

From: CONSERVATOR EAST (Scotland)

To: Mr A Scott

S12
DBF/PP

31 August 1977

DRAFT LITTORAL SITE CLASSIFICATION

Your proposal dated 12 May 1977 refers.

I have these observations:-

- 1 CP - CP should be included as an option on 15i (gross) although it may not be taken up if we succeed with SS. As your instance on Table 2, steps can be taken to reduce frost risk.
- 2 Soil types 15e and 15s should be regarded as non-forest types and omitted from YC table.
- 3 The YC for SS on 15g/G and 15i (gross) appears low. At Tentmuir YC 16 was confirmed on 15g/G sites with premature windthrow at standard rotation minus 5 years.
- 4 The historical performance of crops should be discarded from the YC table Nitrogen inputs should permit these bands being reached at least. I presume you included them for information.
- 5 The spruce option will be preferred on 15i (gross), 15g and 15G; CP on 15d and 15L and SP or LP on 15i (Calluna - E. Cineria).
- * We must not ignore the potential of improved genetical material in LP. Please quote what YC LP has on whatever site types it has been tried in.
- 6 You quote only one input of N. Consider use of subsequent inputs.

It is hoped to discuss your classifications briefly at September District Meeting (or at another time as it is not common to all Districts).

I have noted the restocking difficulties to date are to be inspected when we can arrange a suitable opportunity.

B. Rankin

PP Mr D B Paterson
Assistant Conservator
Forest Management

[Handwritten signature]

Conservator East (S)
Attention Mr D B Paterson

S12

12 May 1977

LOCAL SITE CLASSIFICATION - LITTORAL SOILS

Enclosed is a first attempt at Tables 2 and 3 for littoral soils as requested in your minute of 2 May 1977 for discussion.

A H A Scott
District Officer

ava

Ret.

ju

ESTIMATED YIELD CLASS OF MAJOR SPECIES (MEAN ACTUAL IN BRACKETS)

	15g 15G	15i (grass)	15d	15l	15i (Calluna)	15 e/s
SS	12-14	12				
CP	-	-	8-10 (6)	8-10(6)	6-8(4)	2(2) or check
SP	10(10)	8-10(8-10)	-	8*(6)	6*(4)	2(2) or check

- Assumptions:
1. Elimination of vegetation by surface ploughing or herbicide treatment for CP option on 15i/15l.
 2. Application of 150 kg N/ha to CP on 15d, 15l, 15i after first thinning.
 3. Application of 150 kg N/ha to SP on 15l and 15i after first thinning. * Response subject to further study.

To DISTRICT OFFICE

From

instructing,

Laigh of Moray

Mr. A.H.A. Scott

Your Ref: S 12

Our Ref:

Littoral Site Classification

Ref para 2 of your minute dated 14/9/77
— has with the enclosed list of Culbin samples
containing L.P. on soil type 15. (There are five
other samples at Culbin containing L.P. but these
are on soil type 10 - lowland raised bog.)

With tarpane testing Dr. Forrest has classed
C/3 - Canada as Southern Interior B.C. Rocky
M+ Type (ref Current Info Note 30/77/CEN)

Under "Provenance" there are a number of
blanks. Dr. Yeats' list of 12/9/77 covers some of
these.

pp S.W.R. Stewart c/f

Ant Watson F

29/11/77

Signed _____ Date _____

Littoral Site Classification

L.P. on soil-type 15 at Culbina

Compt. Old.	no. New.	P Year.	Pore/ mix.	Area (ha)	Yield Class	Soil Type	Provenance	Other.
	18b	73	P	1.0	6	15g	65(7114)3 Skeena	
100	36b	58	P	1.0	8	15g	54/643 La Pine Oregon	Ploughed / 1 Year old Skeena SP/LP mix. Skeena species map.
79	41c	57	M	1.0	6	15i		
82	51d	49	M	7.0	6	15d - 60% 15g - 40%		SP/LP mix. SIC on species map.
58	57a	34	P	1.0	8	15i	30/33 Canada. S.T. & B.C. Rocky mts. Type.	5.1
58	58c	34	P	1.0	8	15d	30/33 Canada. S.T. & B.C. Rocky mts. Type.	
70	59e	39	P	0.5	6	15i - 70% 15g - 30%	36/22 Prince George	
63/66	64a	29	P	6.5	4	15 d 1/3 1/2 l.		C 1 ?
63/66	65c	29	P	2.0	6	15d &		
63	66c	54	P	1.0	6	15g	52/549 (E. Cascades mts.) Aberdeenshire.	2 YX.
14/15	67b	54	P	3.0	6	15g - 70% 15g - 30%	52/549 (E. Cascades mts.) Aberdeenshire	5-C
	68e	74	P	1.0	4	15g	65(7114)3 Skeena	65g on species map.
59	75c	34	P	0.5	4	15i	30/33 Canada. S.T. & B.C. Rocky mts. Type.	
41	79d	34	P	0.5	6	15i	30/33 Canada. S.T. & B.C. Rocky mts. Type.	
42	83a	34	P	2.5	8	15d - 70% 15i - 30%	31/28 Columbia River Canada	
43	93b	34	P	1.0	8	15i	31/28 Columbia River Canada	
44	96d	35	P	1.0	6	15i	33/14 Shuswap Lake 425-500m	
7	100d	40	P	1.0	8	15i		
24	102c	25	M	1.5	6	15i/15d		SP/LP/CP
45	104d	24	P	1.0	4	15i		
46	111a	24	P	6.5	4	15i		
46	111d	71	P	0.5	6	15i		
32	113c	30	P	0.5	4	15i		S1 Low Slope (Chilworth) On species map LP/SP P 24.
26	115c	24	M	0.5	4	15i		LP/SP
32	121c	35	P	1.0	6	15i - 70% 15d - 30%		
129	131b	29	P	1.0	6	15i		
155	134b	30	P	5.0	6	15i - 80% 15d - 20% 15g - 80% 15d - 20% 15i - 80% 15i - 20%		
1/153	139a	31	P	2.5	6	15i - 80% 15d - 20% 15g - 80% 15d - 20% 15i - 80% 15i - 20%	65(7114) Skeena	Al. yellow foliage P73 on species map
	141a	74	P	4.5	6	15i - 20%		
127	141d	51	M	3.0	4	15d		LP/SP
	143c	74	P	1.5	6	15d	65(7114) Skeena.	
139	143d	50	P	1.0	0	15d		
128	144d	50	P	1.5	0	15d		
138	146a	31	P	1.0	6	15d/15i		
146	152a	29	P	2.0	8	15i/15d		
	205a	71	P	13.5	6	15g	65(7114)3 Skeena	at

CULBIN INVESTIGATION NOTESExtracts form Entopath nos 58 and 61No 58 - From Thetford data

3 methods of frost prevention

Over- storey

Strip felling

Cultivation (providing bare soil)

Small clearings of less than two ha are found to be particularly frost susceptible.

