FORESTRY COMMISSION

HISTORY

OF

GLENSHIEL

FOREST

N (S) CONSERVANCY

FORESTRY COMMISSION

HISTORY

of

GLENSHIEL FOREST

1924 - 1951

NORTH (SCOTLAND) CONSERVANCY

History of Glenshiel Forest

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HISTORY OF GLENSHIEL FOREST

CHAIRMAN'S COMMENTS

Mr. Seal has compiled a careful record.

Glenshiel has been the most troublesome and most unsatisfactory of all the properties with which the Commission has had to deal. The original object was to make an experiment in taking over the plantable land only in a deer forest. Crofters were heavily involved and it was hoped that in return for steady employment and better houses the crofters would be prepared to surrender any rights they had in the land to be planted.

The total area acquired in 1924 and 1926 was 6,324 acres, of which 4,778 acres were assessed as plantable; and the feu duty was £649. The feu charter was complicated by various considerations which did not work out in favour of the Commission.

The scheme went wrong in its three main aspects right from the start. The fuar was unable to implement his obligations in full, there was serious trouble with crofters (and one in particular) and their sheep, the technica work was poorly conceived and in part at least badly executed. It is with the last aspect that Mr. Seal's history is mainly concerned.

/A note to the Commissioners by Sir John Stirling Maxwell (Chairman) dated January 26th, 1932, states the history and presents the problem then facing the Commission./

Mr. Seal's record of Inspections covers my own attempts to get the technical work right. Already by September 1927 the emphasis was on planting only "safe" ground; in January 1931 I considered the position unhappy and was asking Mr. Sutherland (Assistant Commissioner (Scotland)) to "straighten out the tangle".

In January 1932 I wrote (as Chairman) to the Assistant Commissioner to get "this troublesome case" put on a sound footing, the position being unsatisfactory all round including:

(1) Technical operations and costs;

(2) Relations with the fuar in respect of the supply of land.

(3) Relations with the local population.

In 1937 I remarked on a report dated 3/6/37 that the proposal with regard to labour (reduction in effect to essential maintenance work) should be strictly adhered to and review the position after 5 years.

I have not been able to get on to the ground since 1937 but from a fleeting view which I had from the road recently only a very small proportion of the area seems to be getting away. We know from experience that such plantations may at long last fill up and grow reasonably well but it is a very slow process and not to be accelerated by artificial means except at excessive cost. It would appear that restraint in expenditure should still be the watchword.

Thus this very costly experiment has given an answer which is wholly adverse; it would still have been adverse, even if it had been a good feu and the crofters had co-operated, because of the technical difficulties of afforestation. That I think is the lesson to be learned.

R.

3/3/52

DIRECTOR'S COMMENTS

The difficulties of site were added to by heavy grazing in the westerly plantation by crofters' sheep. No mention is made of the long story of the dispute with crofter McRae who claimed grazing rights in one or more of the enolosures - perhaps it is best forgotten. The dispute was settled, not by any process of the law, but by sending a Gaelic-speaking forester, C. Macdonald, to Glenshiel, who quickly established friendly relations with McRae.

(Intld.) H.B.P.

25th February, 1952.

HISTORY OF GLENSHIEL FOREST

GENERAL DESCRIPTION OF THE FOREST

Situation

The forest is in Glenshiel, in the Parish of Glenshiel and in the County of Ross and Cromarty. The plantation area comprises four enclosed blocks on the northern slopes of Glenshiel. The blocks are bounded on their lower sides by the Invermoriston - Shiel Road. The easternmost of the four blocks is within half a mile of the Tomdoun - Glenshiel road junction. The western end of the forest is five miles east of Shiel Bridge. Inverness, the nearest large town, is fifty miles from Glenshiel, and Kyle, the nearest railway station, is twenty-eight miles away by road. The nearest State Forest is Ratagan, some six miles away. The road serving the forest is poor, but will carry heavy equipment.

Area and Utilisation

Two acquisition reports were originally made covering a total of 12,400 acres. 6,324 acres were actually acquired by two feus from a Mr. A. Edward. Subsequent disposals and re-acquisitions left the Commission in possession of 1,188.5 acres. This area is in use as follows :-

Compartmented	909.5 acres
Enclosed, let for grazing	245 acres
Enclosed but not compartmented	34 acres
TOTAL	1188.5 acres

The 909.5 acres compartmented include:-

Unplantable	101 acres
Written off (following the 1938 Census) ...	44 acres
Plantations remaining on charge at present ...	764 acres

The plantation area of 764 acres includes 22 acres for which "write off" was asked in 1950. Request for further "write off" will be made in 1952.

The area acquired by the Commission but not enclosed amounts to 2,461 acres; this area is leased to the National Trust.

The feu charters under which the Commission hold their lands include the rights to kill vermin and game.

There are no Forest Workers' Holdings, no nurseries and no lands under permanent transfer to the Department of Agriculture.

Physiography

The planted area of Glenshiel is on a moderate to steep slope with a southerly aspect. The forest lies on the north side of the valley of the River Shiel which runs in an east to west direction, and the River Cluanie which flows in a west to east direction. The sources of these rivers are close together and the rivers lie in a common valley which joins Loch Duich to Loch Cluanie.

The forest is traversed by numerous burns which have cut gulleys in the hillside.

The elevation varies from 530 ft. to 650 ft. above sea level on the floor of the valley to a planted limit of 1300 ft.

Occasional flat areas are found; these occur most frequently where streams have formed outwash fans on the valley floor.

Geology and Soils

The underlying geology consists of undifferentiated schists and gneisses, but over the lower slopes extensive morainic deposits occur. These deposits appear to consist of grits, sands, clays and boulders derived from local rocks. Close to the valley bottom they take the form of isolated and well marked knolls, probably being small terminal moraines formed as the glaciers receded up the valleys. The underlying rock outcrops on the upper slopes.

The soil cover is variable, consisting for the most part of mixed clay-grits and bouldery sands. There are small patches of better quality red sandy soils. Podsolization is extensive and iron pan of common occurrence.

The high rainfall has encouraged peat formation; deep accumulations are frequent. On the slopes and morainic knolls a shallow layer of Calluna/Scirpus peat of a crust-like and dry nature is prevalent.

