benefit.
- (f) Beech under larch is not successful where deer are found in any numbers.

(3) Methods of Planting

Notch planting on peat is doomed to failure.

(4) Manuring

The use of manures is markedly beneficial to all species, and on the worst ground, more than one application may be necessary to ensure establishment.

(5) Ploughing

While it is too soon to be certain of the results at Slattadale, the indications encourage the view that this is the best method of establishing the poorer peat areas, wherever practicable.

At the best, the crop would be patchy as the moraine knolls and rocky outcrops covered by shallow peat cannot be dealt with.

(6) Beating Up

Where extensive failures occur for no immediately apparent reason, it is of little use to replant with the same species, using the same methods. The cause of the failure must first be discovered, and the planting methods altered accordingly.

(7) Extraction

A track extraction system should be planned and constructed before the main thinning programme has to be carried out. The best time to do this is during the lull which often occurs between the end of planting and the commencement of the thinning programme.

(8) Acquisitions

Torridonian Sandstone is a very difficult and expensive geological formation to afforest.

(Sgd.) D. Graham-Campbell

District Officer,
North (Scotland) Conservancy.

APPENDIX I

Notes from Inspection Reports

(1) Inspection in October 1928 by Sir John Stirling Maxwell

P.29 (a)

Drains in this area were 11 - 12 yards apart, and turves were distributed at 5½ ft. The peat was from 6 in. - 18 in. deep and the sub-soil consisted of morainic ground with a mixture of reddish loam. Sir John approved the general lay-out of drains, but was of the opinion that the small terraces needed further treatment.

P.26

It was noted that less drainage had been carried out than in P.29, and that surface vegetation conditions were much improved. The species planted was Norway spruce, mixed in places with mountain pine. The spruce showed signs of slow recovery from check, and Sir John said that, if additional drainage was carried out, there was every prospect of a satisfactory plantation being established.

P.27

In the section where Sitka spruce had been planted on turves, growth was considered satisfactory. Sir John thought the method could have been extended with advantage, and that the drains should be laid out to cut off more of the slope water.

P.24

The Norway spruce area was still in check, and in view of the better surface conditions, it was thought to be due to planting too deeply.

P.25

The European larch had been planted on a cleared scrub area, and the surface vegetation included bracken and better grasses. Growth had been satisfactory on the lower slopes, but less so on the higher ground. A partial beat up with beech had been carried out in 1927.

The Sitka spruce on the Molinia ground at the edges of the burns was in the main growing vigorously.

P.22.

The European larch on the higher slopes was poor in quality and unhealthy in appearance. This might be due to the origin of the seed and insufficient drainage. Sir John said more drains would be required.

General

Sir John considered Slattadale a much more difficult subject than he had previously thought, and said there was need for much more drainage than had been considered necessary in previous years.

(2) Inspection in March 1930 by Mr. F. Scott, Divisional Officer.

P.25

In wet patches, Douglas fir should be replaced with spruces. Turf draining would be necessary before planting. This was to be done where the Douglas fir colour was poor, and where its future stability was doubtful.

(3) Inspection in May 1930 by Mr. F. Scott, Divisional Officer.

<u>P.22.</u> The beat up area of 8 acres.)	To be given a surface
<u>P.30</u> 3 acres of turf planting on peat.)	dressing of 2 ozs. per
)	plant of basic slag.

P.28 - Scots pine and Sitka spruce mixture

A small area of Sitka spruce was turf planted here in 1929, and this appeared promising. Pines had not made healthy growth on the whole, though their appearance was better near to the drains. This area to be beaten up in 1931, all species to be planted on new turves. If available, Pinus contorta to replace Scots pine on exposed knolls.

P.27 - Sitka spruce turf planted

The peat here was up to 3 ft. deep. Additional drainage by deepening one turf drain in three had been carried out. Effect to be watched for future guidance.

P.25 - Birch Scrub Treatment

Many stems still alive owing to incomplete girdling. This should be rectified.

P.22 - Beating up on Turves

Turf distribution not carried out until late spring with the result that the turves had generally not had time to settle down to the surface, and the plants were now suffering from drought.

(4) Inspection in June 1942 by Mr. A. H. Gosling, A/Assistant Commissioner
(Also present Mr. A. M. Fraser).

P.28

Scots pine making progress only on the better patches. The Sitka spruce planted among the pines at a later date were making satisfactory progress where soil conditions were moderately good. In the P.28 area, small patches of Sitka spruce P.34, which had been mounded and slagged, were seen to be going into check. Mr. Gosling advised another application of slag on a small section, and if the plants responded, the treatment would be carried out over the whole area.

P.26)
P.29)

Reconstruction work done in 1941 and 1942 was carried out mainly with Japanese larch and Pinus contorta; the Pinus contorta was suffering from late planting.

