5.
Production in a 50 years old *Pinus contorta* stand

Framleiðslan í eini 50 ára gamlari viðarlund av kontortafuru

Tróndur G. Leivsson

Abstract

The Faroe Islands have no indigenous forest trees. Since the beginning of this century small plantations have been established. *Pinus contorta* is a dominant species in these plantations. The provenances used were probably of south coastal origins, i.e. coastal Washington.

The data recorded in this study are from a plantation approximately 1.5 ha in size and located at the village of Selatrað. *Pinus contorta* is the dominant species, followed by *Sorbus intermedia*. The living trees were callipered at breast height as well as measurements of tree height and diameter at stump height were taken. All visible stumps were callipered.

From the calculations, forest inventory figures are presented. The results are discussed in relation to recent literature about this species when used in afforestation on similar areas in the North Atlantic. Present knowledge about provenance recommendations for this species in maritime climates is discussed.

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Introduction

No natural forest vegetation exists in the Faroes except from scattered occurrence, mainly in steep crags, of common juniper (*Juniperus communis* L.) and some dwarf willows (*Salix phylicifolia* L., *S. glauca* L.). Trees are absent (Hansen 1966, Jóhansen 1985a).

For the last 200 years we know that people have been interested in growing trees on these islands, mainly for shelter and ornamental purposes, however, until a hundred years ago with little success. Since the 1880's, people, especially in the city of Tórshavn, have shown an increasing interest in this subject. They tried to structure their effort, and obtained an area for afforestation experiments. In the beginning of this century they also received guidance from Danish foresters (Jóhansen 1985b).

From the general description of fairly successful tree species growing in the Faroese gardens at the beginning of this century, the professionals i.e. mainly the forest officer C. E. Flensborg from Det danske Hedeselskab (The Danish Heath Society) accentuated as promising what is today known as *Sorbus intermedia* (Ehrh.) Pers., *Sorbus aria* (L.) Crantz, *Sorbus americana* Marsh., *Betula pubescens*

Ehrh., *Acer pseudoplatanus* L., different *Salix* spp., *Pinus mugo* Turra, *Pinus contorta* Dougl., *Picea glauca* (Moench) Voss, *Picea sitchensis* (Bong.) Carr. and *Abies alba* Mill. (Flensborg 1903, 1914, 1924). This is also in accordance with the recommendations from the Danish botanist Mr. F. Børgesen who carried out botanical investigations in the Faroe Islands around the beginning of this century (Børgesen 1903). According to Flensborg (l.c.) *Pinus contorta* was first planted in the Faroe Islands in 1917. The young trees were planted in preparated furrows and at a narrow spacing (which most likely means about 10 000 plants per ha).

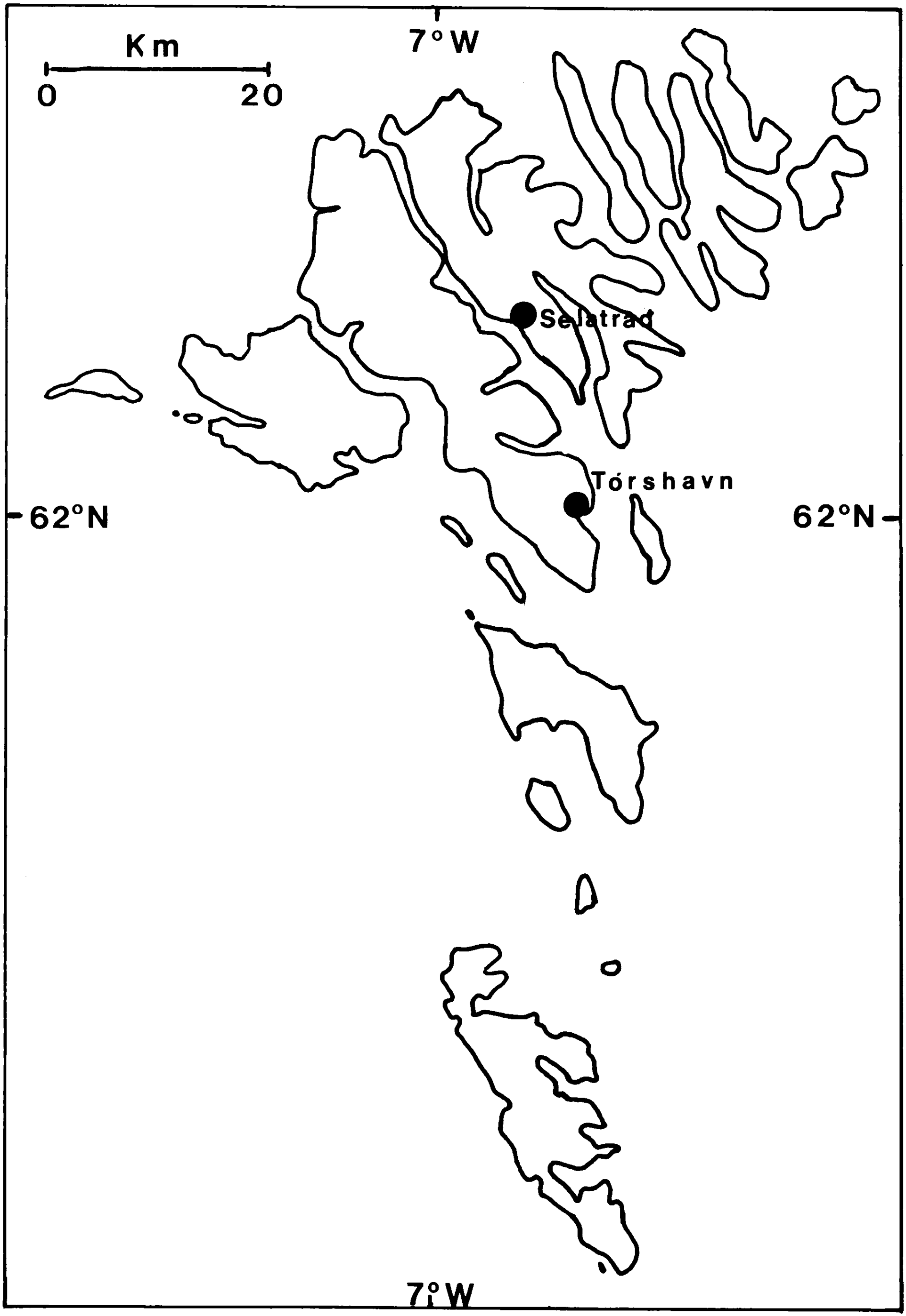
We do not know which seed sources of the different species they used for these early plantations in the Faroes, but probably local Danish and later also to some extent Icelandic (birch) and West Norwegian ones (Norway spruce and Scots pine). White spruce seed sources might have been eastern North American, and Sitka spruce and Shore pine from the southern part of coastal Northwest America. The seed may also have been from European plantations originated from such sources. For this article it is the origin of the Shore pine which is of particular interest. With the present knowledge of phenotypic variation within the natural distributional area of *Pinus contorta,* one can quite certainly determine all the older Shore pine growing in the Faroes to be of south coastal origin i.e. coastal Washington and Oregon. Among others, this was the conclusion from an excursion to the Faroese plantations arranged 1982 by the Nordic Arboretum Committee. Today such origins are not recommended as seed sources for use in high latitude Scandinavian forestry.