Vegetation

The vegetation is fairly uniform along the whole area and is formed

mainly of associations of Calluna vulgaris and Scirpus caespitosus. Nardus and Erica cinerea and Erica tetralix also occur in these associations, as do moss species. These species are all on peat of varying depth. Where the peat is absent, bracken occurs. There are extensive areas of almost pure Scirpus and of almost pure Calluna (the latter especially frequent towards the western end of the forest). On the flat ground and on deep peats, the Scirpus and Calluna are associated with Myrica gale and Erica tetralix. Juncus communis appears beside burns and on outwash fens.

Meteorology

The average rainfall appears to be between 90 in. and 100 in. per annum, though no significant readings are available. Rainfall is known to be considerably higher than at Ratagan, where the mean annual figure is 76 in. A single record of rainfall at Glenshiel was made during 1938, and a total of 147.5 in. was recorded.

The prevailing winds are from the south west, and some sway has been caused by them particularly in larch. The occasional severe east winds have noticeably impeded growth on the highest planted areas. Late frosts are common and snow may lie until April. Serious frost damage occurred in 1935.

Risks

Risk of fire is very slight. Main dangers of this kind are (1) muirburning by neighbouring shepherds, and (2) from tourists and others on the Invermoriston to Invershiel main road. No fires have entered the Glenshiel plantations as yet.

There is a slight risk of landslides and snow avalanches. These have occurred from time to time and have damaged the upper boundary fence. The last big slide which occurred in 1950 took down a big surface between Commission enclosures.

Some damage, especially to slow growing pines, has been done by red deer. Damage was especially heavy in 1930, 1931 and 1932. Heavy damage to young Sitka spruce by sheep was reported in 1929. Working Plan prescriptions in 1928 included heavy shooting of red deer and careful upkeep of fences.

Chermes and Neomyzaphis are present at Glenshiel now. The low vigour of much of the spruce has intensified the direct damage of these pests. Attacks have not as yet caused serious damage. Fungus damage is negligible.

Roads

No roads have been built at Glenshiel. The public road, though narrow and winding, allows the passage of heavy vehicles.

Labour

Labour was made available for planting, partly by the provision of a bothy. The labour force averaged 9 men until 1932, since which year it was reduced by about a man per annum, until in 1937 two men were left. Since 1937 the forest has been in the charge of a foreman with usually one and occasionally two or more men from Ratagan to help him.

SILVICULTURE

Preparation of Ground prior to Planting

(a) Treatment of Vegetation before Planting

There was no tree growth on Glenshiel except a few scattered birch trees on the burn sides. The only vegetation which might have required treatment prior to planting was heather and bracken. The Working Plan prepared in 1927 makes provision for burning long heather prior to planting, but there is no record to indicate that any such burning was ever done. No heather burning was done from 1931. No bracken cutting was done prior to planting.

(b) Fencing

The plantations are in four separate enclosures. Enclosure by deer-proof fencing generally proceeded a year ahead of planting. The final fences are of iron posts and droppers with wires only and no netting. In the fencing of the larger blocks, the iron fencing was put along the top and bottom, and along one side of a block, while temporary wooden fences were erected at the open side until the complete block was planted up.

(c) Draining and Turfing

For the first few years (1925 to 1927 inclusive) very little draining and no turfing was done.

By 1927 the need for thorough drainage and turf planting was

realised and the working plan of that year prescribes that draining and turfing must be done prior to planting in all wet and peaty areas. Drainage per acre rose from a negligible chainage in 1927 to fifteen chains per acre in 1929 and 1930, and over forty chains per acre from 1931 to the end of planting in 1934. Full use was made of the out-turned turves where those were suitable for planting.

Choice of Species

The following tabular statement shows the areas of each species as originally planted, and gives for comparison the areas of effective plantation as assessed today.

Areas by Species as Originally Planted

	J.L.	S.P.	P.C.	M.P.	N.S.	S.S.	N.S./S.S.	S.S./S.P.	Total
P.25	-	-	-	2	50	30	- -	- -	82
P.26	-	10	-	9	98	25	25 -	25 -	192
P.27	-	55	-	2	55	43	- -	- -	155
P.28	-	-	-	-	-	2	- -	- -	2
P.29	-	44	-	3	26	21	- -	- -	94
P.30	-	40	10	8	29	33	- -	- -	120
P.31	-	12	2	3	20	24	- -	- -	61
P.32	-	-	4	1.5	-	24.5	- -	- -	30
P.33	2.5	-	10.5	5.5	-	56.5	- -	- -	75
P.34	0.5	-	-	-	-	1.5	- -	- -	2
Totals	3	161	26.5	34	278	260.5	25	25	813 ø

Present Plantation Areas by Species

Totals	3	50	33.5	28.5	180	286	155.5	72	808.5 ø

Failed Areas Written Off or for which Write Off is Requested (1950)

-	6	1.5	1	27	27	-	3.5	66.0

(This area will be resurveyed and resubmitted in 1952)

Areas of Effective Plantation

3	44	32	27.5	153	259	155.5	68.5	742.5

ø Discrepancy of 4.5 acres due to resurvey of P.27 area in 1950, reducing the planted area from 155 acres to 150.5 acres.

It will be seen that in 1925 and 1926 the main species was Norway spruce with Sitka spruce as the next choice. Scots pine was not used in 1925, but was used in 1926 to a limited extent, the only other species used being mountain pine.

In 1927, Norway spruce, Sitka spruce and Scots pine, each made up about one third of the area. Most of the Scots pine was planted as a nurse in mixture with one or other of the spruces, and, in the worst areas, mountain pine was used in place of Scots pine.

Two acres of Sitka spruce only were planted in 1928.

In 1929 and 1930 the proportions remained similar to those of 1927, though slightly more Scots pine was planted than either of the spruces, mainly in mixture with them as a nurse. Pinus contorta was used for the first time in 1930. Some mountain pine was still used in 1930.

In 1931, Sitka spruce became the main species, closely followed by Norway spruce at about 40% each, with 15% Scots pine, and 5% Pinus contorta and mountain pine. This was the last year of planting Norway spruce.

From 1932, Sitka spruce was the main species forming about 80% of the crop, the balance being Pinus contorta and mountain pine, except for some three acres of Japanese larch, tried as an experiment.