The grass mat insulates the soil, preventing absorption of heat during the day, and release of heat during the night as the temperature drops.* Litter, lop and top will act similarly to grass.

On frosty nights differences of up to 7° C (12°F) were recorded between grass and bare soil sites and the frequency of damaging frosts from 19 to 5.

Plants (CP) in grassy areas were 8" tall. Those in bare soil were 13" + tall.

Fomes is a big adverse factor at Thetford. Stump removal has reduced fomes killing from 16% to 2.6%. Regarding Thetford inference being that stump removal to reduce fomes will also provide cultivation to reduce frost.

No 61

* An in-depth article on above.

In daylight solar radiation (infra - red) reaches absorbing surfaces and raises their temperature. Some heat is conducted to materials below, eg soil, and some warms the air above and surrounding by contact. (The air is scarcely warmed at all by infra red waves). These warmed surfaces then radiate heat outwards, usually at longer wave lengths than received, and temperatures strive to strike a balance between incoming and outgoing radiation.

At night, with a clear sky, incoming radiation is negligible.

Materials with large surface areas, dead/live grass, needles, leaves, loose litter (all of these are small heat stores anyway) cool rapidly. Cooling is also rapid when thermal conductivity is poor as in a dry bare soil, the heat being lost from the surface more rapidly than it can be replaced from below. On the other hand thicker woody debris, moist bare soil, and of course water itself - these also loose but they have a greater heat store. On cloudy nights the same process goes on but clouds re-radiate back some of the heat loss.

On clear nights with a wind, the wind brings in heat with the moving air. With no wind to circulate the air, temperatures above the surface become increasingly colder, density of the air increases, and the cooler air flows to lower levels. The complicated configuration of grass, many surfaces with little or no heat store capacity, makes it a good heat inter-changer to cool the air in depth. Grasses are therefore ideal for radiation cooling (little heat build-up during the day) and are a major factor in frosting.

Therefore when the soil is moist and bare, the air cools slowly and the risk of unseasonable frost is low. When the soil is covered in dead grass, the air cools rapidly and the risk of unseasonable frost is high.

AWJW.

CULBIN FAILED AREAS ASSESSMENT - JAN '78.

FURTHER NOTES / MEMOS.

AW Watson

Phoned G.J. Mayhead. NRS.

NUTRIENTS - Use of 'N' fertiliser initially? Culbin special case? - Not recommended since the roots would not be established in time to take up the fertiliser the first year. (N ephemeral anyway, say 3-4 years). - This was all confirmed by G.J. Mayhead. G.J.M. added - we would merely stimulate the vegetation already there. He suggested killing off the competing vegetation first, then applying N, say year 3.

HERBICIDES. Kerb may be less effective against sand sedge. Try Fyodulan in the Winter (see Res. Info. Note). Try both the 30 and 35 rate. In Summer try Glyphosate 1-2 kg. (Res. Info. Notes 11 and 27). Lay down small field trial - keep G.J.M. informed.

Phoned. H. Pepper A. Holt.

REPELLENTS. Aprotect 50/50 in water. Dip then successive sprayings. Toxic to growing shoots. Plants must be dormant. Fairly large nozzle. Monacol - less effective than Aprotect. (but Research have some spare). Assuming you have the likelihood of 100% damage. Then with A - expect 95% success. (off-the-cuff figures).
" " M - 75%

Phoned P. Biggin NRS.

P. Biggin is to liaise with Thetford / Tentsmuir etc. on establishing C.P. and is to visit Culbin specifically for this on the afternoon of 3d. July. (Try a small fenced area at least).

Sent Samples of sand to Macaulay.

Three samples sent to H. Miller for analysis, also asked for his views. - letters cover.

Laid out 8 fertiliser/control plots. Details on back of one of the small map sheets.

Scrub cutter yet to be borrowed from Speymouth - borrowed already but had to be returned prior to being used.

SEE NEXT SHEET.

Memos. - discussion points raised by others etc.

Ploughing not necessarily the answer - S.W.R. Stewart
Mechanical sowing being tried - A.W. (Not a success)
We do not want to lose the organic horizon - A.H.A. Scott.
Lay out fertilizer plots. - J.D. Manjies. (Done A.W.).
Take soil samples - A.W. (Done. Minutes cover.)
Investigate rooting - S.W.R. Stewart. (Done A.W.).

Reading.

Entopath no. 37 P8.

also no 58 P3.

'Spring Frosts affecting the Establishment of Second Rotation Crops
in Thetford Chase' - J.D. Low / BSW Greig.

Forest Experiment Record Form No. 7

Laigh of Moray.

Page No.

Date

ASSESSMENT OF (Forest)

Culbin

Expt. No.

P

Species VariousCharacteristics Assessed HeightMethod and Percentage of Sampling See Sheet detailsUnit of Measurement Plots 2, 3, 4, 5 - 0.1mPlots 7, 8 - 1mAssessed by A.W.F.W. Calculated by A.W.F.W.

Checked by

Plot area = 0.05ha.
(22.36m/side)Standard measuring stick
borrowed from Research.

Plot 7/8 - 2cm classes. Every line every second tree. North line in plot 7.
Plot 2/3 - 0.1m classes. Two trees out of 3, discriminating parameters.
Plot 4/5 - 0.1m classes. 50% of plot
Plots 1-5 - 0.1m classes. 50% of plot excepting
Second Forest