P.23

Japanese larch crop had been thinned in 1938/1939 and Mr. Gosling said it should be done again in 1942. Growth and form considered good. An area originally left unplanted, but subsequently planted in 1939 and 1940 with Sitka spruce mainly, and Sitka spruce/Pinus contorta mixture or Japanese larch pure on the shallower patches was inspected. Mr. Gosling advised that Sitka spruce should never be planted pure on peat at Slattadale, but pines, preferably Pinus contorta, should be added, the percentage to vary according to soil conditions.

P.28 (b) - Douglas fir

Recently pruned. Some good stems observed.

Mr. Gosling commented that a lot of good "reconstruction" work had been done, but it was costly, and its success in parts not yet beyond doubt. We should not be justified in so tackling the very bad sites. He did not think that the tendency to check after the first effect of the original slagging had worn off was likely to be prolonged, except on the worst sites, but he thought a second slagging should be tried. He said that thinning was more urgent in present circumstances than reconstruction work.

(5) Inspection in August 1943 by Sir Roy Robinson, Chairman

Also present:	A/Assistant Commissioner	Mr. A. H. Gosling
	A/Divisional Officer	Mr. A. Watt
		Mr. C. A. Connell
		Mr. Dunnet
	District Officer	Mr. A. M. Fraser
	Forester Grade II	Mr. G. Mackenzie

P.23

Japanese larch, thinned 1942, extraction in progress. Many of the thinnings sold as telegraph poles for the Army. Quality considered good.

A reconstructed area, and part of a peat flat area, originally left unplanted, and subsequently planted in 1939 and 1940 with Sitka spruce mainly, and Japanese larch and Pinus contorta on the poorer areas, was inspected. The Chairman did not favour the planting of Japanese larch in small patches. On a Molinia peat, where there was a mixture of Norway spruce, Scots pine and Pinus contorta, the Norway spruce was growing much slower than the Pinus contorta. The Chairman advised the cutting back of the Pinus contorta branches, where these were interfering with the growth of Norway spruce.

P.32

Where conditions were favourable, Sitka spruce was showing promise, but on the Scirpus, heather, in spite of considerable preparatory work, the Sitka spruce had not responded. The Chairman emphasised the importance of pine as a nurse for Sitka spruce where conditions are unfavourable. The Chairman favoured Pinus contorta for such poor conditions. Two knolls, each 1 acre in extent, were to be interplanted with 800 - 900 plants per acre, one with Scots pine and one with Pinus contorta, each to receive similar treatment.

The Chairman commented that Slattadale had always been considered one of the most difficult areas, and the state of knowledge at the time of acquisition was unequal to the task of afforesting much of the ground. Growth on the better ground had been excellent.

Chairman's General Note on Certain Forests in the Western Highlands, following Inspections at Achnashellach, Ratagan, Inverinate, Slattadale, North and South Strone in 1943.

Afforestation has now been proceeding long enough to show up clearly the main successes and the main failures in these and similar areas, and it is the purpose of this note to draw some conclusions and to speculate on the future lines of advance.

The natural conditions in relation to tree growth are of course not identical in all the forests but, broadly speaking, they are very similar. The climate is maritime, very wet, and exposure to westerly winds considerable except at relatively low elevations. Spring frosts can be a nuisance locally. The soils are broadly either "creep", and are then associated with a good surface vegetation or the remnants of indigenous broadleaved species; or morainic, associated with heather and heather associations characteristic of the wet mild climate. This broad generalisation omits "flush" types and inter-moraine peat developments.

The growth of selected species on the first broad type is very rapid. The chief problem is to select from the spruces, larches, Douglas fir, etc., that which will give the optimum result, and there is already enough evidence on the ground to avoid gross errors in the future.

The second broad type, namely, the moraines, constitutes the major problem in afforestation. Morainic deposits are often more extensive than would appear at first sight. In the valleys and on the lower slopes they are easily detected by their characteristic rounded shape, but they also occur extensively higher up the hills in less characteristic form. They are sandy in composition and on most, I suspect, the soil has been leached and a pan formed. Our experiments show that, except in exposed places, it is possible to raise certain species (Japanese larch, hybrid larch, Sitka spruce, Pinus contorta) moderately well, provided the surface is deeply trenched and basic slag is applied.

Practically everywhere the planted morainic areas show up as backward or unstocked. Spruce (generally Norway) was planted in the earlier P. years and was quite obviously the wrong choice. Extensive deep drainage has got the plants slowly on the move in some cases, but future development also is bound to be slow.

The first important point to note is that the morainic soils require special attention and the second that they can be detected with certainty before planting. The gross errors of the past can, therefore, be avoided if only by refraining from planting. That course, however, would be a confession of impotence to which I am not prepared to subscribe.

How then are we to proceed? There are two courses open: first the mechanical method of developing our ploughing technique to overcome the

special topographical difficulties and second to adapt our silvicultural methods to the special conditions. Both courses must be explored. I have asked that the experimental ploughing shall be pushed at Achnashellach next spring. Here I am concerned only with the silvicultural method, which incidentally should help also on ploughed ground.

I think it is almost certain that these moraines were originally covered with Scots pine which reached pleasing dimensions on the lower parts and presumably tailed off into scrub at higher elevations.