The particular plantation which is the basis of this article is situated near the village of Selatrað on the island of Eysturoy. Figure 5.1 shows the location, and Figure 5.2 gives a view of the plantation. Total area is 1.5 ha and the elevation is some forty meters above sea level. The exposition is SW-facing.

The soil is rather typical for the lowlands, Podsols with a relatively thick organic horizon and Organic Soils. The soil is rather shallow and the solum often 1 m in depth.

The nearest meteorological station is Hoyvík (now in the city of Tórshavn) about 17 kilometers' distance from this plantation. Table 1 shows some characteristic climate data. The most striking characteristics are the low temperatures in the growing season, the rather long duration of this period, and the very mild winter temperatures. Also the small amount of hours with sunshine and the fairly high exposure to wind should be noticed. Leivsson (1985) carried out some experiments with exposure flags (tatter-flags) in the Faroe Islands at altitudes from about 40 to 300 m a.s.l. These results indicate exposure rates in the lowlands well below what is today known in Scotland as the limit for commercial afforestation, i.e. 13 cm^2 per day.

The area was in 1913 handed over from a local peasant for tree-planting purposes. Up to then it had been sheep pasture. Det danske Hedeselskab conducted the establishment of this plantation, but we do not know the exact history with respect to tree species and origins used at first, methods of cultivation etc.



5.1. Føroyakort, har Tórshavn og Selatrað eru avmerkt.
Map of the Faroe Islands indicating the capital Tórshavn and the village of Selatrað.

5.2. Viðarlundin á Selatrað.
The plantation at the village of Selatrað. (Photo T. Leivsson, Apr. 1986).

Today, this plantation as a whole should be characterized as a Shore pine dominated stand.

It seems like tall bare root plants (2/2 size or older) have been recommended from the beginning. As well as planting in furrows, they also planted in thoroughly cultivated pits, each approximately 0.15 m^2. There is no knowledge regarding the use of fertilizers, neither during the planting operation nor later to the young stands. The importance of weeding in the young stands was emphasized. Thinning operations are mentioned (Flensborg 1947) but no records are available. Some fifteen years ago thinning operations were also performed in this plantation but no records are available here either. Also some trees have blown down from wind gales during this period, but the space left open has been replanted with e.g. *Thuja plicata* D. Don, *Tsuga heterophylla* (Raf.) Sarg., *Abies procera* Rehd., *A. grandis* Lindl., *Chamaecyparis lawsoniana* (Murr.) Parlatore, *Cryptomeria japonica* (L.f.) Don and *Nothofagus betuloides* (Mirb.) Oerst. (pers. comm. from Leivur Hansen).

Although the forest vegetation is young on the islands, there are some reports on insects harmful to the trees. In some years the broad-leaved trees suffer badly from larvae defoliation. According to Koponen (1985a) this is mainly due to the geometrid moth *Operophtera brumata* (L.). Also the firs, especially the *Abies nordmanniana* (Stev.) Spach suffer from the sapsucking *Dreyfusia* sp.. An important

Table 1. Climatic data from the station Hoyvík for the normal period 1931–60 (Lysgaard 1969).

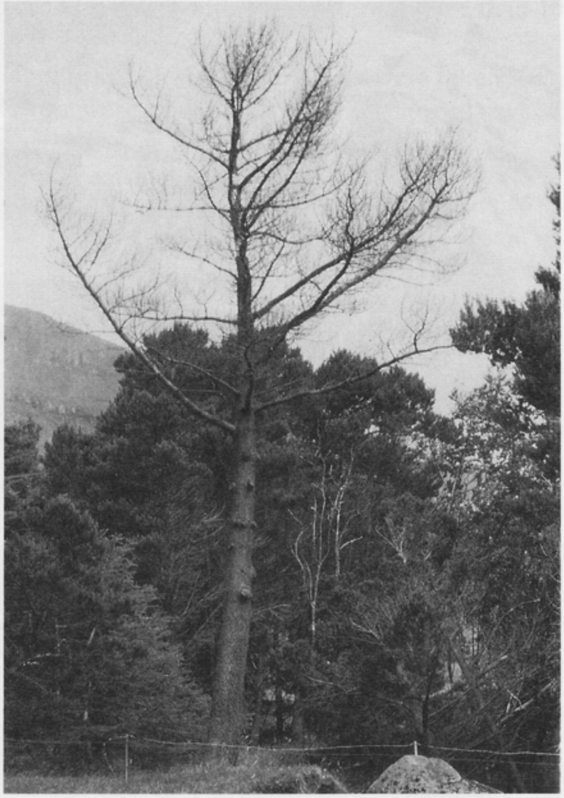
	Jan.	Febr.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Temp. °C													
– avg. min.	0.9	1.6	1.2	3.2	5.0	7.5	10.1	9.3	8.1	6.1	3.9	2.0	6.3
– mean temp.	3.9	3.7	4.6	5.4	7.3	9.2	11.0	11.1	10.0	7.9	6.1	5.0	7.1
– avg. max.	6.2	6.4	7.4	6.9	8.8	11.1	12.1	12.4	11.3	9.7	7.8	7.0	7.9
Number of days with frost (T. min. <0)													
– mean	9.4	8.9	7.7	3.9	1.1	–	–	–	–	1.1	2.6	6.1	40.8
Hours with sunshine													
– mean	15	41	76	113	137	140	109	102	82	58	22	7	902
Precipitation mm													
– mean prec.	149	136	114	106	67	74	80	96	132	157	156	168	1434
Rel. humidity %													
– mean	82	82	82	82	83	84	86	87	86	83	84	83	84
Wind velocity m/s													
– mean	6.3	5.8	5.5	5.1	4.5	4.4	3.9	3.9	4.9	5.6	5.8	5.9	5.1
Freq. of prevail. wind direction %	SW	N=SW	S=SW	N	N=E	SW	SW	SW	SW	SW	SW	SW	SW
– mean	19	18	17	18	16	16	17	18	20	20	19	21	18