Cpt. 204

Cpt. 141

Cpt. 201

Dead or Missing: Plot

Total Element N

Assessment Part

Headings

Spot

Broadcast

1

2

3

4

5

6

7

8

9

0

1

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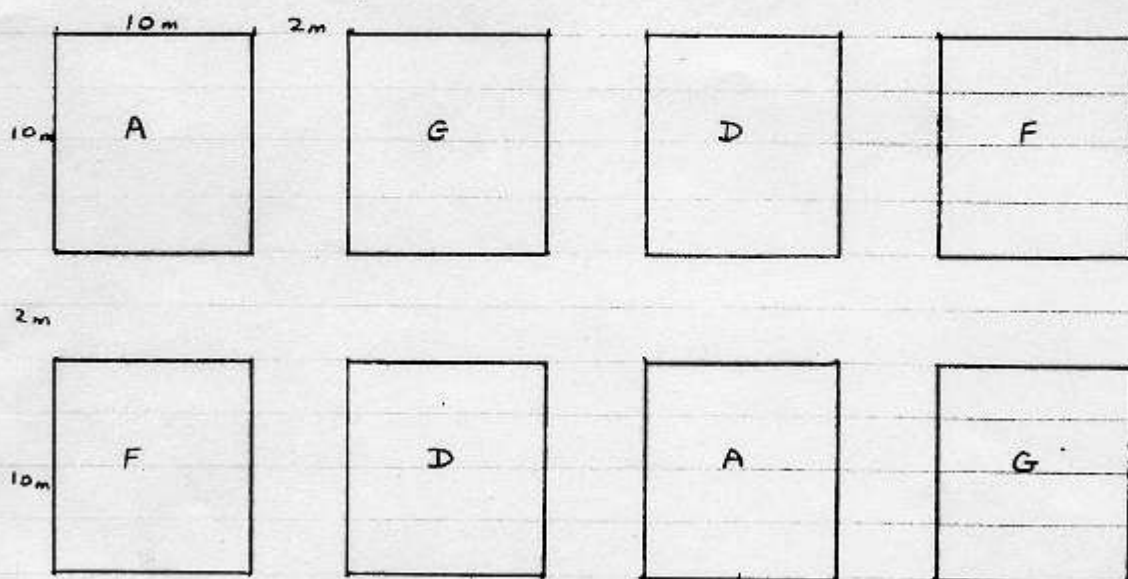
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Culbin - Carex arenaria Areas

HERBICIDES.

Herbicide Trial - Compt. 184.



Plot size = $100m^2 = 0.01 ha$.

Atrazine :- 10 kg of 50% wettable powder/ha in med. volume (200 litres).
Rate per plot = 100 grammes 50% wettable powder in 2 litres water.

Dalapon :- 17 kg of 74% soluble powder/ha in med. volume (200 litres).
Rate per plot = 170 grammes soluble powder in 2 litres water.

Glyphosate :- 5.5 litres of 36% w/v concentrate/ha in med. volume (200 litres).
Rate per plot = 55 ml product in 2 litres water.

Fydulan :-

(Self only engaged in survey and subsequent discussions - Summer '78 on H.E.M. full time - J.O. Margie's was i/c F.M. Junction. Not sure therefore whether this trial was carried out as intended by J.O.M. I understand J.O.M. did try Glyphosate but this was not a success).

AWW.

Date of application :-
Condition of vegetation :-
Weather after application :-

ROOT INVESTIGATIONS.

CURBIN - ROOT INVESTIGATIONS.

A.W.F. Watson.

(Memo. regarding frost-example. On 14 June 1978 - air reading at Newton + 3°C. At Kinloss - 6°C ground, -3°C air. S.S.P73 in cpt 201 severely frosted - current shoots - slide covers. Despite Birch 0/stony).

Root Investigations.

In cpt. 141 a tree was dug up between plots 4 and 5. This was to assess root spread. (Slide covers).

Sample - L.P. Height to start of '78 season = 45cm.

Site was a clear-felled area, low lying with minor undulations, adjacent to low dunes. Vegetation mainly Calluna with a preponderance of Carex arenaria in the lower parts (app. where the sample was taken from). Polytrichum and Cladonia in the base vegetation layer. Previous crop had been S.P., average stumps 20-30 cm. in diam. Previous crop had been felled in the 1960's (some 8-10 years previously). The present crop, of which the sample was part, was planted in 1973. (Area beat-up several times?).

The organic layer was on average 4-5cm in depth. The sand profile was very lightly stained down to 40cm.

Roots of L.P. sample. - Lateral roots extended to 240cm +. Roots ramifying mainly just below the organic layer - from 0-3cm below. Usually just beneath or through the dense mat of Carex rhizomes. One or two roots went down to app. 45cm in depth, one in particular went down to 110cm +. In all, about 5/6 main laterals, with 2/3 sinkers down to 45cm, but one to 110cm.

Cpt. 204 An L.P. dug up between plots 7 and 8.

The area had been a sedge flat with some Calluna vulgaris. Low dunes surrounding. The previous crop had been felled in the 60's. The site was finally space-furrow ploughed (sickle plough) and planted in 1975. Plant position was at the side, down by the bottom of the furrow.

The L.P. sample measured 12cm. to the start of the '78 growing season, but had been buried by sand about 7cm. This tree had

SEE NEXT SHEET.

much finer roots than the larger sample in cpt. 141, therefore they were much more difficult to trace to their full extent. lateral roots to 67 cm +. There was a definite tendency for the roots to make towards the sandwich layers. (ie. those reaching this zone by chance would survive and develop). Roots appeared to go down only 15-20 cm.

On top of the ridge were 4-5 cm. of very loose dry sand. Under this was 22 cm app. of moist humus - rootlets and *Carex* rhizomes. If planted on the ridge the trees would have ~~been~~ benefited from this damp humus, double, horizon, in spite of having to compete with the *Carex* root system. It must be said however, that on the sandy lower sides of the furrows, the sand is moist 10-12 cm under the surface.



Autw.

S 12

Laigh of Moray Forest
 Newton
 ELGIN
 Moray
 IV30 3XR

6 June 1978

Dr H G Miller
 Dept of Pedology
 Macaulay Institute for Soil Research
 Craigiebuckler
 ABERDEEN


 Dear Hugh

SAND SAMPLES EX CULBIN, LAIGH OF MORAY

Could you please have the enclosed three sand samples analysed.

In restocking at Culbin over the last ten years there are a number of flat sedge areas where growth is very poor and as future clear fellings take place, these will increase.

These sites are currently being examined in an attempt to make them more productive: Main problems are deer damage (no fences), frost in hollows, perhaps nutrient deficiency associated with those sedge areas?, and competing vegetation. On the dune areas usually characterised by dense broom the trees are also severely cropped back by deer but eventually they do gain apical dominance and the plantation is established. In contrast, in the flat sedge areas, the trees never surmount the damage stage. What is the main cause, frost or nutrients and sedge competition? There is far more moisture in the sedge areas. (Some of these flats in the past may have been miniature winter lochs now long since dried out.) With all the research work you have undertaken on Culbin, your views would be most welcome.

The three samples comprise

LOM CULBIN Compt 18	-	Flat sedge area
LOM CULBIN Compt 18	-	Dune area
LOM CULBIN Compt 184	-	Flat sedge area

Many thanks,

Sandy Watson
 For S W R Stewart
 Chief Forester

PS I have just received a soil sample from Benbecula, from one of our Gangers who has just returned from holiday. Could a simple analysis be done on this? Thanks.