There is evidence that the indigenous pine when planted will behave in much the same way though probably the first crop will be poorer and the limit of scrub pine will be lower than with the old indigenous forest. If, therefore, we had planted Scots pine originally on many of the morainic deposits, the lower parts of the forests at least would have presented a continuous as opposed to the present moth-eaten appearance. On the other hand, on the upper moraines, the Scots pine would have been blasted and as a pure crop would have been hopeless.

In the experimental treatment of moraines, more attention has been paid to Pinus contorta and mountain pine than to Scots pine, and more attention still to the larches (hybrid and Japanese) and spruces than to the pines. In my opinion the pines are a better pioneer crop than the larches or the spruces because they are deeper-rooting and thus activate a greater volume of soil. How far this is essential in such a wet climate remains to be seen. I have seen Sitka spruce growing really well up to 30 years on almost bare igneous rock at Thirlmere (Lake District). Nevertheless, depth of activated soil is obviously of importance and I view with some suspicion the shallow-rooting habits of the spruces and larches in pure plantations.

Coming now to the characteristics of the individual species. My present view is that as regards the pines, Scots pine should be planted pure on these sites which are reasonably sheltered and in mixture with Sitka spruce on these sites where it will develop sufficiently well to get the spruce away. Mountain pine I would relegate to the worst and peatiest morainic sites again in mixture with Sitka spruce. I am still uncertain of the part Pinus contorta should play. It suffers severely from deer damage which is a great drawback. Silviculturally, it is in some ways

unsatisfactory; it casts very little shade, compared with Scots pine and mountain pine, and is therefore slow in suppressing surface vegetation. It is very apt to be top heavy and to grow crooked. On the other hand, it appears to be deep-rooting and to stand exposure better than Scots pine. I know there is a difference of opinion on the status of this species, and I think it important to review the data which are available. My own inclination at this stage is to rely much more on the indigenous Scots pine than on a tree of which we have relatively speaking very small experience.

As regards the larches, we can obviously write off European larch at any rate in pure crops. I was impressed with the growth and form of hybrid larch on good sites but on the experiments on moraines there did not appear to be much in it between hybrid larch and Japanese larch up to 8 years or so. I did not see any older experiments.

To summarise my views as to possible future advances in the treatment of morainic soils:-

- (1) An important point to be kept in view is the deepening of the active soil. This can best be started by ploughing and where that is impossible by deep rooting species which should also form a part of the crop on ploughed ground.
- (2) We require to know far more about the rooting systems of all species which come into consideration. This calls for systematic investigation not only of experimental areas but also of older stands. For example, we should learn a lot by investigating the root systems of Scots pine and European larch on the areas being felled near Achanalt. The loan of a caterpillar from the Newfoundland Unit would enable stumps to be uprooted easily.
- (3) We require to know more about the silviculture of the indigenous Scots pine on the west coast - how much exposure will it stand, how fast does it grow, and so on - I have the feeling that with soil preparation it will not only grow quicker but will also stand a good deal more exposure than we have hitherto thought.

"R. L. R."

(6) Inspection in September 1945 by Sir Roy Robinson, Chairman.

Also present:	Lord Jowitt	Lord Chancellor
	Mr. Price, M.P.	
	Mr. A. M. Fraser	District Officer
	Mr. G. Mackenzie	Forester
	Mr. A. Mackenzie	Forester
	(Achnashellach)	

P.23

Japanese larch, thinned twice and a particularly good stand. The previous crop on this site was European larch.

P.22)
P.23)

On the peat area, the original crop had failed, partly on account of insufficient drainage, and partly through bad choice of species. It was now found that it was essential to use mounds on this type of peat, and to give each plant an application of 2 ozs. of slag. Mixtures of species are also advisable. The results in this area appeared satisfactory, although there were still some areas of Sitka spruce in check.

The Chairman expressed a desire to see the plough tried out, especially on the land in close proximity to the Loch in P.24 and P.27.

P.28

Douglas fir and Sitka spruce. The Douglas fir had been thinned in F.Y.44. It was noted that the Sitka spruce was superior in form to the Douglas fir.

P.22

European larch was seen to be suffering from the effects of wind. The Chairman said that underplanting with Douglas fir or some other suitable species could be carried out after more of the leaning trees had been removed.

In the P.22 area, in a stand of Pinus contorta, Sitka spruce mixture, planted in F.Y.30, the Pinus contorta was towering above the Sitka spruce. The Sitka spruce was, however, showing signs of recovery from its long check.

The Chairman commented that the difficult areas seemed to be improving steadily. He noted a considerable improvement in the backward areas lying on both sides of the road over to Gairloch. There was no doubt that we could get the trees away quicker by our newer methods.

(7) Inspection in October 1948 by Mr. J. Fraser, Conservator.

Present: Mr. R. A. Innes, District Officer

Mr. G. Mackenzie, Forester.