defoliator feeding on Shore pine seems to be the tortricid moth *Zeiraphera diniana* Guenee, (Koponen 1985b). Although serious, the attacks do not seem to be as harmful as known e.g. from Britain. Some years Sitka spruce is suffering badly due to attacks from sapsucking aphides, most likely the *Elatobium abietinum* Walk which is known to cause restraining growth to this species e.g. in Scandinavia and Britain.

Of forest pathology two matters should be dealt with. In some years red and dried out shoots and needles are observed on the Shore pine. This could be symptoms of attacks from the fungus *Gremmeniella abietina* (Lagerb.) Morelet, but no exact information is available. Second, and more serious, especially for this plantation, is the attack of the root rot fungus *Heterobasidion annosum* Bref. on the Shore pine. The author discovered such attacks in 1980 and sent samples of sporophorae to the Hørsholm Arboretum, Denmark for confirmation. Since then even more trees have been killed from such attacks, and this infection should be considered as serious. A possible way of infection to the area might have been via fresh Norway spruce fence poles from Denmark which were used around 1960 (Leivur Hansen, pers. comm.). Figure 5.3 shows a recently killed Shore pine and Figure 5.4 shows the sporophorae on a windthrown Shore pine root.

The aim of this article is to throw light on the yield which could be expected from such a first generation coniferous plantation. Such information is generally considered as being one of the most important parameters in forestry evaluation. Along

5.3. Nýliga deyð kontortafura. Helst hevur hon fingið rótrotssopp.
Recently killed Shore pine, probably by attack of the root rot fungus.
(Photo T. Leivsson, Apr. 1986).



with the discussion of the data recorded from this plantation, experiences with this species from other relevant regions in the North Atlantic will be presented. Together, this might help elucidating a partial answer to the more complex question of what results can be obtained from further afforestation activity in the Faroe Islands.

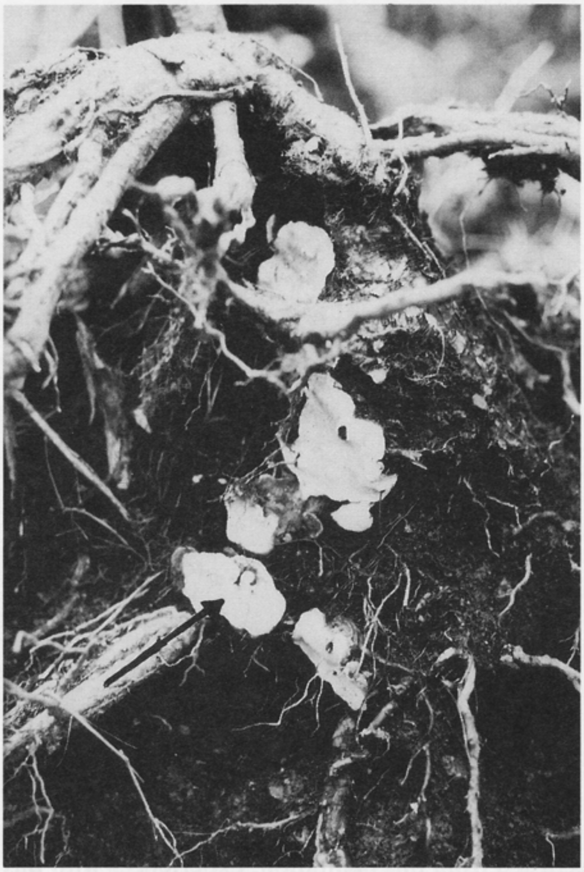
Material and methods

The field work was done ultimo March 1986.

The plan was to calliper the breast height diameter (dbh) of all the trees in this plantation (dbh > 5 cm) and also to record the diameters of all visible stumps (diam. > 5 cm). The trees recorded were grouped in genera (*Pinus contorta* separate from other *Pinus* sp.), but the stumps were pooled together in one group. Because of limited time at disposal and quite varying weather conditions from day to day, the mensuration covered only a part of the area.

Trees planted as a "second generation" i.e. replantings for the last fifteen years or so, were not counted.

Each tree measured received a number and later 47 of these trees, representing



5.4. Grólikamið á rótrotssoppi á eini vindfeldari kontortafururót. Sporophorae of the root rot fungus on a windthrown Shore pine root. (Photo S. Ødum, Apr. 1986).

the diameter range, were sampled for tree height measurements with a SUUNTO. It was attempted to let each tree sampled represent an approximately equal basal area. In addition to the records of height these trees also were callipered at stump height. Together with the already recorded dbh these data could be used to estimate a breast height diameter and a tree height for the present stumps, as well as the heights of the growing trees.

From lack of local yield functions one has to depend on functions for single tree volume, stock volume, and yield, developed for other but similar species or areas. Therefore, when planning this work is was decided to carry out the volume calculations either with the use of the Tariff Table from Hamilton (1975) (input, Single Tree Tariff Chart for Lodgepole pine) or with the use of Volume Functions for Scots pine from Brantseg (1967, p. 703 no. 4) (inputs, dbh and tree height).

To control the validity of the calculations it was desirable to know how well the table and the function fitted the trees of this plantation. Therefore 7 randomly sampled windthrown trees were volume measured by sections. The stems were measured until top diameter 5 cm, and branches with a diameter of more than 10 cm at the basis were also included.

To determine the age of the stand, plug samples at breast height were taken from some trees. In addition, annual rings were counted on the stumps of several recently logged trees.

The mean diameter by basal area was calculated from the equation:

$$\bar{D} = \sqrt{\frac{\Sigma\, d^2}{N}}$$

where d = diameter and N = number of trees.