Handwritten initials: Rt and JW

THE MACAULAY INSTITUTE FOR SOIL RESEARCH

Director: Professor T. S. WEST, B.Sc., Ph.D., D.Sc., C.Chem., F.R.I.C.



TELEPHONE (0224) 38611

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R. C. MACKENZIE, D.Sc., Ph.D., F.G.S., F.R.S.E.

Department of Pedology

CRAIGIEBUCKLER

ABERDEEN

AB9 2QJ

HGM/SJH

27th October, 1978

A. Watson, Esq.,
Forestry Commission,
Laigh of Moray Forest,
Newton,
ELGIN,
Moray, IV30 3XR.

Dear Sandy,

I now have the analysis results for restocking samples at Culbin.

		Sample		
		Compartment 18		Compartment 184
		Dune	Flat	Flat
% comprising	Sand	99	99	99
	Silt	<1	<1	<1
	Clay	1	1	1
Exchangeable cations (me/100g):				
	Ca	0.11	0.09	0.11
	Mg	<0.02	0.03	0.02
	Na	0.09	0.08	0.08
	K	0.02	0.02	0.04
	H	0.5	<0.1	<0.1
	Total	0.7	0.3	0.3
pH value:				
	→ in water	4.4	4.4	4.4
	in CaCl ₂	3.6	3.4	3.6
Organic fraction:				
	% organic matter	1.0	0.9	0.3
	%C	0.60	0.55	0.16
	%N	0.09	0.05	0.06
	%AI	6.7	11.0	2.7
Phosphorus				
	mgP ₂ O ₅ /100g	15	15	17

According to our soil chemists these samples are nothing but sand with a few particles of sea shells - which sounds a fair description of Culbin. I am sure however, that the answer to your problem lies in the nitrogen figures, as you can see, the dunes contain appreciably more nitrogen than either of the flat areas. I would suggest applying nitrogen. Perhaps applying about 85 kg nitrogen per ha (190kg urea ha⁻¹, 1½ cwt per acre) every two or three years until the plants become established (a heavier rate would probably be damaging).

I hope that these observations will be of assistance.

Yours sincerely,

Hugh
H. G. Miller.

AW.



COMPT. 5a - Larger area. No cultivation. S.S. on flats / C.P. on dunes. S.S. have been planted within the last few years (difficult to tell) in the flat hollows. Many of the S.S. are still under 30cm. They are still alive but being continually frosted back. There are a few scattered taller S.S. from 3-5m. There are signs of frosting even on these. Some have cones (small), suggesting they are older than they look. These taller S.S. have acceptable leaders. Scrub birch is widespread, but most of this has been cut back. A soil-pit was dug on the flat, with 7-10cm of humus then pure sand. Pure sand to 70cm then some rounded shingle amongst the sand. Sand moist all the way down (December). C.P. on the dunes, here broom is widespread; where this is not too tall, say 1m, the C.P. are coming through alright. Where the broom is 2m there is only the occasional tree to be seen mainly in any small gaps. Even on these areas there are possibly enough trees to eventually give some sort of cover.

Action - None apart from keeping the deer at bay and reviewing the state of the S.S.

COMPT 5a - Smaller area. S.P. growing well through tall broom.

Action - None.

COMPT. 13c - C.P. pure. Trees good on the dunes. The S.E. edge is poorer (flatter). The remainder of the wide area is good being dune. Scrub birch is widespread, worst at the beginning (southern end) of the narrow part. Going N.W., the narrow part flattens out to a sedge area where all the trees have died (frost). This continues into Compt. 14a. Beyond this is dune with broom rank. The trees here are very small (some only 15cm) but stocking is nevertheless good. The very top of the area has completely failed.

Action - Suggest space-furrow ploughing the sedge area and replanting with a pine. Parts of the S.E. edge would also benefit from cultivation. Discuss use of "Swipe" on broom in upper narrow part where the trees are so small anyway. (They are much smaller here than in the wide area). Perhaps set the Swipe high? Difficult to understand the failures in the hollows, a soil-pit being dug here and pure moist sand was encountered as far as 80-90cm and beyond. Send soil samples to Macaulay? Also use plough on topmost area.

COMPT 14a - Being a sedge area a failure.

Action - Plough and replant with pine,

COMPT 16. - Mixture containing D.F. and S.P. or C.P. planted in 1968. Various species have since been used in beating up. Apart from the strip immediately below the power line, all the area has been space-furrow ploughed. There has been a dense cover of broom, most of which has now been cut down. There still remains a strip of broom immediately north and alongside the P12 S.P. A number of D.F. are managing to grow through this, and those that have succeeded are growing very well. There should be sufficient D.F. here to form reasonable stocking density. The eastern half of the compt. is well stocked with D.F. These have suffered quite a bit from aphid damage. Their leaders are very poor with symptomatic distorted needles. (This is in contrast to the D.F. poking through the strip of broom already mentioned). The D.F. in this eastern half are now well above the frequent broom patches. The western half of the compartment is the problem area. This has failed altogether, apart from a few C.P. in the "gushet" at the eastern end, and the very occasional D.F. Those trees remaining have recently (?) been freed from the obviously dense mat (2m) of broom. This has resulted in some very spindly specimens. This area has been well cleared of broom, there remaining only shattered stumps. This cleared half has been recently replanted, but these have failed. All planting has been on the ridge top. Soil-pits were dug, the soil being quite dry on the ridge top immediately below the sandwich layer. The sand appears to have dried out with the ploughing, since a pit dug on unploughed ground was quite moist. The profile is pure sand apart from the surface humus. The sand is very compact.

Action - Replant as soon as possible in order to benefit from the already old ploughing. Also try to beat the possible broom re-invasion. (Often however broom grows itself out after 6-10 years, and may be less likely to regenerate through the layered dead broom). Perhaps consider the use of a Brush-cutter to prepare screefs on the ridge top. This may or may not be feasible, but there are no stones whatsoever, just a sandy mat of grasses/sedges with splintered broom stumps. Replant with pine. When inspected there was a hard crust of frost on any bare sandy areas.

COMPT 18a - S.P. P73/74. The section by the roadside. No cultivation. The whole area apart from the N.W. corner is mainly flat with a dense mat of sedge. The planted S.P. are very poor, natural regeneration being as good as anything planted. Most are still in the region of 10-15cm and that is after 4-5 years. They have been continually cropped by deer.
Action - The trees are unacceptably small for 4-5 years. ~~Scrub~~^{Plough} and replant. Try Monacol perhaps? Even every second row?