P.22 - Compartments 6 and 7

The Sitka spruce/Pinus contorta mixtures demonstrated the beneficial effects of Pinus contorta as a nurse for Sitka spruce. The Pinus contorta were spaced at about 10 ft. intervals, and the Sitka spruce were coming away fairly satisfactorily.

P.23 - Compartments 16 and 17

The Sitka spruce on the flat peat area, planted in F.Y.39, are growing fairly well.

Compartments 11 and 12

Originally planted with Norway spruce, and beaten up with Pinus contorta at 10 ft. spacing in 1932. The Norway spruce remained in check until about 1943. The end of the period of check was attributed to intensive draining in 1941 over the northern third of each compartment, and beating up with 1000 Pinus contorta, 400 common alder, and 3,300 Japanese larch. The difference in the growth of Norway spruce between the treated and untreated areas was striking.

P.28(b) - Compartment 55

Douglas fir and Sitka spruce. Thinned in 1948. Selected Douglas fir stems, not to exceed 100 per acre, to be high pruned.

P.26)
P.29)

The part of these plantations to the south of the Achnasheen - Gairloch road was now established and well stocked. P.26 had been beaten up intensively from 1940 - 1945. The irregular patches to the north of the road showed poor growth. The introduction of Pinus contorta into areas of pure Sitka spruce would help.

Slattadale Forest History

APPENDIX II

Supervision

Divisional Officers

Mr. F. Scott	1921 - 1931
Mr. J. Fraser	1931 - 1939
Mr. D.S. Spraggan	1939 - 1942
Mr. A. Watt	1942 - 1945
Mr. J.T. Fitzherbert (S.F.O.)	1948 - 1949
Mr. J.A. Dickson (S.F.O.)	1951 cont.

Conservator

Mr. J. Fraser	1946 cont.
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District Officers

Mr. L. A. Newton	1921 - 1925
Mr. J. W. Mackay	1925 - 1927
Mr. J.A.K. Meldrum	1927 - 1931
Mr. D. S. Spraggan	1932 - 1936
Mr. T. A. Robbie	1936 - 1938
Mr. A. M. Fraser	1938 - 1947
Mr. E. G. Richards	1947 - 1947
Mr. R. A. Innes	1947 - 1951
Mr. D. Graham-Campbell	1951 cont.

Foresters and Foremen in Charge

Mr. K. Mackay	1921 - 1922 (Foreman i/c)
Mr. K. Mackay	1922 - 1928 (Forester II)
Mr. G. Mackenzie	1928 - 1931 (Forester II)
Mr. D. J. Urquhart	1930 - 1934 (Foreman i/c)
Mr. G. Mackenzie	1934 - 1949 (Forester II)
Mr. A. Mackenzie	1949 cont. (Forester II)

APPENDIX III

P. Year	Area Claimed at 30.9.34 (O) and existing at 30.9.50 (N) by Species																			
	E.L.		J.L.		D.F.		N.S.		S.S.		S.P.		P.C.		Mixed		Other		Total	
	O	N	O	N	O	N	O	N	O	N	O	N	O	N	O	N	O	N	O	N
22	11.5	15.7	-	1.4	-	-	-	-	30.0	53.2	-	-	-	-	70.5	33.8	-	-	112.0	104.1
23	-	-	43.5	51.5	-	-	50.0	2.0	-	14.2	-	6.1	-	6.5	44.8	-	-	100.0	118.6	
24	6.0	-	-	-	13.0	10.4	31.0	5.6	9.0	-	-	-	-	29.0	8.9	-	-	88.0	24.9	
25	9.5	12.1	-	-	50.5	48.7	13.0	.8	13.0	10.5	8.0	-	-	6.0	11.8	-	-	100.0	95.6	
26	-	-	-	-	-	-	-	-	-	8.7	-	-	-	100.0	55.5	-	-	100.0	64.2	
27	-	-	-	.6	-	-	63.0	-	-	11.0	10.0	-	-	-	28.0	.4	-	-	145.0	14.9
28	-	-	-	.2	13.5	12.9	-	-	72.0	8.1	9.1	-	-	28.0	1.8	-	-	50.0	32.1	
29	-	-	-	2.5	4.0	5.3	14.0	-	8.5	3.7	-	-	-	34.0	30.7	-	-	52.0	56.4	
30	-	-	-	-	25.0	34.0	36.0	26.8	-	-	-	-	-	-	-	-	-	61.0	60.8	
31	-	-	-	-	-	.9	2.0	2.5	36.0	36.3	-	-	-	-	-	-	-	36.0	36.6	
32	-	-	-	-	-	-	2.5	1.3	4.0	4.5	2.0	-	-	-	-	-	-	8.0	7.9	
34	-	-	1.5	-	-	-	2.5	1.3	.5	-	1.0	-	-	-	-	-	-	5.5	2.5	
Total O	27.0	-	45.0	-	106.0	-	211.5	-	173.0	-	21.0	-	-	274.0	-	-	-	857.5	-	
Total N	-	27.8	-	56.2	-	112.2	-	53.2	-	150.2	-	23.7	-	6.1	-	189.2	-	-	-	618.6
Range O	3.1	-	5.2	-	12.4	-	24.6	-	20.2	-	2.5	-	-	32.0	-	-	-	100	-	
Range N	-	4.5	-	9.3	-	18.5	-	8.7	-	24.5	-	3.8	-	.1	-	30.5	-	-	-	100