The mean tree height was calculated as Lorey's mean height.

Results

Total area of this plantation is 1.55 ha and of these 0.92 ha (59 %) are analysed.

A total amount of 1359 living trees are registered per ha, 901 conifers (66 %) and 458 broad-leaved trees (34 %) per ha, respectively.

The number of conifers are distributed into 673 *Pinus contorta* (75 %), 162 *Abies* sp. (18 %), 52 *Larix* sp. (6 %), and 14 *Picea* sp. (1 %), all per ha.

The corresponding records for the broad-leaved trees are 382 *Sorbus* sp. (83 %), 57 *Acer* sp. (13 %), and 19 *Betula* sp. (4 %), all per ha.

Pinus contorta (almost only the var. *contorta*), makes up 50 % of the total stem number and *Sorbus* sp. (*S. aria* and *S. intermedia*) 28 %, respectively.

Figure 5.5 shows the distribution in diameter respectively for the conifers and the broad-leaved trees.

The callipering of dbh shows a total basal area at breast height (overbark) of 44 m^2 per ha, 39.5 m^2 per ha (90 %) for the conifers and 4.5 m^2 per ha (10 %) for the broad-leaved trees, respectively. From this records *Pinus contorta* represents 34 m^2 per ha or 78 % of total basal area.

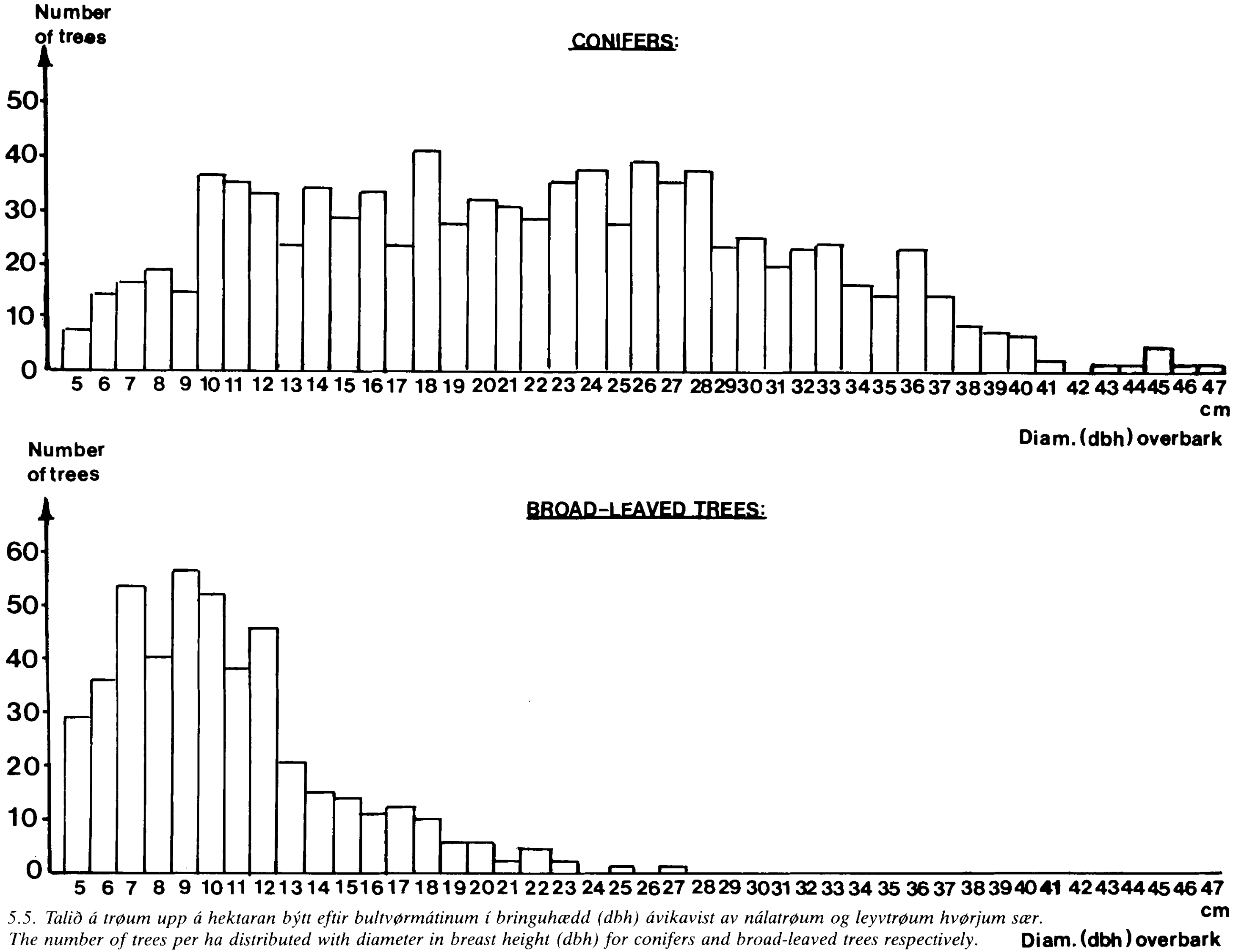
The diameter corresponding to mean basal area at breast height is 24 cm (overbark) for the conifers and 11 cm for the broad-leaved trees, respectively.

From the data of the trees measured by heights, dbh and diameter in stump height, a transformation of the tree heights and the dbh into logarithms has made it possible to calculate by regressions an equation for the tree heights:

Equation No 1

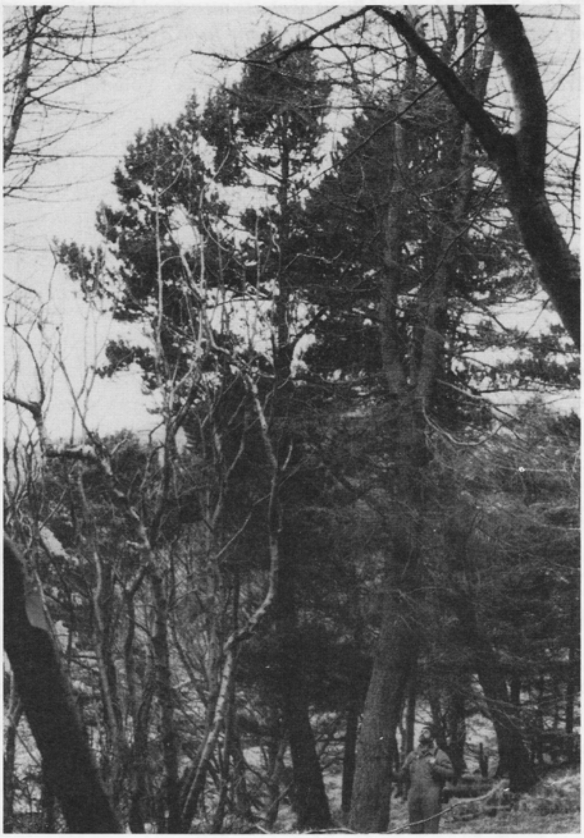
$$\ln \text{tree height} = 1.281 + 0.393 \ln \text{dbh} \qquad r^2 = 0.54$$

The mean tree height for the conifers in the plantation is from this equation calculated to be 13.3 m.



5.5. Talið á trøum upp á hektaran býtt eftir bultvørmátinum í bringuhædd (dbh) ávikavist av nálatrøum og leyvtrøum hvørjum sær.
The number of trees per ha distributed with diameter in breast height (dbh) for conifers and broad-leaved trees respectively.

5.6. Kontortafura í miðjuni og japanskur lerkur longri frammi (Søren Ødum næstur hjá). Shore pine in the centre and Japanese larch in the front (flanked by Søren Ødum). (Photo T. Leivsson, Apr. 1986).



The largest tree registered is a Japanese larch with an actual height of 18.5 m and a dbh of 45 cm overbark (Fig. 5.6).

The volume measured by sections from the seven *Pinus contorta* is shown in Table 2. The corresponding figures for Lodgepole pine from the Tariff Table and from the volume function for Scots pine are also given. The correlation coefficient between volume measured by sections and volume from the Tariff Table is 0.73, while the correlation coefficient between volume measured by sections and the volume function for Scots pine is 0.91 (**). Because of better agreement to the volume measured by sections, the volume function for Scots pine is used in the further work. The volume measured by sections is 13 % heigher than the volume from the function. This could indicate that the calculations are not too optimistic.

The growing stock derived from the volume function of Brantseg (l.c.), is estimated to a total of 284 m^3 per ha (overbark), 257 m^3 per ha (91 %) for the conifers and 27 m^3 per ha (9 %) for the broad-leaved trees, respectively. In these total figures *Pinus contorta* represents 226 m^3 per ha or 80 %.

Total number of stumps registered is 815 per ha, and the mean diameter by basal area is 16 cm (overbark).

Table 2. Tree volume of Pinus contorta measured by sections and corresponding figures from a tariff table of Lodgepole pine (Hamilton 1975) and from a volume function for Scots pine (Brantseg 1967). All in m^3.

Tree nr.	Volume measured by sections	Volume from tariff table	Volume from Scots pine function
1	0.58736	0.410	0.58847
2	0.58463	0.320	0.52381
3	0.99430	0.400	0.70156
4	0.48471	0.240	0.47531
5	0.29989	0.180	0.22158
6	0.57332	0.390	0.56584
7	0.35342	0.290	0.34281
Sum	3.87763	2.2230	3.41938

Similar to equation No 1, calculations have also been made for the relationship between tree height and stump diameter:

Equation No 2
ln tree height = 1.120+0.4234 ln stump diameter $r^2 = 0.54$

and for the relationship between dbh and stump diameter:

Equation No 3
dbh = –1.076+0.9001 stump diameter $r^2 = 0.97$

With basis in equation No 3, a mean diameter by basal area at breast height has been calculated to 13 cm (overbark) for these former trees. Likewise, equation No 2 has made it possible to calculate their mean tree height to 11.3 m. The volume of this former growing stock is calculated to 69 m^3 per ha.

Altogether this implies a total yield of approximately 353 m^3 per ha.

The registration indicates an age of about fifty years as an average for the trees in this plantation. Figure 5.7 is a cross section from the base of a Shore pine stem showing the annual rings. The annual yield (or mean annual increment – m.a.i.) therefore can be estimated to about 7 m^3 per ha per year.

Table 3 is a summary of the data recorded in this plantation.

Discussion

The plantation investigated was not designed as a scientific research plot. Therefore, this area should be considered as a demonstration plantation. Lack of exact information upon species used, seed origins, methods of planting and spacing, fertilizing, thinnings and by that harvesting of premature volume, are elements influencing the validity of the results.

5.7. Tvørskurður niðast av einum buli av kontortafuru, ið er vaksin á Selatrað. Legg til merkis breiðu viðingarnar og myrklitta hjómaviðin. Helst kemst hesin myrki litur av ígerð av rótrotssoppi. Til samans eru viðingarnar 52 fram til árið 1985.
Cross section from the base of a Shore pine stem from the Selatrað plantation. Note the rather wide annual rings, and the dark colour in the sapwood. Probable, this dark colour is due to attack from the root rot fungus. Total annual rings are 52 until 1985. (Photo A. Langhammer, Sept. 1986).

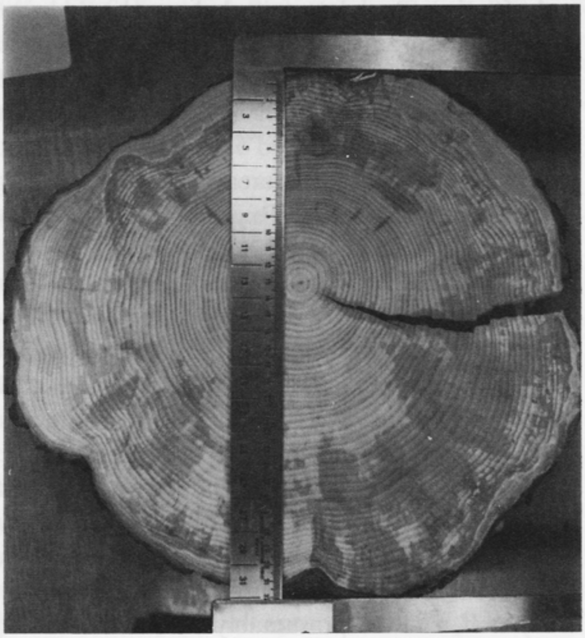


Table 3. Key values from the registration at the Selatrað plantation 1986.