COMPT 18g - C.P. P73/74. Adjoins the previous section. These are a good deal better, they are on small dunes, and as usual broom is widespread. Stocking is good, heights are around 20-40cm. Trees have failed on a narrow sedge covered strip up the eastern edge. Along the western side a narrow strip of dense broom is wasting ground. Soil (applies to both sections). Even on the lower sedge areas where S.P. are so poor or non-existent, there is pure moist sand to .7-1.0m, and beyond with no shingle encountered. Details of previous crop?
Action - Leave to form a crop. Discuss broom problem. In both areas deer browsing is the key factor.

COMPT 18b - L.P. P73/74. A haven for deer. Good space-furrow ploughing with not a tree surviving. Grasses are rank with tussocks of Marram. No sedge, no broom.
Action - Replant, fend off deer which may be impossible. Monacol certainly worth a try here.

While in the area, looked at the strip of C.P. in Compt 29- ridge planting on spaced furrow ploughing. These are growing vigorously at 2m and over. Why did these succeed when the environment appears the same? Heather is rank instead of grass/sedge.

COMPT 53f - G.F. P68. The two smaller areas have failed. One is a circular shaped clearing now covered with leggy Calluna. All the G.F. have failed. The second small area is adjacent to the forest road- G.F. planted under Birch. Again the G.F. have failed.

The third area, the largest one, does have patches of G.F. at a height of 1.5m approx. The remainder of the introduced crop are short, moribund, or dead stalks eaten by deer. The Birch overstorey is far too dense. Leaders of those G.F. which have survived are very short due to lack of light. These trees have also had most of their branches eaten back by deer, only the topmost 2-3 whorls remaining intact. Only one tree was noticed frayed, but this will be the next problem. A lot of deer marks were noted amongst the frozen grass on the ride adjacent.

Action - Forget about the two small areas. The third area is more of a problem. The over-storey of Birch will have to be cleared from the three or so small areas of G.F. which have passed beyond the browsing height. Not an economic operation.

COMPT 55e - The G.F. P71 have failed. The result of deer damage and lack of light. Groups of severely deer cropped G.F. can be found whenever the Birch over-storey is slightly open. Prior to considering a crop in this case, the Birch would have to be felled or thinned out drastically. There is no light filtering through even in winter. Ref. Culbin 27P66 re. underplanting with G.F., albeit this was an S.P. over-storey.

Action - Leave to the Birch. There are plenty of other areas in greater need of attention.

COMPT 57c - G.F. P74. No cult. The G.F. have failed. Clearings had been created in the Birch (some scrub Birch / some mature trees) when the previous conifer crop had been removed. These clearings had then been planted up with G.F. with no success. There are some older G.F. now 1-2m high in the western corner. These are now past browsing damage but some of the Birch over-storey will have to be cut to relieve them. There was hard frost on the plants when inspected, but the most likely cause of failure would have been animal browsing. Quite a few burrow scrapes were noticed.
Action - Cannot use a plough. Thin out more Birch leaving a few standards only. Uneconomic but better to fell now probably. Could use L.P., but if so more Birch would have to be felled. D.F. (mature trees adjacent) and G.F. are growing well, but I would think with the surrounding crop we are now dealing with frost hollows. W.H. is one of the best trees for underplanting Birch, but very frost prone. W.H. is certainly less prone to damage when the over-storey is felled.

COMPT 68e. - L.P. P74. No cult. No L.P. to be seen. This is a basin shaped area with very poor semi-moribund S.P. planted on shingle. Where there is some surface sand, the trees are marginally better. Due to frost, far too hard to dig. Would need to re-visit. Round the perimeter, the C.P. and S.P. on the dune areas are all-right, presumably where all the sand and nutrients have been blown to.
Action- Suggest none. Leave the scrub S.P. till the surrounding areas are being felled.

COMPT 90c - S.P. P68/69. No cult. This is on dunes, with some of the 1888 planting to the north. No problems here. The trees are bushy due to initial animal/bird damage, but most are now self-singled. Height varies from 1-1.5m. Broom is mainly confined to the edges- presumably rides. Any trees not on a dune area are a good deal smaller, also yellower.

Action - None. Noticed a small rectangular enclosure/trap with an opening on top in the shape of an inverted cone, also some white pegs. Some research project?

COMPT99b - S.P. P68/69. As for 90c above. Trees not quite as vigorous, more distinctly poorer ones still struggling.

Action - None.

COMPT 111d - L.P. P71. No cult. a small area, flanked with P23 S.P. on one side with P24 L.P. (coastal var.) on the other. The planted L.P. have failed or at least they are indistinguishable from the nat. regen. which is widespread. Most of the nat. regen. is L.P. The trees are buried in rank knee-high Calluna. At least most of the trees have buds. Any bare areas (covered in Cladonia) have no trees. The rank heather is preventing the trees from being eaten?

Action - Discuss this one. Personally would leave since there are far worse areas.

COMPT126b - S.P. P68/69. No cult. Dune area. Trees now growing well, and sorting themselves out. Av. ht. - 1m. Quite a lot of deer marks on any sandy areas. No current damage noted. Calluna rank.

Action - None.

COMPT 127c - S.P. P68/69. As above.

Action - None.

COMPT 141a - L.P. P73/74. No cult. On low dunes. Some naturally regenerated S.P. Older clumps of S.P./L.P./C.P. on the dunes. The planted L.P. have been well browsed but current buds are mainly intact. Calluna is quite rank. There are one or two sedge areas in hollows, oddly here colour of the L.P. is better than in many of the non-sedge areas (no Call.) but damage has been worse amongst the sedge. It does show conflicting potential on these sedge areas. Do deer prefer browsing in sedge to rank Calluna?

Action - None.

COMPT 143a - L.P. P73. No cult. Low dunes. Calluna cover. L.P. very poor, there are trees but these are very yellow and have been browsed year after year.

Action - Possibly leave to come away, but very negative forestry.

COMPT 143c - Could not find this area, just Birch scrub with some willow.

COMPT 144a - S.P. P73/74. In the north corner of the compt., the small area of S.P. on the dunes can be left. There are almost as much nat. regen. L.P. as planted S.P., but eventually some sort of cover will develop. The main section of this sub-compt. is on a sedge area, and this has failed completely.

Action - Space-furrow plough the large sedge area and plant L.P. or S.P.

COMPT 168d - Had been planted with Broadleaves which have failed. No cult. Quite a number of drains full of water, no flow. Misc. short ride-pins dotted about.

Action - Clean drains. Imperative to plant a rich site such as this immediately. Adj. to Reception Centre, therefore plant something aesthetically pleasing next road with perhaps a species demo. behind. For the benefit of visiting parties/schools etc. Ref. the Eamhill dev., will the F.C. Centre be used more educationally in the future? Only use local indigenous species along the road-side.