* Note: 245.0 acres were written off in 1938

APPENDIX IV

Plant Supply

Showing Species, Identification Numbers and Utilisation

1932 - 1951

Year of Working	Species	Ident. No.	Age	Utilisation
1932	S.P.	Howden	2 + 2	B.U. P. 24, P. 25
	J.L.	28/37	2 + 1	B.U. P. 24
	D.F.	29/37	2 + 1	B.U. P. 24, P. 30
	N.S.	Lake Vyrnwy	2 + 2	Planting and B.U. P. 22, P. 25, P. 28
	S.S.	28/43	2 + 1	Planting and B.U. P. 22, P. 25
	S.S.	26/50	3 + 2	B.U. P. 25
1933	S.P.	Howden	2 + 1	B.U. P. 28, P. 25
	J.L.	28/57	2 + 2	B.U. P. 23, P. 29, P. 25
	D.F.	30/5	2 + 1	B.U. P. 29
	N.S.	29/31	2 + 2	B.U. P. 30, P. 23
	S.S.	28/43	2 + 1 + 1	B.U. P. 24, P. 26, P. 27
	S.S.	28/43	2 + 2	B.U. P. 22, P. 24, P. 25, P. 26
1934	S.P.	Ex Elgin	2 + 1	Planting
	S.P.	Howden	2 + 1 + 1	B.U. P. 32 and Planting
	J.L.	31/87	2 + 1	Planting and B.U. P. 22
	N.S.	29/31	3 + 1 + 1	Planting and B.U. P. 32
	S.S.	30/29	2 + 1 + 1	Planting and B.U. P. 25, P. 32
	S.S.	30/29	2 + 2	B.U. P. 22, P. 29
	S.S.	30/29	3 + 1	B.U. P. 25, P. 26
	S.S.	28/43	2 + 2 + 1	B.U. P. 28
	P.C.	-	2 + 1	B.U. P. 25, P. 26
	G. Alder	32/24	1 + 1	B.U. P. 30
G. Alder	31/47	2 + 1	B.U. P. 30	
1935	S.P.	Ex Elgin	3 + 2	B.U. P. 27
	E.L.	66	2 + 1	B.U. P. 24
	J.L.	33/43	1 + 1	B.U. P. 25
	J.L.	31/96	2 + 1	B.U. P. 22
	S.S.	30/29	3 + 1	B.U. P. 22, P. 24, P. 26, P. 27
	S.S.	30/29	3 + 2	B.U. P. 22
	M.P.	29/22	2 + 4	B.U. P. 26
	G. Alder	32/24	2 + 1	B.U. P. 30
1936	S.P.	Native	1 + 1 + 1	B.U. P. 22
	J.L.	33/43	1 + 1 + 1	B.U. P. 22, P. 27, P. 29
	J.L.	33/43	2 + 1	B.U. P. 26, P. 27, P. 28
	S.S.	33/12	2 + 1	B.U. P. 22, P. 27
	S.S.	30/29	3 + 1 + 1	B.U. P. 22, P. 27, P. 28
	N.S.	30/12	3 + 2 + 1	B.U. P. 30
	Oregon Alder	34/21	1 + 1	B.U. P. 26
Alnus Viridis	33/22	1 + 1 + 1	B.U. P. 27, P. 28	
1937	J.L.	34/48	2 + 1	B.U. P. 22
	S.S.	33/13	2 + 1	B.U. P. 22
	S.S.	33/12	2 + 2	B.U. P. 22
	Oregon Alder	35/25	2 + 1	B.U. P. 22
	Oregon Alder	35/25	1 + 1 + 1	B.U. P. 22
1938	J.L.	35/58	2 + 1	B.U. P. 22, P. 23, P. 29
	S.S.	35/14	2 + 1	B.U. P. 22, P. 23
	Grey Alder	36/14	1 + 1	B.U. P. 29, P. 22, P. 23
	Oregon Alder	35/25	1 + 1 + 1	B.U. P. 23
1939	J.L.	35/38	2 + 1	B.U. P. 23
	J.L.	36/18	2 + 1	B.U. P. 23
	J.L.	35/58	2 + 1	B.U. P. 29
	J.L.	35/58	2 + 1 + 1	B.U. P. 29
	S.S.	35/39	2 + 1	B.U. P. 23
	S.S.	35/14	2 + 1 + 1	B.U. P. 23
	S.S.	35/14	2 + 2	B.U. P. 23
	N.S.	-	2 + 2	B.U. P. 28 B
Grey Alder	37/72	1 + 1	B.U. P. 23	
1940	J.L.	37/24	2 + 1	B.U. P. 23, P. 27, P. 25, P. 26, P. 29
	S.S.	37/36	2 + 1	B.U. P. 23, P. 25, P. 26, P. 27
	P.C.	37/40	2 + 1	B.U. P. 23, P. 25, P. 26, P. 27, P. 29
	Tsuga	36/28	2 + 2	B.U. P. 28, P. 30