Total number of trees per ha		1359	100 %
– number of conifers per ha		901	66 %
– number of broad-leaved trees per ha		458	34 %
– – *Pinus contorta,* in part of total	50 %		
– – *Sorbus* sp., in part of total	28 %		
Total basal area in breast hight (m^2 per ha, overbark)		44	100 %
– basal area in breast height for the conifers (m^2 per ha, overbark)		39.5	90 %
– basal area in breast height for the broad-leaved trees (m^2 per ha, overbark)		4.5	10 %
– – *Pinus contorta,* in part of total	78 %		
Mean diameter by basal area in breast height, the conifers (cm, overbark)		24	
Mean diameter by basal area in breast height, the broad-leaved trees (cm, overbark)		11	
Mean tree height (Lorey) for the conifers, m		13.3	
Total stock volume (m^3 per ha, overbar)		284	100 %
– stock volume for the conifers (m^3 per ha, overbark)		257	91 %
– stock volume for the broad-leaved trees (m^3 per ha, overbar)		27	9 %
– – *Pinus contorta,* in part of total	80 %		
Total number of stumps per ha		815	
Mean diameter by basal area (cm, overbark)		16	
Estimated volume from these former trees (m^3 per ha, overbark)		69	
Total yielding (m^3 per ha, overbark)		353	
Mean annual increment – m.a.i., 50 years (m^3 per ha, overbark)		7	

As for the actual data recorded one should keep in mind that rather few trees are volume measured by sections. Since one can assume that the volume function for Scots pine is only fairly well adapted to the Shore pine species and to the Faroese growth conditions, it would have been desirable to have more trees measured by sections.

Why there is such a difference between the single tree volumes calculated from Hamilton (l.c.) and from Brantseg (l.c.), and why Brantseg's function is of better agreement with the volume measured by sections, is difficult to explain. However, the material which was the basis for the work done by Hamilton were presumably plantations, while Brantseg based his material on naturally regenerated trees. Therefore, Brantseg's material might have a better representation of trees from poor sites compared to Hamilton. This would influence the tree height, and the low tree heights are also the striking feature within the Faroese material. Contradictory to this, one must remember that the Faroese trees are planted as well as those used by Hamilton. Also they are of the same species, although maybe from two separate varieties. So no clear answer can be given to the questions.

Anyhow, the data recorded should be considered as reliable. This is mainly because of the rather extensive diameter registrations, also including the stumps fairly well, and the presumably sufficient tree height measurements.

The importance of a good stand climate for tree growth is well accepted. This small plantation has a high ratio of circumference per area. Also the distance to the border is very short from any place in the plantation. Certainly the trees have had difficulties in building up a good stand climate. Very likely, this has influenced the tree heights in particular.

The fact that this area is rather small also brings in a more general problem, namely whether the site chosen for the plantation is representative for the variation in growth conditions in this village area.

Comparing the growth conditions for this particular plantation to those in the Faroese lowlands in general might be difficult and would therefore be of a more or less subjective nature.

The village of Selatrað is sheltered from winds of northerly directions. As a character of topoclimatology, northern winds often bring a clear sky and sunshine both in the area of Selatrað and Tórshavn. Being sheltered from the cold winds this might contribute to a somewhat higher day temperature. Since the prevailing wind directions are westerly this might not be of any significant importance. Because of the relatively high mountains on the other side of the contiguous sound, the prevailing winds are often strong and very turbulent. With respect to wind gales and possible windthrow damages one might therefore expect this plantation to be rather exposed. On the other hand, this area has not as much pressure from even wind exposure as the west facing mountainsides on the westborder islands. From the exposure rates measured by "tatter" flags (Leivsson 1985), the general impression is that most of the lowlands are moderately exposed, i.e. the tatter being < 10 cm^2 per day. The soil conditions in this plantation should be considered about normal for the lowlands, although one can easily find areas more shallow than this.

As mentioned earlier the provenances used are south coastal, probably from Washington. Nowadays, these southern provenances are neither recommended for high latitude areas in Scandinavia nor on the severely exposed areas in the north of Scotland.

Compared to the actual tree hights measured, the calculations tend to underestimate the heights of the larger trees. In the next turn this will affect the volume calculations towards lower figures since the taller trees are contributing relatively much to a stock volume. Also the volume measurements by sections are 13 % higher than calculations using the volume function, even though actual tree height is used. Because of what is mentioned here, one can assume that yield figures presented from this particular plantation do not tend to show a result as optimistic as possible.

The Norwegian experiences with *Pinus contorta* in the west coastal region, in spite of small scale trials, seem to be rather promising on poor soils and at severe exposure. Magnesen (1977) emphasizes Shore pine provenances from Alaska for the outermost and middle areas of the West Norwegian fjords, and only to use the Lodgepole variety farther away from the coast. He mentions (p. 31) a particular trial with a Shore pine provenance at the area of Stadt (same latitude as the Faroes) so severely exposed that no natural Scots pine will thrive. This Shore pine stand has produced a yield equal to site class II (second best) for Scots pine in western Norway.

In a study of early performance (4 years old trial) of coastal (Alaska) and interior (British Columbia) provenances of *Pinus contorta* growing in the Norwegian county of North Trøndelag (64°30′N and a moderately coastal climate), the interior provenances appeared to be the best for the area considering height growth and frequency of multistemmed plants (Aitken 1982). This is in agreement with results from other but more continental climate regions of Scandinavia as reviewed by Skrøppa (1982). Magnesen (l.c.) warns against use of interior sources near the coast, mentioning that several *Pinus contorta* plantations from interior provenances, when used in the coastal areas, have shown a falling off after some 15 to 20 years of promising growth.

In two sample plots of Shore pine in coastal Norway (age 45 and 34) Brekken (1968) found a m.a.i. of respectively 4.7 and 7.3 m^3 per ha.

In Iceland, *Pinus contorta* provenances from northern coastal areas are preferred, especially the Skagway provenance (Bjarnason 1978). Benedikz (1982) presents yield figures from a 21 years old trial (Skagway) near Reykjavík. The m.a.i. is 2.01 m^3 per ha.

