21). Bailey. S.W.H.D.G.
7/4/97

THE ORIGIN OF SCOTS PINE IN SCOTLAND

Mike Phillips

As a generalisation, there is comparatively little variation in growth, form or survival between Scottish sources of Scots Pine (native or planted) irrespective of their Continental origin, following the post-glacial migration of the species from the continent into Scotland. However, quoting from Forrest (1982):

> "It is postulated that the Scottish north-western relicts were derived from middle or southern European sources and the south-western relicts primarily from Scandinavia, while the remaining bulk of the Scottish population shows similarities with middle European sources."

It is of considerable interest to note that:

> "The large differences to all other Scottish sources in the monoterpene biochemical analysis in the extreme north western relicts suggests that they may be of long standing undisturbed origin."

However, if we make direct comparisons between Scottish and Continental sources through provenance trials in Scotland we see very large differences in rates of growth, form and survival. This is not at all surprising when we consider the vast natural range of Scots Pine which runs from the Atlantic seaboard in the West, across Europe and Asia, to the vicinity of the Pacific Ocean in the East, and from beyond the Arctic Circle in Scandinavia to the Mediterranean.

It is postulated, therefore, that Scottish Scots Pine which constitute the westernmost sources of the natural range have become 'adapted' to the point where they now bear little resemblance to the Continental origin.

Further to this question of origin and the resultant diversity under Scottish conditions, it is of interest that about 1860 there were large imports of Scots Pine seed from the Continent due to the succession of unfavourable seasons which occasioned a great scarcity of Scots Pine in Scotland. According to Gregor (1868), the resultant plants were utterly worthless except in the most favourable situations, and though height growth was rapid the girth was less than our native species and the trees had a tall slender appearance even with ample space. Nursery growth and survival was poor and browning was much in evidence.

Matthews (1949) quotes from a meeting with Mr. Feaks, a forester at Darnaway, that the trees of German origin brought in to satisfy the huge demands of planting schedules were of rough, dark bark the whole way up the stem, and the timber was knotty and of poor quality. Stevens in 1920, compares the native Scots Pine to those generally found in England and Scotland and wrote "it is fairly certain that many of the latter have been grown from foreign seed of not too good a type". Murray in 1920 writes that the variation in Scots Pine, regarding variants, may be of great value under our conditions, while others are likely to be practically useless". Hobart Hampden in 1914 stressed the importance of using the most suitable provenance of Scots Pine and says "beyond doubt the results of using foreign seed have been disastrous". From the records available, it appears most probably that Continental Scots Pine seed came from the forests of Haguenau, in the Bass Rhin region (Pinus S. Haguenensis Louden) and from South Karlshuhe according to Gregor, Hutchison and Kienitz.

In more recent times, between 1920 and 1956, the Forestry Commission imported 223 lbs. of Scots Pine seed from 12 different countries, compared to 70,000 lbs. collected in Britain, of which 28,000 lbs. came from Thetford in Norfolk, the bulk of which, if not all, was collected from the famous "Breckland Hedges" and which has a similarity to Speyside in origin according to terpene analysis.

Both Gregor and Anderson commented that a factor in the influx of seed referred to may have been cost, as it was reported that Scots Pine seed was imported from the Continent at less than half the price of native seed at that time.

As regards the mixing of genes, once the flowering commenced there may have been an effect upon the genetic composition of native stock by gene flow into adjacent woodlands through pollen dispersal under favourable conditions.

We see then that the results indicated by the provenance trials strongly suggest that, due to the poor performance of Continental Scots Pine in Scotland, many, if not most plantings of the 1860 era, are likely to have failed completely, or have been slow grown (var. Scotica) evolved from the poor quality Continental Scots Pine exhibited in progeny trials gives food for thought.

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NATIVE TREE SEED -GENE POOLS

Mike Phillips. Forest Tree Seed Consultancy, Newton, Elgin

I am delighted to see two further adherents to the cause of good sound seed collections from native tree populations in articles by Jim Hamilton and Steve Roderick published in The Native Woodlands Discussion Group Newsletter No 16 (Points of View).