Year of Working	Species	Ident. No.	Age	Utilisation
1941	J.L.	39/26	1 + 1	B.U. P. 29, P. 31
	J.L.	38/45	2 + 1	B.U. P. 23, P. 26, P. 29
	S.S.	37/36	2 + 2	B.U. P. 31
	S.S.	37/36	3 + 1	B.U. P. 29, P. 26
	P.C.	37/55	2 + 2	B.U. P. 23, P. 29, P. 31
	Alder	39/36	1 + 2	B.U. P. 23, P. 26, P. 29, P. 31
1942	J.L.	39/26	2 + 1	B.U. P. 26, P. 28, P. 29
	J.L.	38/45	3 + 1	B.U. P. 29
	S.S.	37/30	2 + 1 + 2	B.U. P. 29, P. 22, P. 30, P. 28
	P.C.	39/36	2 + 2	B.U. P. 26
1943	P.C.	37/55	2 + 2	B.U. P. 26
	P.C.	39/22	2 + 2	B.U. P. 29
	H.L.	41/1	2 + 0	B.U. P. 26, P. 29
	J.L.	39/26	1 + 1	B.U. P. 26
	S.S.	39/22	2 + 2	B.U. P. 26
1944	S.P.	40/150	2 + 1	B.U. P. 31
	P.C.	41/2	2 + 2	B.U. P. 26
	P.C.	41/2	2 + 1	B.U. P. 26, P. 29, P. 31
	J.L.	41/1	2 + 1	B.U. P. 26
	J.L.	39/26	1 + 1 + 1	B.U. P. 26
	S.S.	39/28	2 + 3	B.U. P. 28, P. 29, P. 26
1945	J.L.	41/1	2 + 2	B.U. P. 23, P. 26
	P.C.	39/22	2 + 2	B.U. P. 23
1946	P.C.	41/7	2 + 2	B.U. P. 23, P. 25
1947	P.C.	44/5	2 yrs.	B.U. P. 31
	S.P.	42/10	2 + 1	B.U. P. 31
1948	P.C.	44/5	2 + 1	B.U. P. 25
	S.S.	44/1	2 + 2	B.U. P. 29
1951	S.S.	46/7	2 + 2	Planting
	P.C.	49/55	2 + 0	Planting and B.U. P. 25
	Tsuga	48/33	2 + 1	B.U. P. 30
	M.P.	20	2 + 0	Planting
	M.P.	75	2 + 0	Planting
	M.P.	344	2 + 0	Planting
	M.P.	416	2 + 0	Planting

APPENDIX V

Progress Towards Establishment

P. Year	Total Area Originally Claimed	1935		1938		Area Written Off 1938	1947		Total Area Stocked 1950
		E.	N.	E.	N.		E.	N.	
22	120	11.5	108.5	32.5	69.5	12.5	95.0	23.0	104.1
23	100	28.5	71.5	41.0	59.0	-	76.0	2.0	118.6
24	80	4.0	76.0	16.0	72.0	55.0	20.0	-	24.9
25	100	16.5	83.5	73.0	27.0	9.5	77.0	3.0	95.6
26	100	-	100.0	25.0	75.0	31.0	32.0	-	64.2
27	145	-	145.0	4.5	140.5	122.0	8.0	-	14.9
28	50	13.0	37.0	25.0	25.0	15.0	24.0	-	32.1
29	52	3.0	49.0	21.5	30.5	-	59.0	6.0	56.4
30	60	9.0	51.0	45.5	15.5	-	69.0	-	60.8
31	36	4.0	32.0	11.0	25.0	-	23.0	-	36.6
32	8	-	8.0	4.0	4.0	-	5.0	-	7.9
33	-	-	-	-	-	-	-	-	-
34	5.5	-	5.5	-	5.5	-	-	3.0	2.5
38	-	-	-	-	-	-	26.0	-	-
39	-	-	-	-	-	-	17.0	-	-
40	-	-	-	-	-	-	10.0	-	-
Total Established		89.5	-	299.0	-	-	541.0	-	-
Total Not Established		-	767.0	-	558.5	-	-	37.0	-
Total Written Off		-	-	-	-	245.0	-	-	-
GRAND TOTAL		856.5	-	856.5	-	857.5	-	578.0	618.6

NOTE

- (1) These figures do not include the acquired plantations.
- (2) There is an unexplained difference between the 1938 figures and the 1947 figures, i.e. $857.5 - 245.0 = 612.5$, not 578 as shown in the 1947 total. I think the explanation may be that the 1935 Working Plan recommended the "write off" of 329 acres. Deducting 329 from 857.5 gives 528.5, and a further 2.5 acres were destroyed by fire in F.Y. 37 and F.Y. 41, leaving 526 acres. In fact, only 245 acres were written off in 1938.
- (3) The areas shown as planted in F.Y. 38, 39 and 40 in the 1947 Census, refer to reconstruction work in the older plantations - they were not actually claimed as new plantings.
- (4) The Total Area stocked in 1950 was obtained by re-survey of the Forest in F.Y. 51.