Lines (1966) discusses the features of several different provenances within the major seed collecting regions of the natural distribution area for *Pinus contorta*. His recommendations for exposed areas in the north of Scotland are provenances from the north coastal area, i.e. coastal and intermediate Alaska and British Columbia. Dealing with the problem of basal sweep, a considerable problem in many plantations on the British Isles, and obviously present in the Faroese plantations, Lines & Booth (1972) emphasize the fact that coastal Alaska and Queen Charlotte Island provenances rarely suffer from this problem in British plantations. They also give some examples of m.a.i. from approximately thirty year old plantations of ten different provenances replicated at two different sites, Wykeham (Yorkshire) and Millbuie (Scotland) respectively. In the Scottish trial m.a.i. varied from 4.7 to 7.8 m^3 per ha, the south coastal yielding highest but most of the British Columbia provenances yielding more than 6 m^3 per ha.

In a still maritime but milder and less harsh climate, like the Irish climate, the south coastal provenances seem to be superior in yield, although problems of basal sweep are mentioned (O'Driscoll 1980).

Along with the yield figures for volume, dry matter contents and wood quality should be emphasized. No such measurements were taken in this Faroese plantation but some indications could be obtained from literature. In an approximately thirty year old provenance trial Henderson & Petty (1972) found the nominal density in stemwood to be 470 kg per m^3 and 390 kg per m^3 from a south coastal provenance and a central interior provenance, respectively. Formation of compression wood on the other hand was higher in the coastal provenance. They also found differences in other wood quality characteristics between the provenances but these differed in both directions.

The yield data from this Faroese plantation, supplemented with the figures of nominal density (Henderson & Petty l.c.), can be converted into amounts of fuel. According to Dickens et al. (1983), 7 m^3 of solid wood is equivalent to approximately 1.3 tons of oil equivalents – toe, or to 14–15 MWh.

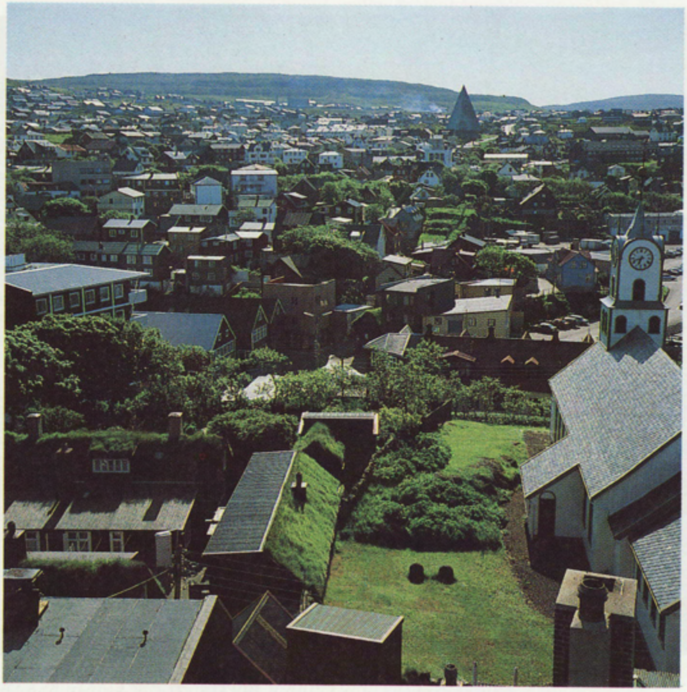
Whether a Sitka spruce plantation would have yielded more can only become speculations. The general view from the afforestation literature seems to be, that on fairly good soils the Sitka spruce yields considerably more even on quite exposed sites. Although no measurements on the Sitka spruce in particular have been done on the Faroes, there are indications that Sitka spruce of Alaskan provenances can thrive rather well, except from the cycling attacks of the *Elatobium* aphis.

Although the Faroe Islands have no indigenous forest, scattered plantations established in this century have shown that forest trees can thrive in this harsh and maritime climate. The plantations have only been on a small scale and no older trials with a scientific design exist. Therefore, the data obtained in this study are of a certain limitation and should not be used separately as a basis for an evaluation of the prospects from an afforestational programme.

There is a lack of information about the seed origins used in the older Shore pine plantations on the Faroes. However from their appearance these trees certainly could be characterized as south coastal provenances, most likely from Washington. The yield figures recorded from this particular plantation on the Faroe Islands agree with results from this species on other but similar areas in the North Atlantic. From literature, good evidence is found that at high latitudes like the Faroes,

Viðarlundin í Gundadali.
The plantation in Gundadalur, Tórshavn. Photo T. Leivsson, 1988.

Viðarbular úr viðarlundini í Gundadali.
Woodpile from the plantation in Gundadalur. Photo T. Leivsson, 1988.



Útsýni yvir Havnina vestureftir av takinum á Hotel Hafnia.
View of Tórshavn from the roof of Hotel Hafnia towards west. Photo S. Ødum, June 1986.

Útsýni yvir Havnina norðureftir av takinum á Hotel Hafnia. Viðarlundin í Gundadali sæst eisini.
View of Tórshavn northwards from the roof of Hotel Hafnia. The plantation in Gundadalur is seen in the background. Photo S. Ødum. June 1986.

provenances from the northern part of the natural distribution area do have better stem form than do these southern ones. Also, the northernmost provenances seem to have less damages from windthrowing, heavy snow ect. compared to the southern. On the other hand, these northernmost provenances to some extent show a decline in volume production.

Whether or not other species, e.g. the Sitka spruce, might show a better growth and higher yield under the Faroese conditions compared to the *Pinus contorta*, has not been investigated.

Although this article does not discuss the utilization of forest products, there should be no doubt about the value the yield recorded might represent to a farmers income, both in their own, and more interesting in combination with other traditional agricultural activities.

Acknowledgements

Being a professional forester and also born in the Faroe Islands it is natural for me to be interested in the progress and history of the afforestation trials on these islands.

Therefore I was grateful when the chairman of Skógfriðingarnevndin (the Faroese governmental afforestation committee), Andrias Højgaard, asked me to contribute with an article for the present report emphasizing the more strict forestry aspect of yield and production in a Faroese plantation.

I wish to thank my good friends Tóri í Hoyvík, who is the city gardener of Tórshavn, and Søren Ødum, the State dendrologist of Hørsholm Arboretum (Denmark), for the time they spent together with me during the field operation.