It is very encouraging to see that the FC in particular is giving a real lead to the seed procurement question and in more recent times recognising the importance of basic control and follow up recording.

In the very early days of seed importing and procurement there were very good records maintained by the FC (and here I refer mainly to the period from 1920 to about 1970), every seed lot being entered in a master register and given an identity number by year of collection or importation following it right through the nursery stage to the Final planting with an exact permanent reference kept as to its location by compartment, through the standing forest stock map. Unfortunately however in more recent times the old maps were superseded by new forest stock maps with changed compartment numbers and boundaries and the old maps which referred directly to the permanent records were 'lost' so that it is now often impossible to locate and identity provenances and origins planted.

Most of the early records refer of course to 'commercial' seed lots and only a comparatively small number of collections were from native sources.
I must hasten to add that the above comments are only made to stress and highlight the critical importance of good recording which enables "follow-up" in the long term and no new systems should be allowed to upset this procedure.

As both Jim Hamilton and Steve Roderick well illustrated, the cost factor is a problem in achieving wide base genetic population seed. It is, however, of the utmost importance that the problem is overcome by better techniques and funding.

We must recognise the importance and value of seed both in a commercial and an environmental and conservation sense. Much greater effort must be made in the processing and raising of seed and plants to achieve maximum yield. One of the ways to help ensure an acceptable return of plants on the costly collection outlay is to widen the population seed zone thereby widening the genetic base and overcoming the problem of small inbred populations with low seed yields. Extremely large differences in seed yield have been recorded within and between populations of a magnitude certainty of nil if not to infinity!

Great care would be required in deciding the limits of these wider population zones and in the absence of long term research on the subject, we must rely on individual knowledge and experience.

My suggestion is to create a gene pool of native tree seed within each locally defined zone with strict controls over seed collections by the authority (FC).

Gene pools would be added to on a long term basis as seed years, funding and physical collections dictated, but once established, seed could be sold back to the 'conservation market' if I might use such a term, thus funding the whole operation - at least to a degree. Perhaps I might suggest here that 'degree' might be weighed in favour of conservation rather than pure economics which would have the effect one would hope of attracting owners to join the scheme rather than incurring higher costs of their own collections.

Actual amounts of seed are likely to be small from individual populations, grams rather than kilograms but each lot would be 'certified' as to nativeness, origin, precise location, purity and acceptable number of individuals within pollination distance of one another.

Each seed area would be registered as acceptable to the authority and contained in a central register.
To simplify the procedure seed collectors or consultants would be appointed from the private sector by the authority to put forward seed collection areas on behalf of owners who would be paid a standard fee for each collection of seed. Appointed seed collectors would in turn be 'contracted' by the authority and advised as to specific collections required by the Highland Woodland Advisor in any one year.

An ideal would be to establish a seed extraction and storage facility in the north by state and private funding where the gene pool would be established. In the event of such a scheme being unacceptable then extraction and storage would require to be undertaken at Alice Holt.

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NATIVE PINE SEED YIELDS - SOME INTERESTING RESULTS

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During the period January to May 1991 I undertook seed collections from 8 native pinewoods observing the necessary Forestry Commission rules and guidelines.

At each pinewood collection a number of trees were sampled for the purposes of a seed cut test by taking one cone per sample tree with the number of trees sampled in any one native woodland ranging from 11 to 43. Seed was extracted from the cones under heat and all the seed cut to determine the number of sound full seed which in turn gave the number of full seed per cone.

The number of seed per cone from the 8 woodlands averaged 2.2 to 9.9 with a range of 0 to 33.
A rough guide as to the number of full seed per kg (not viable seeds) can be obtained which in the above examples ranged from 25,000 to 110,000.