The main criticism of the choice of species is the excessive use of spruces on heather ground, and the insufficient use of pines, whether as a crop or as nurses for the spruces, except in 1927, 1929 and 1930, and, even in those years, more pines should have been used. It also seems likely that more Japanese larch could have been used with good effect, mainly as a nurse and to suppress heather.

(3) Planting

(a) Spacing

There is nothing special to note except that in some areas of P.29 to 32, Sitka spruce was planted on the poorer ground in heather at a six foot spacing, with a pine interplanted between each, making a three foot spacing and a 50% mixture. There is still some evidence of this, though such areas have generally failed or checked badly, due to lack of drains, turfing and manure, and later very heavy beat up, with many plants still existing and showing very close spacing, has masked this.

(b) Type of Plants and Source of Supply

Information on source of supply is very sketchy, and all that can be said with certainty is that plants came almost entirely from Ratagan, Inchnacardoch and South Laggan nurseries in the late years at least.

As regards the age and type of plants used for first planting, the following tabular statement may be of interest, particularly the three thousand Sitka spruce used in 1930 aged 2 + 1 + 1 + 1 + 1 !

P.Year	N.S.	S.S.	S.P.	M.P.	P.C.	J.L.
25	2+3	2+3		2+2 2+3		
26	2+3	2+2	2+1 2+1+1 2+2	2+1		
27	3+2 3+2+1 3+3	2+2 3+2	2+1+1 2+2	2+2		
28		3+2				
29	2+3	2+3	2+1	2+3		
30	2+3+1 2+4 2+5 3+4+1	3+2 2+1+1+1+1 (3M)	2+1+1	2+1	2+1 3+1	
31	2+1 2+5 3+3 2+0 (6M)	3+0 (6M) 2+1 2+2	2+1 2+2	2+1+1	2+1+1	
32		3+2		2+1	2+1 2+1+1	
33		2+0(5M) 2+1		2+1+1 2+1	2+1	2+0
34		2+1+1				2+1

The over-age category of Norway spruce used did not increase the chances of survival of the trees.

(c) Method of Planting

From 1925 to 1927 inclusive, planting was entirely done by notching, using planting mattocks and, later, Schlich's spade.

The two acres planted in 1928 were Sitka spruce planted in turves, and from 1929 onwards turf planting was done on an ever increasing scale, the turves being laid out at the time of draining in the preceding summer. The working plan of 1927 to cover the period 1928 to 1932 laid down that "Notching with the Schlich spade or mattock must be confined to those

areas where peat is absent or where it is shallow and dry in character", and this instruction appears to have been followed.

(d) Annual Rate of Planting

As may be seen from the table on page 10 above, planting proceeded steadily at the rate of some 150 acres per annum from 1925 to 1931, except for 1928, dropping to some 50 acres per annum from 1931 to 1934.

The planting of only two acres in 1928 was due to sheep getting into the enclosure, and to very serious friction between the Commission and the local crofters at this stage. It was about this time that a photograph in post card form of the "Latest Kintail Industry - Luibeneorn Spruce Tree Mines - 1000 plants from one peat bog" was published by a Kyle photographer to embarrass the Commission. These plants were probably buried during planting, or beating up, and showed up slack supervision by a foreman who left under a cloud at the time.

(e) Manuring

The first time that manure was used at Glenshiel was in 1930, when it was used on turves in beating up P.25. with Sitka spruce in that year. It was applied in the form of basic clag; Semsol or ground mineral phosphate appears to have been used regularly for beating up from 1930 onwards.

Manures were first used at the time of planting in 1932; in this year some manuring was in fact done at the time of draining, several months before planting, but this was not the usual practice. Normally, the manure was applied at the time of, or immediately after, planting. Slagging of all first planting did not begin until 1932.

(f) Success of Establishment

Assessments were made in 1934, 1938 and 1947/49 and these show the progress of establishment as follows:-

Year of Assessment	Established	Not Established	Total
1934	21	792	813
1938	61.5	752	813.5
1947/49	121	723	844 ø

ø Check up on the planted areas in 1950 shows that the 813 acres claimed for original planting was substantially correct. In summarising the figures for 1947/49 there has been an error due to "write offs" in compartments. If the error is distributed, the figures read :-

Year of Assessment	Established	Not Established	Total
1947/49	116	697	813

44 acres of P.26 had failed and were written off at 1938 census :-

20 acres Norway spruce
19 " Sitka spruce
4 " Scots pine
1 " Mountain pine
44 acres in Compartments 1 and 2

Since 1938 a further 22 acres have failed (as at 1950) and "write off" has been sought :-

Compartment	Species	Acres	P. Year
4	Norway spruce/Sitka spruce/Scots pine	13	26
5	Pinus contorta/Sitka spruce	3.5	32
6	Scots pine/Sitka spruce	3.5	31
8	Sitka spruce	2	31
	Total:	22.0 acres	

Thus the area of effective plantation at present is 742.5 acres, of which 116 acres are established and 626.5 not established. This is not at all satisfactory but not surprising in view of the poor soil conditions, insufficient soil preparation, exposure and lack of manures at the time of original planting. The process of natural consolidation by linking up of established groups continues, however, and it is still too soon to despair of the eventual formation of a useful forest crop.

Ploughing

No ploughing was done at Glenshiel Forest.

Beating Up

The following statement shows the extent of beating up that was done at Glenshiel and the percentage of species used in this work. Except for an occasional acre, there has been no beating up at Glenshiel since 1943.