COMPT 184a/b - S.P. P73. No cult. Trees have failed in this flat sedge area. Exactly similar to 144a.

Action - Space-furrow plough, plant L.P. or S.P.

COMPT 194b/195c - S.P. P70. No cult. A track divides these two compts., the description is common to both.

194b/195c cont. - Both compts have pockets of cleared areas, mainly on the flat, the vegetation being rank Calluna/ Carex. There are very few S.P. surviving. Some S.S. are coming away in the south corner of compt. 195, also in an enclosed area in one of the clearings of compt. 194.

Action - In compt. 195 some groups of old S.P. could be felled which would greatly increase the effective area to be planted. Worthwhile plough runs would then be feasible. Spaced-furrow ploughing could be done in a fair proportion of both compts, this would be cost intensive but we have already tried the other option.

COMPT 196a/197b - No cult. Good ground (large stumps) wasted by deer browsing and heavy encroachment of Birch/Willow. In 196 there is a reasonable scattering of N.S. which have been continually browsed mainly by deer but also frost. The trees are better in amongst any hag or Birch/Willow scrub. 197 is a smaller area and there is very little growing here.

Action - None. Eventually there will be some sort of N.S. crop G.F. (5-10cm) growing well adjacent.

COMPT 198b - (Two areas) S.P. P73/74. No cult. Trees are there but cropped right down. Rank Calluna - large stumps - hag now breaking up.

Action - To be discussed, plough or leave.

COMPT 199b - Two areas S.P. P71/72. No cult.

Narrow strip adjacent to road - S.P. growing up through Birch, as much natural regeneration as anything.

Action - None.

Main area - A lot of Birch left considering the planted species was pine. All the trees are badly cropped, being less than 20cm after 6-7 years. Growth is better in the Birch/Calluna areas.

Action - A fair proportion of this area could be ploughed (sedge parts). Need to cut a few Birch to give the plough more room.

COMPT 200a - S.P. P70/71. No cult. Much the same as the previous compt. More Birch - better areas of growth.

Action - None.

COMPT 201a/b/d - S.P. and S.S. P71/73. No cult. Most of this compt. has been planted with S.S. P73. Birch over-storey far too dense, especially at the eastern end, but this would have lessened frost damage. Many signs of frosting, but most trees are putting on good leaders and have good colour in spite of the Calluna. Not unnaturally deer seem to favour ^{firm to} spruce to pine. The pine areas are similar to the others, enough to form a crop if they grow out of the damage stage. Noticed the lack of depth on root plates of wind-blown old pine.

Action - None, but debatable. The S.S. are doing very well indeed. The Birch at the eastern end could be thinned, but this would uproot a lot of the S.S., but if we leave the Birch we lose the S.S.

COMPT 202 b/d - S.S. P73/74. No cult. As in the compt. adjacent, the S.S. under Birch are well established. Most are now suffering from lack of light and the Birch will have to be thinned drastically. This will entail the loss of many S.S. The S.P. areas have virtually failed. These are sedge covered and there are quite a lot of whins spreading.

Action - As in previous compt., thin out Birch to help S.S. Plough the sedge areas. Worthwhile using a mechanical "Swipe" against the whins?

COMPT 204a - S.P./L.P./C.P. P72/76. Space furrow ploughed, apart from the northern end. In this northern end (mainly L.P.), there are enough trees to form a crop. Trees are yellow in some heather areas. The small pocket of S.S. are being frosted back but will eventually come away, and together with natural regeneration, older planting etc., will cover the ground. The remainder of the area has been space-furrow ploughed. Most of this is flat and sedge covered. Ploughing has certainly helped the trees. There is an awful lot of browsing damage, but by their colour etc., they should eventually grow out of this. There are some lines completely dead at the north end of the ploughing.

204 a cont. - These trees had been very tall at planting, only long dead stalks remaining. The newly planted area does not conform to that on the map. This has been altered roughly by pacing. Trees had all died in the two fenced no-plough areas. Action - Nil apart from beating-up the few plough furrows at the northern end.

COMPT 205 a - L.P.P71/72. No cult. The L.P. are growing out of the damage stage. Yellow in Calluna areas. Poor in the northern corner, but not worth altering. A lot of scrub Birch coming in. Meantime the trees are growing well enough, in fact leaders seem to be better under the Birch cover. (Less damage.)
Action - Nil.

COMPT 210 b - S.P.P70/71. No cult. Has been replanted since this. Seems to be now mainly L.P. The trees are there, but even the most recently planted ones are being browsed. Less damage in the small fenced enclosure.

Action - Nil since there is a tree crop at close enough spacing. A long, long wait.

COMPT 211b - S.P.P71. No cult. Poorer even than 210. Very unsatisfactory. Just the occasional tree.

Action - Discuss. Possibly not worth taking a plough. Large stumps.

COMPT 221b - S.S.P73/74. No cult. S.S. are doing well on this rich site. Some beating could be done in the western half of the area. S.S. are often best amongst whins, juniper, or piles of hag, where presumably deer have found access difficult and the trees have been sheltered by frost. Very little frost damage noted.

Action - Some beating-up could be done in the western half, say a hundred or two plants

COMPTS 225-229 - No cult. Apparently areas have been planted more than once. Eaten or failed.

Action - Scrub cut whins. Fell more Birch. Space-furrow plough. Try S.S.?

COMPT 235b - D.F.P75. No cult. G.F. as well as D.F. Plants are looking well. Very little damage. The Birch over-storey is too dense and will need thinning soon.

Action - Nil meantime.

COMPT 236d - D.F.P75. No cult. Completely failed. Very good bracken soil. More Birch and one or two old S.P. and scrub oak could be removed.

Action - Remove unwanted over-storey, replant direct with D.F. or Abies.

COMPT 246 - L.P.P76. No cult. Trees growing well. No damage. Young scrub Birch.

Action - Nil, apart from slashing down the young Birch.

CONCLUSIONS

Regeneration problems there certainly are, since of the 165 plus ha looked at, only 50 ha or 30% could be termed satisfactory. The remaining two thirds present a sorry picture of either outright failure of the plants to survive, due to vegetation competition and lack of nutrients, or so severe animal/bird damage, there is nothing left. Naturally the two are compounded.