I am very grateful to Skógfriðingarnevndin who provided financial support. The field-work and subsequent processing of data were carried out during my employment at The Dep. of silviculture, The Agric. University of Norway.

Special thanks are due to professor Oddvar Haveraaen and associate professor Lars Helge Frivold at this department for encouragement and valuable criticism. Also thanks to other members of the staff who assisted me in this work.

Føroyskt úrtak

Upprunaliga vaksa eingi skógartrø í Føroyum. Síðan síðsta aldamótið hava smáar viðarlundir verið gróðursettar kring landið. *Pinus contorta* er eitt tað týdningarmesta slagið í viðarlundunum. Upprunin at hesum trøum er óivað fræ, ið er innsavnað á vesturstrondini á Norður-Amerika, í ríkinum Washington.

Tilfarið í hesum riti er savnað í viðarlundini á Selatrað. Hon er um hálvan annan hektara í vídd. *Pinus contorta* er týdningarmesta slagið í viðarlundini, síðani kemur slektin *Sorbus* sp. Øll tey livandi trøini vóru tvørmátað í bringuhædd, nøkur vóru hæddarmátað og bulurin tvørmátaður niðri við svørðin. Allar tær sjónligu klóturnar vóru somuleiðis tvørmátaðar.

Skógarfrøðilig tøl fyri vøkstur o.s.fr. eru útroknað. Úrslitini eru umrødd í mun til hóskandi skógarfrøðiligar bókmentir um hetta træslagið, har tað er nýtt til gróðurseting á økjum við Norður-Atlantshavið, og har vakstrarlíkindini eru átøk teimum føroysku. Somuleiðis er umrøtt, hvaðani besta fræið av hesum træ fæst til føroysk gróðrarlíkindi.

References

Aitken, S. 1982. Early performance of coastal and interior populations of *Pinus contorta* in North Trøndelag, Norway. Norwegian Forest Research Institute, Division of Forest Genetics and Tree Breeding. (Internal report). Ås. 24 pp.

Benedikz, T. 1982. Útdráttur úr skýrslu fyrir árið 1980. Ársrit Skógræktarfélags Íslands 1982: 82–86.

Bjarnason, H. 1978. Stafafura *Pinus contorta*, Dougl. Ársrit Skógræktarfélags Íslands 1977 og 1978: 16–18.

Brantseg, A. 1967. Furu sønnafjells. Kubering av stående skog. Funksjoner og tabeller. (Volume Functions and Tables for Scots Pine. South Norway.) Meddr norske Skogfors Ves. 22: 689–739.

Brekken, P. 1968. *Pinus contorta* på Vestlandet. (*Pinus contorta* in West-Norway). Tidsskrift for skogbruk 76: 275–295.

Børgesen, F. 1903. Lidt om Træernes Liv og Livsvilkår paa Færøerne. Tidsskrift for Skovvæsen 15: 94–107.

Dickens, C. H., Eden, P., Hogfors, S. & Persson, J. 1983. Wood Fuel. Domänverket och SSR, Stockholm. 75 pp.

Flensborg, C. E. 1903. Plantning paa Færøerne. Hedeselskabets Tidsskrift 23: 79–104.

Flensborg, C. E. 1914. Lidt om Plantningsforsøgene paa Færøerne. Hedeselskabets Tidsskrift: 222–232.

Flensborg, C. E. 1924. Om Plantningssagen paa Færøerne. Hedeselskabets Tidsskrift: 143–157.

Flensborg, C. E. 1947. Plantningsforsøgene paa Færøerne. Hedeselskabets Tidsskrift 68: 52–58 & 62–68.

Hamilton, G. J. 1975. Forest Mensuration Handbook. Forestry Commission Booklet No. 39. Her Majestys Stationery Office, London. 274 pp.

Hansen, K. 1966. Vascular Plants in the Faeroes. Horizontal and Vertical Distribution. Dansk Botanisk Arkiv 24 (3): 1–141.

Henderson, J. & Petty, J. A. 1972. A comparison of wood properties of coastal and interior provenances of Lodgepole pine *Pinus contorta* Dougl. ex Loud. Forestry 45: 49–57.

Jóhansen, J. 1985 a. Studies in the vegetational history of the Faroe and Shetland Islands. Annales Societatis Scientiarum Færoensis. Supplementum 11: 1–117.

Jóhansen, J. 1985 b. Plantufrøðiligar bókmentir Føroyum viðvíkjandi frá elstu tíðum til 1980. (A Faroese botanical bibliography from oldest times to 1980.) Fróðskaparrit 32: 51–98.

Koponen, S. 1985 a. Herbivorous insects on planted birch in the Faroe Islands. Notulae Entomologicae 65: 119–122.

Koponen, S. 1985 b. *Zeiraphera diniana* (Guenee) (Lep., Tortricidae) attacking *Pinus contorta* Douglas in plantations in the Faroe Islands. Fauna norv. Ser. B 32: 109–111.

Leivsson, T. G. 1985. Eksposisjonens betydning for dyrking av trær under værharde forhold. M.Sc. thesis in forestry, Department of Silviculture, Agricultural University of Norway. Ås. 54 pp.

Lines, R. 1966. Choosing the right provenance of Lodgepole pine (*Pinus contorta*). Scottish Forestry 20: 90–103.

Lines, R. & Booth, T. C. 1972. Investigation of basal sweep of Lodgepole and Shore pines in Great Britain. Forestry 45: 59–66.

Lysgaard, L. 1969. Foreløbig oversigt over klimaet på Færøerne. Det danske Meteorologiske Institut. Meddelelser nr. 20: 1–19.

Magnesen, S. 1977. *Pinus contorta* på Vestlandet. Pp 29–32 *in*: Dietrichson, J. (Ed.). Proceedings of the Norwegian Forest Research Institute conference on *Pinus contorta*. (Internal report). Ås. 58 pp.

O'Driscoll, J. 1980. The importance of Lodgepole pine in Irish forestry. Irish Forestry 37 (1): 7–22.

Skrøppa, T. 1982. Erfaringer med *Pinus contorta* i andre land. (Experiences with *Pinus contorta* in other countries). Sveriges Skogsvårdsforbunds Tidskrift – Specialnummer 1–2/82: 77–86.