Acres Beaten Up in each P. Year

B.U. Year	Total	P.25	P.26	P.27	P.28	P.29	P.30	P.31	P.32	P.33	P.34
26	75	75	-	-	-	-	-	-	-	-	-
27	80	80	-	-	-	-	-	-	-	-	-
28	6	-	6	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-
30	3	3	-	-	-	-	-	-	-	-	-
31	45	31	14	-	-	-	-	-	-	-	-
32	91	47	-	-	-	-	26	18	-	-	-
33	38.5	14.5	-	4	-	-	11	9	-	-	-
34	149	70	50	-	-	2	-	25	2	-	-
35	124	-	-	96	-	3	16	-	-	9	-
36	33	-	17	15	-	-	1	-	-	-	-
37	32.5	16	4	8	-	4	-	0.5	-	-	-
38	16	2	-	-	-	7	7	-	-	-	-
39	12	-	-	-	-	10	-	-	-	-	2
40	16	-	-	-	-	4	-	12	-	-	-
41	30	-	-	-	-	3	10	14	3	-	-
42	23	-	-	-	-	3	10	10	-	-	-
43	19	-	-	-	-	7	2	10	-	-	-
Totals		338.5	91	123	-	43	83	98.5	5	9	2
Original Area of P.Year		82	192	155	2	94	120	61	30	75	2

Percentages of Species Used in Beating Up

Year of B.U.	S.S.	N.S.	S.P.	P.C.	M.P.	J.L.	O.A.*	G.A.*
31	-	15	43	42	-	-	-	-
32	14	-	-	43	43	-	-	-
33	100	-	-	-	-	-	-	-
34	96	-	-	-	-	4	-	-
35	70	-	-	20	2	4	4	-
36	75	-	-	-	-	-	25	-
37	60	-	7	12	-	3	-	18
38	92	-	4	-	-	4	-	-
39	34	-	33	-	-	33	-	-
40	72	-	-	17	-	11	-	-
41	72	-	-	17	-	11	-	-
42	72	-	7	7	-	14	-	-
43	60	-	20	-	-	16	4	-

* O.A. - Oregon alder. G.A. - Grey alder

The beating up of years 1926 and 1927 comprised the replacement of casualties with the same species (Norway spruce and Sitka spruce), without any other work.

The six acres beaten up in 1928 were done with Sitka spruce on turves, after putting extra drains in the area treated.

The three acre beat up of 1930 was also done with Sitka spruce on

turves, after extra draining and with basic slag as manure. In this year also, 2.5 acres of backward existing Sitka spruce was treated with slag to see if this would assist growth.

It is known that slagging of existing plants (mainly spruces) was done on a considerable scale for several years, but unfortunately records do not show what areas were done accurately or any other useful details. The work was done at the same time and over the same ground that was beaten up in that year.

From 1931 starts the main beating up period or periods for Glenshiel, when attempts were made to complete the stocking of areas already planted. Spruces from this year onwards were invariably planted on turves, after additional draining, and the plants were manured. The use of Norway spruce was discontinued after 1931.

In 1931 a small quantity of Norway spruce was used (the last time this species was used in beating up), and no Sitka spruce. The main species used in both 1931 and 1932 were pines; Scots and contorta in 1931 and contorta and mountain in 1932; and these were put in between the existing spruces to act as nurses and in an attempt to get a closed canopy as early as possible by closer spacing. The desirability for this was expressed in inspection notes which are appended.

From 1933 Sitka spruce was the main (and in 1933 the only) species used in beating up. In 1934 the use of Japanese larch was started, and this species was used thereafter regularly almost every year. Mountain pine was not used after 1935, but Scots pine, and Pinus contorta, were used to a fair extent almost every year. Oregon alder was used in 1935 and 1936, and grey alder in 1937.

In 1935 and 1936, Semsol was generally used as the manure, though some basic slag continued to be used. From 1937 the only manure used was ground mineral phosphate.

Almost all the Oregon alder and much of the grey alder and Japanese larch used in beating up failed to establish itself and has died out from frost and exposure, but most of the other species used persist and are in some cases forming crops.

Up to 1937, turfing was done for Sitka spruce only and very few of the pines were manured. From 1937 almost all plants used for beating up were

both turved and manured.

In 1937 the Chairman and Assistant Commissioner, after inspecting the "consolidation" work done at Glenshiel, stated that "Everything possible that could be done had been done, and no more beating up should be done."

The District Officer requested that he be allowed to continue to complete some good hollows in P.29, and this was agreed to on the basis that a two man squad should be sufficient for this work, to be done in 1937 and 1938, and that one man only should be employed thereafter.

Beating up in P.29 - 32 areas continued on a much reduced scale up to 1943, when all such work was finally stopped.

The extent of beating up done on this forest has been phenomenal and may be taken as a warning for the future. In the case of P.25, for example, the area covered by subsequent beating up operations is four times the total area originally planted.

The results of beating up have been only fairly satisfactory, but growth is very slow in this inhospitable area.

Weeding

Unfortunately, the history of weeding is not very complete from 1938 onwards. To that date, the areas weeded were as follows, and this work was almost entirely bracken cutting.

F. Year	P. Year on which Weeding was done	Area weeded over	No. of Weedings in the Year
1928	27	65 acres	2
1929	25	19)	1
	27	25) 65 acres	2
	29	21)	1
1930	25	27)	1
	27	20)	2
	29	17) 96 acres	2
	30	32)	2
1931	25	17)	2
	27	19) 63 acres	2
	29	15)	2
	30	12)	2
1932	25	92 acres	3
	27		
	29		
	30		

By 1938 it was stated that "only a few areas now require weeding", and these appear to have remained under weeding until about 1940. From

that date, weedings are mentioned over very small areas, and presumably refer to areas recently beaten up.

Mixture of Species

In P.25, the two main species, Norway spruce and Sitka spruce, were planted in separate blocks. In P.26, about half the area was planted to pure Norway spruce and half the remainder to pure Scots pine, mountain pine or Sitka spruce. The remaining quarter was planted with a Norway spruce/Sitka spruce mixture ($\frac{1}{2}$) and a Scots pine/Sitka spruce mixture ($\frac{1}{2}$). Details for P.27 are not available, but it appears that, while Scots pine, Sitka spruce and Norway spruce were planted pure to a considerable extent, there were also considerable areas planted as Scots pine/Norway spruce and Scots pine/Sitka spruce mixtures. In both P.26 and P.27 the mountain pine was mainly planted in mixture with Sitka spruce.

The Working Plan made in 1927 by Mr. G. B. Ryle for the period 1928 to 1932 prescribes the choice of species as follows :-

"A climate of high rainfall combined with a generally peaty condition of the soil indicates that this area must be predominantly a spruce one. Finally, the main crop will consist of Sitka spruce, though in the initial stages the introduction of pines - Scots pine, mountain pine and Pinus contorta - as soil protectors and canopy formers will be necessary in many places.

"On the shallower and fairly dry peats, the use of Japanese larch, probably only as a temporary crop or as nurses for the main spruce crop, should be tried. On the bracken areas also, where there is little or no peat, Japanese larch should flourish, though these areas would also do well under Sitka spruce, and in view of the small percentage of this type of ground, the introduction of isolated patches of larch into the main spruce crop would hardly be justified.