A number of cones in each woodland sample failed to open with a maximum of 5 such cones in one case, these cones being counted as a nil yield in the calculations. The reason for the non opening of cones is not fully understood as far as I am aware and no research has been undertaken, however the physical opening of cones has been done and often reveals a few full seeds.
The yield of full seeds per cone from 22 native pinewoods in previous years showed a tendency to low yields with numbers of sound seeds per cone ranging from 1.2 to 13.3 with half the number of woodlands having yields of 5 seeds per cone or less.

There are certainly large differences between native pinewoods in this respect with the differences appearing to be largely constant though a great deal of research would be required to determine if there is any significance in this. Out of a total of 27 native pinewoods which were sampled for seed cut tests, 6 showed average yields of seed (from general data on seed yield) ie 110,000 seeds/kg so I think it would be wrong to suggest that all native pinewood exhibit low seed production. Many complex factors are likely to affect the amounts of seed produced from year to year quite apart from any variations which may be due to local origin.

A simple but detailed record of weather patterns in the locality of each native pinewood over a number of years during the period April to June including a seed cut test in January to April might be of value in determining if there is a correlation between weather and final seed yield and indeed if there are local origin effects. It is suggested that the FC and the SNH might be interested to carry out research to record and analyse the data.

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TECHNIQUES IN SEED COLLECTIONS FROM NATIVE PINEWOODS

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In order to satisfy Forestry Commission guidelines for native pinewoods, large numbers of trees across the entire woodland as defined by the Forestry Commission Register of Native Scots Pine Seed Collection Areas must be sampled for seed in order to achieve and capture a “reasonable” expression of the genetic diversity of any particular population.

This is part of the basic requirements in order to quality for the Native Pinewood Grant and all such seed collections are therefore monitored by the Forestry Commission.

There are no guidelines regarding the methods to be employed in seed collections and it is the aim of this brief article to discuss the ways and means and highlight some of the difficulties involved.

In a few instances young natural regeneration or planted native pine can be harvested for

seed by climbing but this is a comparatively rare situation and the majority of collections arc undertaken in the old native natural woodlands.

Climbing for seed in the old pinewoods can be very difficult and almost impossible but nevertheless it has been attempted. However, because of the limitations imposed of time, effort and expense the tendency having reached the crown of the selected tree is to collect a maximum yield of cones which in turn can lead to an imbalanced collection particularly if only a few trees are sampled.

Cone collections from branches within reach of the ground are rarely possible and in any event could be unproductive as there are indications that seed yields are likely to be low due to poor cross pollination with a high proportion of selfing, leading to inbreeding depression.

Selective felling for seed may be an option but only where it is compatible with woodland conservation and does not conflict with the accepted guidelines. It is probably only applicable to very large areas of native woodland where timber is an accepted part of management.

The method used by the author involves the use of high pruners to a workable height of 8 to 10 m, where between 1 to 3 small cone bearing branches with a maximum diameter of 3 to 4 cms are cut from each individual tree.

The use of a shotgun using LG cartridges may also be employed in many cases where cone crops are out of reach of pruners.

The system of branch removal has been criticised as damaging' but in the absence of acceptable alternative methods and providing there are strict limitations as to the number arid size of branch cutting per tree there would appear to be a minimal effect on old native pinewoods.

There are vary sound genetical and conservation reasons for collections of few cones from many trees not many cones from few trees, hence new branches.

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GENE CONSERVATION OF NATIVE WOODLANDS

M.TT. Phillips of Forest Tree Seed Consultoncy, Elgin. Moray, briefly discusses the establishment of gene books to assist in the conservation of our native woodlands.

Everywhere in Scotland native woodlands are under pressure from increasing deer populations, grazing of domestic animals, muir burning and, in the recent past, from commercial forestry. All conservation minded bodies are aware of this problem and the creation of the recent 'Highland Birchwoods' initiative is an expression of such concern.

Its aim is to persuade owners and tenants of woodlands to regenerate these for their own benefit and for the wider good of the tourist industry, wildlife conservation and landscape. Natural regeneration of woodlands is probably the best way to ensure their conservation but not all landowners will be persuaded to take action. Indeed, in the foreseeable future our native woodlands will, for the most part, remain under threat of extinction.