APPENDIX VI

Growth and Condition of Main Species in Areas

Showing Best Growth for that Species

Cpt.	Species	P. Year	Age	Geology and Soil	a Altitude b Aspect c Slope d Exposure	Mean Height of Dominants (feet)	Mean Annual Height Increment (inches)	Current Annual Height Increment during last 5 years (inches)
68	S.S.	31	24	Torridonian Sandstone with glacial drift over. 2 in. - 6 in. humus layer, 2 ft. sandy loam, 1 ft. 6 in. and fine gravel and sand (former arable land).	a 40 ft. b N.E. c Slight d Exposed to east, mainly sheltered	37	18	21
67	N.S.	29	27	do.	a 50 ft. b N.E. c Slight d Slightly exposed to east.	30	13	14
67	D.F.	25	30	Torridonian Sandstone 16 in. light sandy loam, 9 in. irregular dark sandy layer with pan formation, on rock. (Former arable).	a 70 ft. b N.E. c Slight d Slightly exposed to East and N.W.	40	16	21
16	J.L.	23	32	Torridonian Sandstone with glacial drift over, 8 in. light sandy loam, 4 in. leached layer, 9 in. dark sand over stones.	a 100 ft. b N. c Moderate d Sheltered	50	18	21
22	E.L.	25	30	Torridonian Sandstone, 18 in. uniform light sandy loam, boulders below.	a 140 ft. b E. c Steep d Slightly exposed to E.	43	17	21
28	S.P.	25	31	Lewisian Gneiss, 4 in. sandy loam 8 in. yellow sandy drift over boulders	a 190 ft. b E. c Steep d Slight to N.E.	23	9	12
7	P.C.	22	23	Torridonian Sandstone, 6 in. peaty loam, 6 in. leached clay, 14 in. deposition layer over stones and drift.	a 100 ft. b N. c Slight d Sheltered	15	8	12
61	*A.N.	29	26	Lewisian Gneiss with drift over. 5 in. friable peat, 3 in. peaty loam, 5 in. second peat layer, over boulders and drift	a 400 ft. b N. c Steep d Exposed to N.E. and N.W.	15	7	19

* A.N. = Abies nobilis

APPENDIX VII

Details of Areas Thinned : 1939 - 1951

<u>Year of Working</u>	<u>1st Thinning</u> (acres)	<u>2nd and Subsequent Thinning</u> (acres)	<u>Total</u> (acres)
1939	2	-	2.0
1940	6.5	-	6.5
1941	34.5	-	34.5
1942	27.0	-	27.0
1943	30.0	2.0	32.0
1944	28.0	5.0	33.0
1945	4.0	1.0	5.0
1946	23.0	9.0	32.0
1947	15.0	8.0	23.0
1948	-	41.0	41.0
1949	33.0	5.0	38.0
1950	3.0	41.0	44.0
1951	<u>23.0</u>	<u>44.5</u>	<u>67.5</u>
Total (1939 - 1951)	229.0	156.5	385.5

APPENDIX VIII

Thinning Yield Plots

Compartment No.	6	13	14	15
Species	E.L.	J.L.	J.L.	J.L.
P. Year	22	23	23	23
No. of Thinning	4th	5th	5th	5th
Years since last thinned	4 yrs.	4 yrs.	3 yrs.	3 yrs.
Elevation	100 ft.	70 ft.	88 ft.	70 ft.
Aspect	N.E.	N.	N.	N.
Date of Thinning	21.2.50	8.2.50	19.11.49	5.10.49

Before Thinning

No. of Stems per acre	740	600	590	590
Av. B.H.Q.G. (ins.)	5	5	5 $\frac{1}{4}$	5
Upper Ht. in feet	37	43	40	41

After Thinning

No. of Stems per acre	500	360	380	390
Av. B.H.Q.G. (ins.)	5 $\frac{1}{4}$	5 $\frac{1}{4}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$

Thinnings

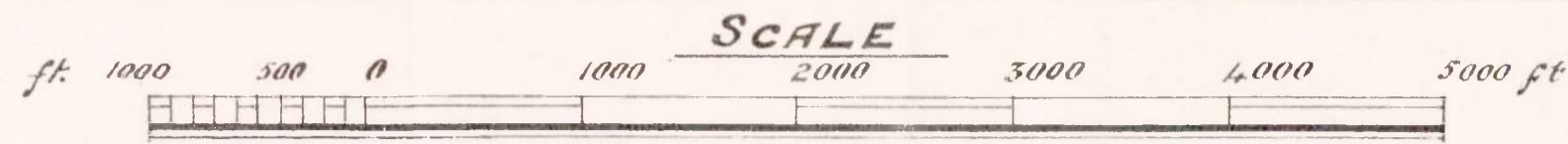
No. of Stems per acre	240	240	210	200
Av. Total Ht. (ft.)	34 $\frac{1}{2}$	38	37	37
Vol. Pitwood (cu. ft.)	445	455	410	370