"There are a very few bracken clad slopes upon which Douglas fir might succeed, but for the same reason it is not thought advisable to plant any of this as Sitka spruce would give approximately the same yield and there would be no advantage in interrupting the main policy of forming a spruce forest.

"As fire belts along the roadside and also in several strips up the

slope to sub-divide the forest, it is proposed to plant a few rows of alder (Alnus glutinosa or Alnus incana). These would probably have no economic value as they would be kept in coppice, but for purely protective reasons their use would be amply justified."

He adds a clear indication of the proportion of ground to be planted with a mixture as follows :-

80 acres Sitka spruce at 6 ft.	Mixed at 2420 trees per acre
50 acres Pine at 6 ft.	
30 acres Japanese larch at 6 ft.	
10 acres Alder	

These prescriptions were not closely followed, but are the only useful guide we have to show that at least considerable areas of pine/spruce mixtures were planted as such at formation in the remaining planting period, 1929 to 1933. There still remain pure established groups of Sitka spruce, Japanese larch and a few promising groups of almost pure Pinus contorta, with patches of almost pure mountain pine where the spruce has failed, and some extensive groups of Scots pine with a few spruces still existing throughout. But as a result of the very extensive beating up operations which have taken place, the greater part of the area now comprises a general mixture of Scots pine, Norway spruce, Sitka spruce, Pinus contorta and mountain pine with usually three at least of these species present, and the predominant species varying over quite small areas throughout.

Rates of Growth

Rates of Growth have been generally slow at Glenshiel. The upper area of the forest now consists of small and scattered patches of faster growth. The lower slopes and gulleys show more extensive and more rapid growth. Good growth of all species has occurred in the best of the lower soils. It is noticeable that good growth extends up the gulleys formed by the streams where alluvial material has given rise to soils which are richer and better drained than those on the slopes and ridges.

The best overall rate of growth is shown by Pinus contorta. This species is slower than Sitka spruce on the better soils but has grown steadily, if slowly, where other species have failed or checked. Pinus contorta on the lower soils shows satisfactory growth. (See Appendix III).

Sitka spruce has grown satisfactorily only in the better flushes. These flushes occur mainly on the lower slopes, but where they occur at high altitudes and in exposed conditions Sitka spruce has still grown moderately well. The low areas of good Sitka spruce growth are extending slowly.

Norway spruce shows poor growth except for small isolated patches in the best of the lower soils.

Scots pine shows moderate growth. Like Pinus contorta, it was frequently used in beating up and has survived and grown where the original planting of spruce has largely failed. Scots pine shows slower growth than Pinus contorta on peats generally, and is slightly slower growing than Pinus contorta on the better soils.

The form of the crops is generally poor or moderate. Pinus contorta on higher ground is of spreading form; on lower ground the form is better, and stems are unforked and cylindrical and branches fine.

Japanese larch has grown vigorously on the good soils to which it was confined, but its form is poor. Crowns are usually distorted by wind, and spiralling is frequent. Taper is marked, and the trees are usually heavy branched.

Sitka spruce in the successful areas is of average form. In exposed places there is very little crown distortion.

Norway spruce is of good form where it has grown successfully.

Scots pine is of varied form. Patchy growth has resulted in persisting and heavy side branches in many cases.

Measurements of crops have been confined to the areas of most successful growth except for those taken in Compartment 3. Measurements are tabulated in Appendix III.

Past Treatment of Established Plantations

The first thinning at Glenshiel was in 1948 when $1\frac{1}{2}$ acres of Sitka spruce were thinned. No thinning has been done since, though 15 acres are prescribed for the present working plan period, i.e. until 1954. Many small isolated patches, particularly of Sitka spruce, are now fit for thinning, but it is more economical to leave these to extend so as to thin the maximum area in one operation.

Cleaning started with two acres of Japanese larch in 1944, and brashing started with nine acres of Sitka spruce in 1946. The present working plan (up to 1954) prescribes 22 acres for cleaning and 13 acres for brashing.

Research

There are no Research Branch experiments at Glenshiel.

Conclusions in the light of experience gained.

The failure to establish fully the plantations at Glenshiel is due mainly to the use of unsuitable species. The bad effects of using unsuitable species were greatly increased by insufficient soil preparation.

In the early plantings, Norway spruce was used in conditions which, with the knowledge now available, were clearly unsuitable, and too little use was made of Scots pine, Pinus contorta and Japanese larch. In the later plantings, the Norway spruce was reduced, but it was replaced with Sitka spruce and Scots pine, Pinus contorta and Japanese larch were still not used on a sufficiently large scale.

With the adverse conditions of soil and climate, Sitka spruce should have been confined to areas of certain success, that is, to the lower and better flushes which were well drained, fresh and free from frosting dangers.

The use of Sitka spruce in beating up was excessive, and greater use should have been made of pines. The results of beating up were not satisfactory.

The conditions at Glenshiel are such that part or whole of the first rotation should have been used for a pioneer rather than a productive crop.

Recent work at Glenshiel has been confined to increasing drainage in the most promising of the checked areas to speed their establishment. There are four types of areas at present:-

(1) Successful areas (e.g. Sitka spruce in the better flushes).

(2) Checked areas where patches are growing and extending.

(3) Checked areas where there is no noticeable progress towards establishment.

(4) Areas where losses have been heavy.

The Glenshiel Working Plan will be revised in F.Y.52. Detailed operations are not yet decided, but general operations will probably be as follows :-

Areas as (1) above : Thinnings will be delayed so as to thin the maximum area in one operation.

(2) above : Draining will be improved where this will help. Other treatment will not generally be applied.

(3) above : These areas will be treated only if they are on the lower slopes and readily accessible, and only where there is evidence on the ground to show that treatment will be effective.

(4) above : "Write off" will be applied for most of these areas.

(Sgd.) D. T. SEAL

District Officer.

APPENDIX I

Notes from Inspection Reports

1. Inspection by Messrs. R.L. Robinson, Sutherland and Scott, on 11.9.27

As a result of the inspection of the planting work done in the two previous seasons, it is decided in future to restrict planting to "safe" ground, i.e. to ground which, on experience already gained, shows good evidence that we can succeed in establishing a satisfactory forest crop.