An alternative approach to the conservation of our native woodland genetic resources is to set up "gene banks" of either vegetative material or of seed. Seed storage techniques now offer long term storage over many years of most of our tree species. Such seed collections would ensure the conservation of a natural resource, they would provide valuable research material and of course would be the source of future regeneration work.

Seed collection and sampling methods
Preliminary surveys of woodlands would determine such things as reproductive capacity, species heterogeneity and ecological and topographical diversity.
On such factors would depend the methods and intensity of seed sampling. Tiny woodland remnants of very few trees would be sampled as a whole while larger woods would be systematically sampled for the main species and selectively sampled for rarer components. Since seed and fruit production is variable from year to year both from individual trees and throughout the crop, sampling may have to occur over more than one season. Each population gene pool would then be represented by a bulked seed sample for each species.

It is proposed that the Forestry Authority is the appropriate body to set up such a system of gene pool conservation in parallel with their efforts to encourage the spread of say native Scots pine. While this latter initiative is to be commended it does not ensure systematic conservation of diverse populations and largely ignores associated tree and shrub species. What of, for example, our western oak populations, the aspen remnants, highland rowan populations and so on - are they safe, under threat or on the way out? It is suggested that seed collection and storage by the Forestry Authority could be self financing when seed is sold back to private and public sector bodies in schemes such as those operated in North America by IUFRO.

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NAT1VE NATURAL PINE REMNANTS IN SCOTLAND

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A Case for Urgent Action

There are as we know a number of very small remnant native natural pine populations which require urgent attention if they are to be saved from extinction in the not too distant future. Four such populations
Are:-
a. Glen Loyne
This is a very isolated very scattered population with only 83 live trees spread out over 200 hectares and with no regeneration (apart that is of one seedling noted by G Tuley in 1993).

b. Glen Falloch

This area has 89 living and 38 dead trees scattered over 143 hectares noted and counted by A S McMullin in May
1989.

c. Glen Avon

The smallest population recorded with only 49 plants and only 20 of these are over 2 metres in height.

d. Coir a' Ghamhna

I have not seen this population which was discovered by SNH stall in recent times but understand that there are between 70 and 80 trees surviving on a steep rock face and in a very isolated situation. This is the only one of the four areas I have listed which was not mentioned by Steven and Carlisle (1959).

In such extreme cases as those quoted above (and there are undoubtedly more) it would seem prudent to look at new ways to solving the problem. One must accept that if such cases are indeed regarded as sufficiently important in a conservation sense then there must be the necessary will and follow-up of financial resources.
I would suggest that one option available (perhaps the only one) to ensure the continued genetic diversity of these very small remnants is by clonal means whereby shoots (scions) are collected from each tree, grafted and grown under polythene where advantage can be taken of very early flowering to freely cross pollinate each graft (ramet). The resultant mixed seed could then be used to grow the necessary plants for return to the source of origin.
A second option might be to raise grafts and plant a complete replication within pollination distance of each other and within or adjacent to the mother trees. Strictly speaking such a system would not accord to natural conservation as no wild population would ever contain two identical individuals. However this approach might find favour with those who look for instant "old trees" whereby using such a method the top of the tree is brought down to ground level. In other words one could have a 300 year old tree genetically and physiologically identical to the mother (ortet), except of course for rate of growth!

Cost would undoubtedly be a deciding factor for such options as grafts are very expensive to produce and maintain and little loss could be afforded as is likely on a difficult pine site even with special planting treatment. Clonal rootstocks might be used to advantage.

In considering the genetic value of and justification for saving these depleted remnants we can turn to the evidence provided by mono-terpene and isozyme loci, which when used as markers, showed that endemic populations are not genetically impoverished in spite of severe contraction in range and numbers as a result of both natural and anthropogenic causes. On the contrary variability in the relic populations is almost the highest of any plant species studied (Kinloch, Westfali and Forrest, 1986).

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