Vegetation. Wherever there are dunes (sand/nutrient deposition) growth is good. However these dune areas are often covered with broom which spreads rapidly, smothering plants. To capitalise on the few good areas we have at present, several will have to be looked at and a method of eliminating this weed hammered out. (Swipe). The major problem lies in the flat areas covered in sand sedge. Here the trees seem unable to survive although when soil-pits are dug one encounters pure moist (Winter-time) sand as far as it is practicable to dig. (Soil analysis comparisons, flats versus dunes)*. These flats will have to be space-furrow ploughed. Only 9% of the ground viewed had been ploughed, but this appears to be the only solution with the sedge areas despite having to cope with quite large stumps, coupled with the danger of too much sand disturbance. Scrub Birch is everywhere a problem and the greater number of mature Birch we leave, more widespread is seed dispersal with

* Ref. minute of 4/6/78 also results from Macaulay dated 27/10/78 - attached.

resultant unwanted scrub. The value of Birch for amenity and soil improvement is realised, but personally I would only leave isolated specimens of good form and remove all others. This would also create worthwhile plough runs. Often trees, including pine, have been planted through these Birch over-storey areas and in no time are suffering from lack of light. Examples of areas requiring opening up are compt. 199 for pine, and 201/202 for spruce, but there are others. The snag with opening up the over-storey is damage to the under-storey. (Ref. Culbin 27P66 albeit this was an S.P. over-storey). Areas which could be space-furrow ploughed amount to some 53ha. Additional smaller areas could be ploughed, depending on their proximity to one another, to economise on plough movements. Isolated smaller areas are better left to the Birch, broom, and any planted trees that may survive. Ecologically, this will balance up the necessary drastic thinning of Birch in the areas to be ploughed.

Animals/Birds. Deer, capercaillie, and hares are responsible, deer being the worst culprits. There is no answer to this problem, apart from fencing to exclude the animals, or a long wait and successive beating-up. There are bird repellents, and I have tried several to protect pines in Genetics progeny areas. These have been only partly successful and as well as being labour intensive, in their application, would be cost prohibitive on a large scale. (Research have spare containers of "Monacol" and a simple look-see trial could be laid down).

The first full forestry cycle, then, is now being completed in parts of Culbin, and we find the obstacles to establishment entirely different. In the first instance the problem was primarily sand stabilisation, i.e. a protection forest. Now that we have realised the area's potential we are thinking in terms of nutrition by artificial means rather than by natural soil enrichment, legumes etc. We now have to cope with unwanted vegetation; frosting due to felling coups (pooling), and the sedge sward (lack of surface radiation); with possibly the biggest obstacle created by the forest itself. This is in providing a suitable habitat for herbivores, be they classed as ⁵⁰ game, vermin, or whatever. Doubtless the obstacles to regeneration were already familiar, but if nothing else, the present survey has proved that there are far too many unsatisfactory areas in Culbin. If we rule out fencing, the only alternative is to localise areas for planting and make these as large as possible, firstly to facilitate ploughing to combat the vegetation/frost factor, to adopt the safety in tree numbers maxim as regards browsing damage, and by repeated shooting hope to drive the deer away from this part of the Forest altogether for several seasons 'till the trees become established.

A.W.F. Watson.
A.W.F. Watson,
Forester.
Jan. '78.

This survey in Jan. '78 covered areas from P76 back to P68 - i.e. mainly older areas where weevil damage would not be so evident.

Later when transferred on to F.M. duties (Summer '82), it immediately became clear that weevils were also a major problem (in spite of insecticidal treatments) as soon as the trees were planted.

Now I would tend to rate reasons for failure in the following order.

1. Weevil
2. Frost (C.P.)
3. Sand sedge competition
4. Roe damage. (Increased Rangel activity also C.P. appears to be less attractive)

Ref. more recent trials etc. in Culbin, an use of genetically improved S.P.,
scarification instead of ploughing etc.

A.W.F. 1984.

L.O.M (Culbin) - planting details since 1968 - as an aid to determining failed areas at Culbin. AWF:W Dec. 77

Compt.	Species	Pure/Mix.	P. Year	Area(ha)	Past Treatments	Present state of crop.	Any other relevant factors	Proposed Treatments / prescriptions
5a	CP	M	1968	2.0	No cult.	See additional notes. Variable	Area has been beat-up with SS. in flats. Broom a problem and waxes.	Review state of SS. Deer / frost problem.
5a	SP	M	68	1.0	No cult.	" Good	S.P. now well through dense broom.	NIL.
13c	CP	P	73	9.0	No cult.	" Variable	Problems of broom and scrub birch. Trees failed (frost) in sedge areas.	Space-furrow plough sedge area. Replant with fast growing species - S.P. Try Mammal? LP
14a	CP	P	73	0.5	No cult.	" Failed	Frost / sedge area.	As above, space furrow plough
18a	SP	P	73	2.0	No cult.	" Failed	Deer / sedge area.	Space furrow plough. Plant pine.
18b	LP	P	73	1.0	Space-furrow ploughing.	" Failed	Deer.	Replant. Will not have to be scraped.
18g	SP	P	73	1.5	No cult.	" Satisfactory.	Broom / deer.	Discuss broom problem.
53f	GF	P	68	1.5	No cult. Three areas, two No cult. planted under birch.	Two small. In the largest area one failed. a few GF now above browsing level.	Deer. Browsing / grazing.	Forget about the two small areas. Need to tell birch in large area.
55e	GF	P	71	1.5	No cult. G.F. planted under birch.	" Failed	Lack of light.	NIL. Leave to the birch.
57c	GF	P	74	1.0	No cult.	Nearly all the G.F. have failed.		Thin out birch. Replant where necessary.
68e	LP	P	74	1.0	No cult.	Failed.	Shingle bed.	NIL. Leave till next time round.
99b	SP	P	69	3.5	No cult.	Satisfactory		NIL.
111d	LP	P	71	0.5	No cult.	Failed.	Very rock Calluna	Suggest too small to bother with. Leave to what trees there are + rest, regrow.
141a	LP	P	74	4.5	No cult.	Severely browsed	Will make crop.	NIL.
143? LP	LP	P	74	3.0 + 5	No cult.	Heavily browsed.	Poor colour.	Possibly nil. Discuss.
144 SP	SP	P	74	2.5	No cult.	Failed	Sedge area.	Space-furrow plough / replant.
168d	BL	P	75	1.0	No cult.	Willows? Failed.	Clean drains	Replant various indigenous species in planting clumps at my discretion. ? Spent some. Replanted
184a	SP	P	73	8.0	No cult.	Failed	Sedge area.	Space-furrow plough. Replant.