Where small areas of doubtful ground occur, in "safe" ground, they should be left unplanted meanwhile.

2. Inspection by Assistant Commissioner (Sir John Sutherland) and Divisional Officer (Mr. F. Scott) on 24th and 25th April 1928

P.26 It was considered that Scots and other pines were making good progress but that the spruces were still in check, with evidence of some recovery in the better ground. It was agreed that it might be necessary to introduce pines to the pure spruce areas before a complete crop could be established.

3. Inspection by Assistant Commissioner (Sir John Sutherland), Sir John Stirling Maxwell and Divisional Officer (Mr. F. Scott) on 23.10.28

P.27 The Sitka on the Molinia ground has got over the check period and is now doing well. Scots pine on the higher elevations is making growth but suffering from exposure. A plot of Norway spruce near the bothies planted on turves was still in check, probably owing to the fact that the plants used had been too large for this class of work. A plot of Sitka on turves below these were also large plants which suffered badly from frost immediately after planting. These are now recovering and in the more sheltered sites had put on 2 in. during the last season.

Sir John was of the opinion that the spacing in the mixtures of pines and spruces had been too wide, and better results would have been obtained if planting had been at the minimum distance for Scots pine.

Many of the Scots, Norway and Sitka plants had been too tall for use on the more exposed sites.

Additional drainage would be required in parts of P.27.

P.25 It was noted that the Norway spruce - the species most used - was in complete check.

Sir John Stirling Maxwell agreed with Mr. Scott that contour drains should be made and a soil improver planted between them. Sitka could then be planted on turves and the present Norway spruce left as a control.

Sir John thought that Glenshiel was a very difficult proposition, and that, in our present state of forestry knowledge, to embark on a heavy planting programme would be unwise.

4. Inspection by Technical Commissioner, Mr. R.L. Robinson, on 21.9.30

P.30 The lower slope of this area was viewed from the road. Intensive draining was carried out, and a large proportion is turf-planted.

P.25 The section of 10 acres, beaten up after intensive treatment in F.Y.20, was examined. Many failures have occurred in the recently turf-planted Sitka spruce. The opinion was expressed that the planting had been carried out in a careless manner. The roots of plants examined had been inserted in the slits without being turned under the turves.

The Technical Commissioner considered that elsewhere in the plantation many of the checked spruces might yet recover, and that accordingly beating up should be delayed. He agreed, however, that 10 acres might be dealt with annually on similar lines to that already treated, but only on such types of ground as experience had shown could be successfully treated by the methods in use.

P.29 The more intensive treatment in this plantation was examined. The Sitka spruce used in turf-planting were considered too large for such an exposed area. A small number of sheep have grazed in this plantation continuously from the time of planting. The damage has been serious only in the non-turfed grass patches and along the fence side at the higher limit. The Technical Commissioner was of opinion the sheep would take much less notice of plants on turves, and desired that this should be tested by experiment, the plot being so planted on a good grass patch and on the higher ground near to the fence.

Technical Commissioner's observation on this report, dated 15.1.31:- "The general position with regard to this area is still unhappy. I presume Mr. Sutherland is attempting to straighten out the tangle and will report progress in due course."

5. Inspection by Assistant Commissioner (Sir John Sutherland), Divisional Officer (Mr. J. Fraser) and Mr. H.C.B. Peirse, District Officer, of 3.5.33.

After an inspection of P.26 (east section), P.27, 30, 31 and 32, Mr. Fraser suggested that no new planting should be done until all the beating up and draining of past plantations could be undertaken. This was agreed to by Sir John Sutherland.

6. Inspection by Sir Alexander Rodger and Mr. H.C.B. Peirse of 22.4.35

P.26 Sir Alexander thought this the most unpromising block he had seen. He remarked on the bad effect that wind had on plants (particularly Scots pine) growing on ridges, and noted the good effect of the shelter given by these ridges to plants growing under their lee. It was thought that, if a western race of Scots pine had been used, the growth would have been better.

7. Inspection by the Chairman, Assistant Commissioner, Divisional Officer, Mr. Oliver, Mr. Spraggan (District Officer), and Mr. W. Murray (Forester) on 3.6.37

The party first inspected the P.26 area where the hollows had been drained and turved, and beaten up with Sitka spruce and Oregon alder in 1936 and 1937. Only the more promising of the Myrica flats and hollows had been treated and all plants had been manured.

Some knolls were inspected which had been beaten up with Japanese larch, Pinus contorta and some Scots pine from western seed, 1937.

The plants had been notched in on the flat and manured, as an experiment in the treatment of the drier knolls.

The Chairman considered that everything possible had been done in this plantation and stated that no further beating up work should be undertaken meantime.

The P.30 - 32 enclosure was next visited, where similar consolidation work had been done in the hollows.

Where treated, the plants were seen to be in a healthy condition.

The Chairman and the Assistant Commissioner both agreed that all possible had been done here and that no further work should be attempted.

Coming to the P.25 - 27 enclosure, some of the best groups of Sitka spruce were seen. Most of the best hollows in this section had been treated in a similar manner to the above.

The Chairman again stated that this work should be stopped and that any work done should be maintenance.

Chairman's Observations

The proposal with regard to labour should be strictly adhered to. We can look into this place again in 5 years, and decide what the future policy should be.

"R.L.R."

Notes on Meeting in Loch Duich Hotel, Ardelve, on evening of 4.6.37
Present: Chairman, Assistant Commissioner, Divisional Officer, District Officers - Mr. Oliver, Mr. Spraggan, Mr. Robbie

The Chairman stated that we had done everything possible that should be done on this area and that no more beating up work should be done. The Assistant Commissioner agreed with this.

The District Officer said he would like this year's programme to be carried out, to finish draining some good hollows in P.29. After discussion, it was agreed that two men could do the work necessary, under the supervision of Mr. W. Murray, Ratagan.

After this year's work, expenditure would be on maintenance of drains and fences, which the Chairman considered could be done by one man.

Glenshiel Consolidation Work

P.26 Enclosure: Compartments 1 - 4

1936

In Compartments 3 and 4 some hollows were drained, turved, beaten up, and plants manured.

1937

In Compartment 3 more hollows were treated as above, and in addition 200 each of Japanese larch, Pinus contorta and western Scots pine were notched into some dry knolls and manured.