Volume Figures from 1951 - 1952 Thinnings

<u>Species</u>	<u>P. Year and Cpt.</u>	<u>No. of Thinning</u>	<u>Vol. per Acre</u>
S.S.	P.31 Cpt. 68	1st	330 cu. ft.
N.S.	P.29 Cpt. 67	1st	250 cu. ft.
D.F.	P.25 Cpt. 26	2nd	490 cu. ft. (Marked by Research)

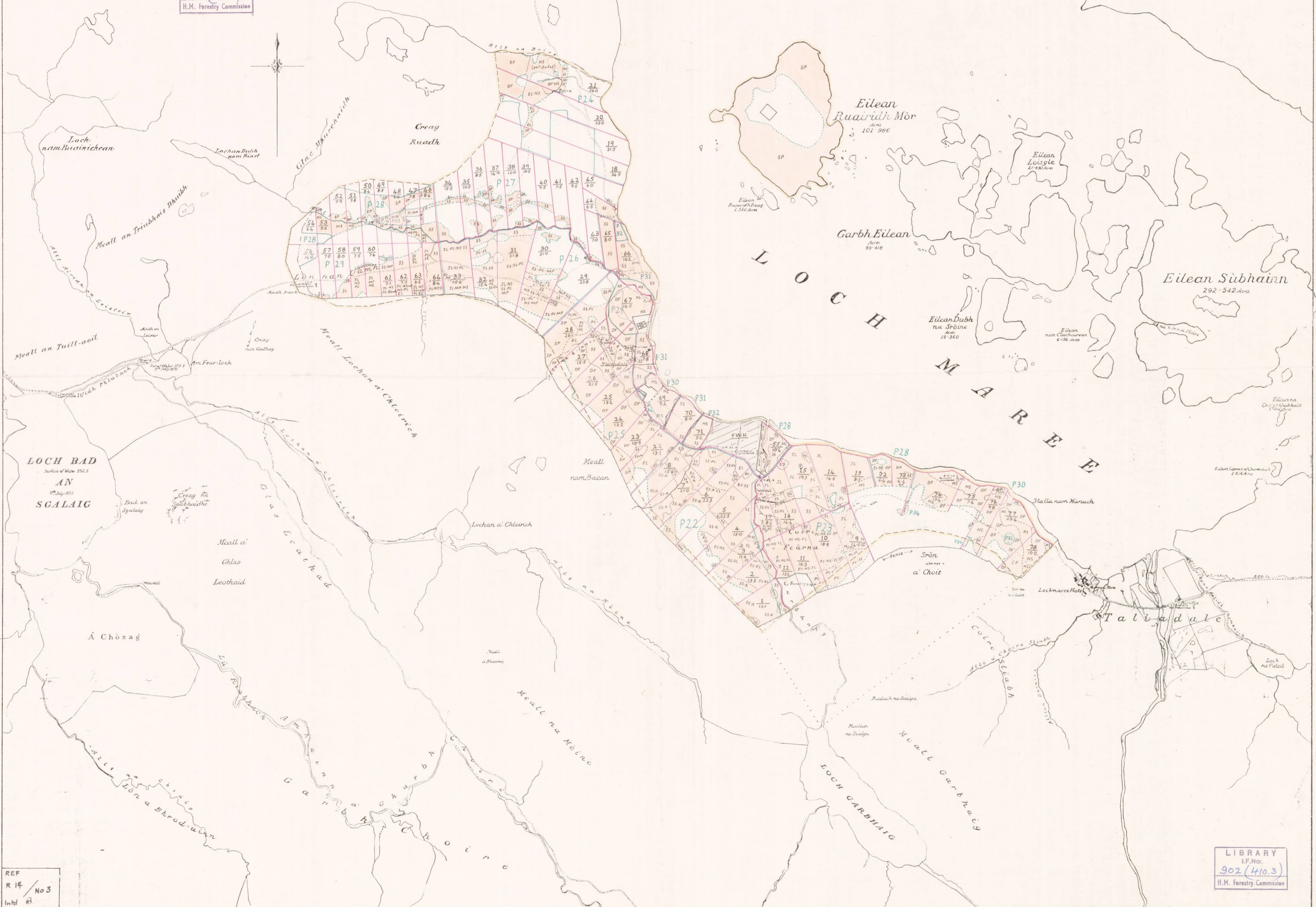
Slattadale

SLATTADALE FOREST



LIBRARY
I.F.No:
902 (410.3)
H.M. Forestry Commission

COUNTY OF ROSS & CROMARTY



REF
R 14
No 3
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I.F.No:
902 (410.3)
H.M. Forestry Commission