Comp.	Species	Pure/Inx	P. years	Area (ha)	Past Treatments	Present status of crop.	Any other relevant factors	Proposed treatments / prescriptions.
184b	SP	P	73	1.0	No cult.	Failed.	Sedge area.	Space-furnus plough. plant.
194b	SP	P	70	8.0	No cult.	Mainly failed.	Sedge in places.	Space-furnus plough where possible
195c	SP	P	70	1.5	No cult.	Mainly failed.	Sedge in places.	Fell more sp. to make longer ploughens. Space-furnus plough.
196a	SP	P	70	2.0 1.5	No cult.	Scattering of browsed / posted NS	Good G.F. adjacent.	NIL
197b	SP	P	71	0.5	No cult.	Mainly failed		NIL. Too small.
198b	SP	P	74	4.0	No cult.	Trees the but browsed right down	Rough Calluna / long stems / heag and breaking up.	Difficult. Discuss plough. Will have a plough in any way.
199b	SP	P	71	7.5	No cult.	In small round strip, will have ploughed but not to give a crop. Main area - badly browsed.	A good proportion of sedge areas.	Leave round strip. Cut more birch. Space-furnus plough most of moist area.
200a	SP	P	71	8.5	No cult.	Much the same as previous Cmpt. Soil better, better areas of growth.		NIL.
201a	SP	P	72	3.0	No cult.			
201b	SS	P	74	7.0	No cult.	SS very good. Pine - browsed as everywhere opening up. Too dense to begin with.	Birch badly in need of opening up. Too dense to begin with.	Open up birch will damage SS and pine but as alternative.
201d	SP	P	74	5.0	No cult.			
202b	SP	P	74	2.5	No cult.	SS good but suffering from lack of light. Pine failed		'Swipe' the whins? Space-furnus plough sedge area.
202d	SS	P	74	1.0	No cult.			Open up Birch to benefit the S.S.
204a	SP/LP	P	76	8.5	- See sheet 3.	Satisfactory	Alot of sedge high. Dams no longer mentioned.	NIL
205a	LP	P	71	13.5	No cult.	Unsatisfactory	Trees on the sedge browsed. Stacking satisfactory	NIL Discuss.
210b	SP	P	71	8.5	No cult.	Virtually failed.	Stacking very poor.	Discuss. Due to large stumps etc. possibly not worth taking a plough
211b	SP	P	71	2.5	No cult.			
221b	SS	P	74	1.0	No cult.	Quite acceptable.	Little browsing at protection damage.	NIL apart from hunting up the western half with some SS
225b	SP	P	71	1.0	Compts 225-229	Failed.		Semib, cut whins. Fell from birch. Space-furnus plough. Try S.S.?
226b	SP	P	71	1.0	No cult.			

Compt.	Species	Pure/Mix.	P. Year	Area (ha)	Post-Treatments	Present state of crop.	Any other relevant factors.	Proposed treatments / prescriptions.
228b	SP	P	71	5.0	Compts 225-229. Nocult.	Failed		Scrub-cut whins, fell more birch. Space given plough. Try ss?
229c	SP	P	72	2.5				NIL. One stray ingested whins, will have to be removed.
235b	DF	P	75	1.0	Nocult.	Good. GF and DF.	Very dense over-story of Birch.	Need to investigate boundary fences. Plant ditto with DF. A lot of birch + part from cutting down very young NIL.
236d	DF	P	75	1.0	Nocult.	Failed completely.	Horses / ponies have been in.	NIL.
246	LP	P	76	1.0	No cult.	Good.		
127c	SP	M	68	1.0	No cult.	Good.	Growing successfully out of browsing damage.	
204a	SP	M	75	2.5	The larger area space - given ploughed.	On to unploughed not very satisfactory.		
204a	Mc	M	75	6.0		Ploughing, mixed quite good apart from northern end. A lot of browsing damage.		

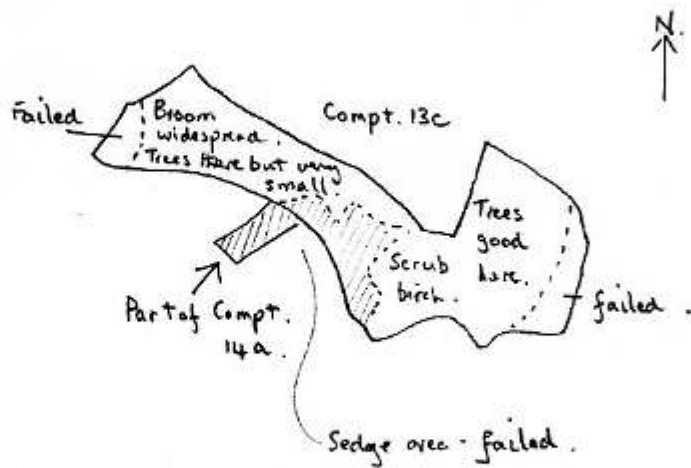
Section 6 - Coastline

16a	DF	M	68	4.0	Space given ploughing.	DF. satisfactory in eastern half of Compt.		NIL.
16a	Mc	M	68	3.5	Space given ploughing.	Trees failed in western half.		Screef ridges, replant.
90c	SP	P	69	2.0	Nocult.	Good.		NIL.
126b	SP	P	68	5.5	Nocult.	Good.	Growing successfully out of browsing damage.	NIL.



Ans. 7. 77.
Dec. 77.

Compartment break-down where relevant.



Copy: Conservator East (S) Attn AC/FM
Mr G Bartlett, Research
Mr S W R Stewart LOM- Copy of Mr Mayhead's letter enclosed.

Via Mr D B Paterson

Mr G J Mayhead
Forestry Commission
Northern Research Station
Roslin
Midlothian EH25 9SY

GJM/LB Culbin General

S4.1/LOM S5.2

17 July 1978

NITROGEN FERTILISING AT CULBIN

Thank you for your minute of 10 July.

1. Experience to date at Culbin suggests that we must draw a crucial distinction between CP and SP. From Hugh Miller, and yourselves we have very convincing data about the response of CP to N, and field practice that has developed from this feels good, although I am the first to admit that we have never found the resources to monitor response as we would like. In 1976 we put standard N on two compartments of P51 CP, ie pre-thinning for the first time. To casual observation the response is good and if confirmed by more detailed survey and foliar analysis, have in mind a 200 ha extension in 80/81.
2. SP is a different kettle of fish. We have not fertilised SP since 1974 except where it happened to get mixed up with extensive CP. Grounds for thinking that P deficiency was not the cause of the apparent lack of response was, almost entirely, 28/68 Macaulay. This is Hugh Miller's work with a P28 stand on 15s (shingle) approaching 15L. He found no response to phosphate (or lime). We think of 15s as one of the worst site types although this particular stand is rather better than the type.

I must agree that many of the SP look P deficient and I have perhaps put too much confidence in one, albeit most comprehensive, experiment.

3. This is a lengthy preamble to the answer to your questions, which are:-

1. No we have not sampled SP in Culbin for P.

11. Yes, we will do so this October along the lines you suggest.

A H A Scott
District Officer