P.30 - 32 Enclosure: Compartments 5 - 8

1935

In Compartments 5 - 8 the hollows below Wade's road were drained,

turved, beaten up, and plants manured with Semsol.

1936

In Compartment 8 more hollows were treated as above, beaten up with Sitka spruce and Oregon alder and manured with Semsol and slag.

1937

On small knoll drained in 1936, some 500 Scots pine and 300 Pinus contorta were planted on turves and manured.

P.25 - 27 Enclosure: Compartments 11 - 19

1932

In P.26 Compartment 12 some hollows were drained, beaten up and manured.

1933

In P.25 Compartments 14 and 15 some hollows treated as above.

1934

In P.25 and 26 Compartments 12 - 15. As above.

1935

In P.27 Compartments 17 - 19, most of the good hollows were drained, turved, beaten up with Sitka spruce and Oregon alder and manured.

1936

Deaths in Oregon alder were beaten up with 1000 plants.

1937

A further 2000 plants were used to beat up the Oregon alder. In P.25 Compartments 14 - 16, a strip above the public road was drained, turved and beaten up with Sitka spruce and grey alder in the hollows, with Pinus contorta and Scots pine on the ridges. Plants manured.

In Compartment 15 between burns a block of western Scots pine were planted; elsewhere Pinus contorta were used.

In P.27 Compartment 17 about 800 Pinus contorta were planted on a ridge, partly on turves. All manured.

In Compartment 19 (above road at corner of fence) ground was drained, turved and beaten up with Sitka spruce and Pinus contorta and manured.

P.29 Enclosure: Compartments 20 - 25

1935 Small bracken patches were beaten up using single turves.

No manure was given. A ridge near the top fence drained and plants manured.

1937

Compartment 20 - A narrow ridge near corner of fence drained, turved, beaten up with Japanese larch and Pinus contorta and manured.

Next ridge drained at 14 yds apart. Old Sitka spruce manured, but no plants available for beating up.

On ridge drained in 1935, groups of Japanese larch and western Scots pine were planted on the solid on alternate sides of the ridge. Plants manured.

Further along, above road, 2 acres drained, turved, beaten up with Sitka spruce, grey alder and Pinus contorta, and manured.

8. Inspection by A/Assistant Commissioner, A/Divisional Officer, District Officer and Forester on 9.2.43.

The party entered the plantations near the east end in P.26. Generally speaking, this part is disappointing on account of the unsuitable soil conditions for tree growth. Reconstruction was carried out here to a very limited extent. The reconstructed patches, originally planted with Scots pine, were interplanted with Sitka spruce and alder amongst the surviving Scots pine. This is now promising and was favourably commented on. It was noted that very little Sitka spruce was planted originally in P.26.

On returning to the cars, the company proceeded to P.31 by road and then continued to inspect the area. A considerable area has been reconstructed here on the upper slopes where conditions are comparatively good. Here the A/Assistant Commissioner commented on the large number of plants per acre. It was explained that this was due to survivors of the original crop recovering after conditions were improved by draining. While returning to the road, the A/Assistant Commissioner instructed that the original drains on the poor Scirpus parts be kept open.

The party now proceeded slowly by car to a point opposite the bothy where lunch was taken. Thereafter some promising Sitka spruce and Scots pine and Norway spruce in mixture were inspected in P.27. From well up the slope a good view could be obtained of the surrounding area which is generally promising. On the return journey through Scots pine and Sitka spruce, wet and checked patches were observed which would respond to

drainage.

Remarks by A/Divisional Officer

I agree Mr. Fraser's report. It is clear that, with the limited squad available (two men), the progress of reconstruction work will be slow. Care will need to be taken to ensure that maintenance work, e.g. drainage upkeep, cleaning, etc., is not allowed to fall behind in order to overtake the reconstruction work in the checked areas.

Remarks by A/Assistant Commissioner

Agreed.

9. Inspection by Director (Sir Henry Beresford Peirse), District Officer (Mr. R. O. Drummond) and Mr. A. Mackay (Forester) on 31.8.49

West Section - P.29 and 30

On entering the area, the Director noted that the fence posts were becoming rusty and required tarring or black paint.

Compartment 21 is progressing well now, probably as a result of introducing much Scots pine, and the beating up having been done by planting on turves, with considerable drainage and use of slag for spruces.

From the appearance of the soil, ground flora, etc., it seemed probable that similar good results could have been attained throughout the block by similar treatment. It was, however, too late now to spend more money on any further beating up. The failure was due largely to the fact that planting in this forest was done before we had experience of the correct choice of species, method of planting, and the necessity for really concentrated drainage in such areas.

Had Sitka spruce, with an adequate mixture of Scots pine (or Pinus contorta in the worst areas) been used instead of Norway spruce, planted on turf instead of by notch planting, with slag or ground mineral phosphate and adequate drains, it seems likely that quite satisfactory results could have been achieved.

(Director's Comments: This puts matters a little too optimistically. I think conditions in Compartment 21 are better than some of the ground further west).

A regular programme of drainage upkeep should be maintained. Every effort should be made to obtain one more man at least for this forest.

West - Central Section: P.25 - 27, 33

A small area of Sitka spruce thinning was seen. It was decided that it was probably better to allow thinnings to fall slightly in arrears and to accumulate a fair area before attempting further thinning. Bad weather could be spent more profitably on brashing.

The serious damage done to great lengths of deer fence of the all-metal type used in this forest by land- and snow-slides was noted. The Director approved the District Officer's suggestion to attempt to put in strainers on both sides of these chronic slip sections, and to make a separate section in the slip area, which may be carried away without damaging the fence for great distances on both sides.

Other Sections.

These were not examined in detail. The District Officer informed the Director of his intention to take up with the State Forest Officer or Conservator the question of converting the existing stock fence at the east side of P.32 into a deer fence, and contracting out of the Forestry Commission's obligation to maintain the deer fence round the big unplanted area at the east end of this block, which is grazed on lease by Major Wilkie. The Director agreed to this in general terms.

Glenshiel Forest History

Supervision

APPENDIX II

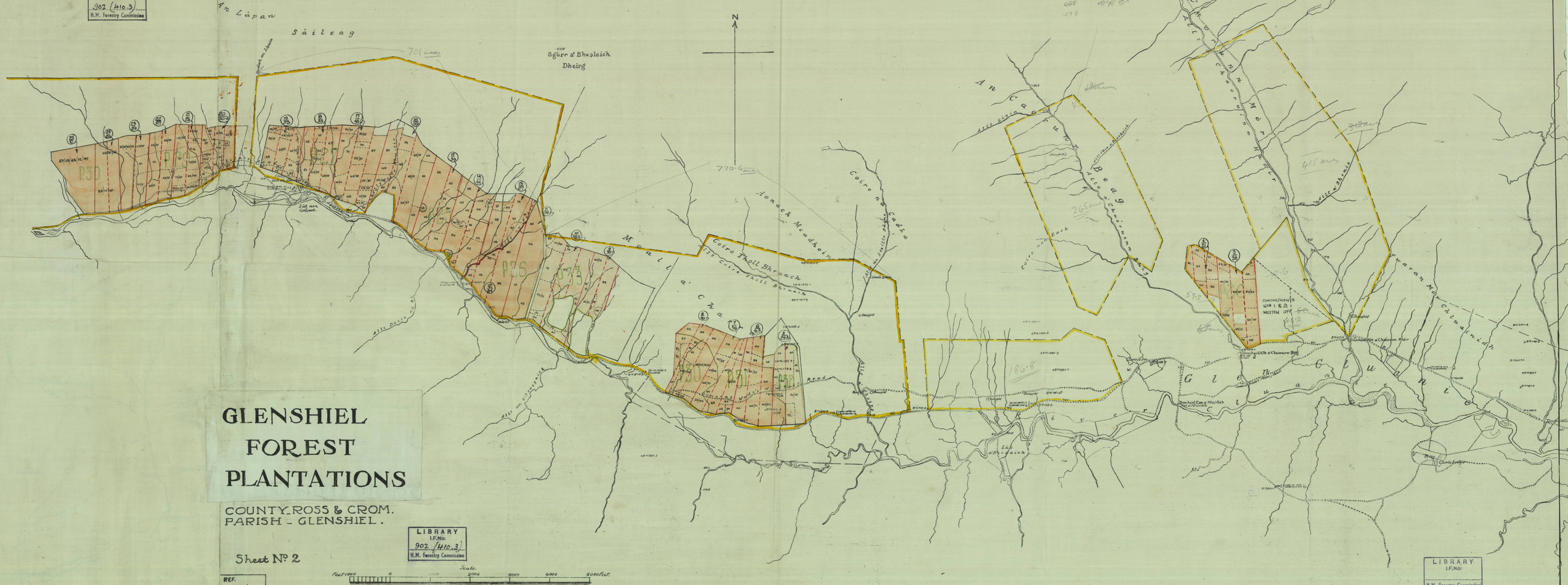
Divisional Officers	Mr. F. Scott		1925 - 1931
	Mr. J. Fraser		1931 - 1939
	Mr. D.S. Spraggan		1939 - 1942
	Mr. A. Watt		1942 - 1945
	Mr. J.T. Fitzherbert (S.F.O.)		1948 - 1949
	Mr. J.A. Dickson (S.F.O.)		1951 cont.
Conservator	Mr. J. Fraser		1946 cont.
District Officers	Mr. J.W. Mackay		1925 - 1927
	Mr. J. Meldrum		1927 - 1932
	Mr. H.C.B. Peirse		1932 - 1935
	Mr. D. S. Spraggan		1935 - 1939
	Mr. A. M. Fraser		1939 - 1946
	Mr. A.L. Orr-Ewing		1946 - 1947
	Mr. D. S. Spraggan		1947 - 1949
	Mr. R.O. Drummond		1949 cont.
Foresters and Foremen in Charge	Mr. J.T. Mackay	1925 - 1927	(Foreman i/c)
	Mr. H. Mitchell	1927 - 1929	(Foreman i/c)
		1929 - 1930	(Forester II)
	Mr. R. Campbell	1930 - 1932	(Foreman i/c)
	Mr. C. Macdonald	1932 - 1937	(Foreman i/c)
	Mr. C. Macdonald	1937 - 1938	(Forester II)
	Mr. W. Murray	1938 - 1946	(Forester I)
	Mr. W. Murray	1946 - 1949	(Head Forester)
	Mr. A. Mackay	1949 cont.	(Forester I)

APPENDIX III

Glenshiel Forest - Rates of Growth

Compartment	Species	P. Year	Age	Geology and Soil	a Altitude b Aspect c Slope d Exposure	Mean Height of Dominants	Mean Q.G.B.H. of Dominants	Mean Annual Height Increment	Current Annual Height Increment	Remarks
10	J.L.	33	19	Old scree beside a stream. Mainly mica schist boulders with some red granite and quartzite. A brown forest soil. 1 inch of undecomposed humus. 6 inches of sandy loam. Freely drained.	a 750' b South c Gentle d Mod. exposed	28.8'	5¼"	1.5'	1.3'	Current Annual Height Increment = Height Growth during last 5 years / 5 Formerly a bracken area with a little heather. Luzula now present.
12	P.C.	32	20	Schist boulders - alluvial - some boulders with a high mica content. Soil 0" - ½" undecomposed humus ½" - 1½" black fibrous peat 1½" - 5" amorphous black peat 5" - 19" dark grey-brown sandy soil - rich in mica grains. Moderately freely drained.	a 800' b South c Medium d Mod. sheltered	38'	4½"	1.9'	2.4'	
14	S.S.	25	27	Schist boulders - alluvial - some boulders with a high mica content. Soil 0" - 1" decaying needles and mor humus 1" - 1½" podsolised layer - often absent. Grey white. 1½" - 12" dark brown sandy soil with many mica and quartz grains. Freely drained. No pan.	a 700' b South-west c Gentle d Mod. exposed	44.2'	6½"	1.6'	2.4'	
14	N.S.	25	27	Schistose gravel over schist. Soil 0" - ½" humus ½" - 12" dark brown forest soil, even texture with little gravel. High humus content. A loam. Freely drained.	a 680' b South c Gentle/None d Mod. sheltered	34.0'	4¾"	1.3'	1.6'	

Glenshiel



GLENSHIEL FOREST PLANTATIONS

COUNTY ROSS & CROM.
PARISH - GLENSHIEL.

Sheet No 2