Points of view about Scots pine transfers in Sweden and Finland

Written by Dag Lindgren 090705 and distributed in this version as an email attachment. Edited 090708. Bengt Andersson suggested that I initially join the discussion and sent me notes from first meeting (June 11-12). This is a reaction (I sometimes overreact and am somewhat unpredictable, but you can interpret it as a reaction to the expressed interest of my comments) to give those most concerned something to think about. I may develop this document as a part of my input.

## The basic idea is a good one

It is very positive that Sweden and Finland discusses about joint areas of forest genetic materials to be better able to draw from each other’s resources. To modify “Planters guide” (Hannerz 2007, “Plantval”) so it works for both countries seem a good and realistic approach of large practical significance, and I am also sure much will be learnt in the process. However, I suggest it would be easier to reach an operational solution (a new Planters guide) with a narrower and more goal focused approach than the wide and open minded approach which now seems to be intended.

## Mature provenance experiments can contribute only limited information about “provenance” performance.

Provenance experiments contain typically “stand progenies” with seeds collected a single year from a limited number of mature trees in the same stand. At analyses they are exposed to regression analyses assuming a mainly continuous variation. The residuals from this explanatory model will be large. The number of trees sampled for seed collection themselves may be rather small, and sampled trees represented with different number of seeds and different fathers, thus the effective size of the sample give some uncertainty. The progenies are tested only on some sites and probably only a certain year. The plant production and plantation may not be random over lots, and field tests may not be representative for real forestry (e.g. fenced, weeded, planting in grids, accessibility is important, and dense spacing common), and interactions may contribute to error variation. The mother trees may not be representative. Natural selection in the creation of the particular stand under the particular circumstances it was collected may have made the mother trees different from “typical”. The particular pollination conditions (in particular wind) matters for a part of the fertilizing pollen, this pattern very different years and add to the uncertainty of the genetics of the seed source. Mating of relatives will reduce the performance of stand seeds to a different degree for different stand progenies. The conditions causing “after-effects” (to some degree reflected in field test results) are different years and for different stands. On an individual site the provenance is usually represented by a few plots with considerable variation between them, thus a large statistical error. Safe estimates of production for many provenances require unrealistic large trials. We know now that individual field tests are wildly different for discriminative power and genetic variation, thus the size of variation among provenances is subject to large error depending on the limited number of sites. I am sure that there is some variation among stands at different geographic levels, but this cannot be identified neither utilized as many more samples are needed to lineate possible good areas and the question can be asked how long time this kind of variations in nature remains. Some of these problems would be reduced if national provenance variation patterns were judged from the open-pollination tests of plus-trees, thus in my opinion this should be given a higher priority than old provenance trials.

Provenance trials are usually measured and evaluated at a much younger age than final harvest. To evaluate production in old field trials it needs to be evaluated what has been harvested at thinnings. Production is estimated from planted plants, but in a real forest non planted trees are of importance. New fresh evaluations based on new measurements can be informative, ranking can change, early survival becomes less important.

When transfer information gained from provenance trials is applied for seed orchard transfer further uncertainties appear. Inbreeding because of related parents is less than dealing with stand seeds, the influence of fathers of distant provenance larger, seed orchard seeds can be seen as provenance hybrids and mixed origins, while provenance trials have purer stand provenances as test lots. Naturals have a considerable influence for Scots pine plantations (Ackzell), the influence of that should be better evaluated.

Of course it is meaningful to think on transfers again, I do not mean it is meaningless. But it has to be remembered that the information the old provenance trials can give is uncertain and do not stand extraction of information of many explaining factors obtained by some sort of trial and error, and that detailed “black box” analyses (looking for hundred of site factors) may obscure the genuine large uncertainties. The reason for looking at many site factors is not so much to predict provenance performance as to clump together areas (indices) where the same material is suitable.

## The Eiche trials

After 1977 the responsibility of the Eiche series as well as provenance research was at the unit of Garpenberg (a part of a department localized to Garpenberg). 1995 Garpenberg and the departments where was closed down but partly the Uppsala department inherited the science (called “gene ecology”). SLU reorganized responsibility for field trials on a special unit (now headed by Christer Karlsson in Siljansfors). The series itself is well documented through arbetsrapporter by Sven Andersson and these have been used for a good documentation at the field unit. I guess it is more than two decades since last measurements and it may be difficult to get and interpret original data. I recommend getting the data which are available without delay to evaluate what is available before detailed discussion of what is desirable. The Eiche series has two spacing’s and is thus very suitable for studying early survival effect on production, which is one reason to measure it again. I have worked with the Eiche series once (e.g. Lindgren and Raymond 1987).

## Explaining variables

 Scots pine transfer research has been going on for a century in Finland and Sweden. The most important factors have been found to be latitude and (for site description in northern Sweden) altitude. That is logic. In Sweden we now call it light climate and heat sum, in Finland with its smaller elevational ranges, the focus on heat sum. Future work with Planters guide should assume that the main input (latitude and elevation of the planting site and latitude of the seed source) will remain the same and all other factors will have the character of adjustments. Rather than some sort of completely fresh runs.

I am rather doubtful to longitude as explaining factor, too confounded with other factors, not clean enough and not very variable. But consider adding transfer distance in kms (see local provenance below).

A list of “international climatic variables” which TREEBREEDEX enquired about is attached. I recommend a contact with Berthold Heinze about this.

## The climate at stations and at sites

The weather is followed at a number of meteorological stations. Trials and seed sources are not situated at stations and this must be handled. This can be done in different ways but is never safe; a considerable remainder will cause uncertainty in the relation to climate. It is done in TEMPPRED (below) and at calculating TSUM maps of heat sums in Sweden and Finland, but for new measures it has to be done again.

## The tempred program and “arbetsrapport 51”.

I have compiled temperature (based on monthly 30 year averages) for “all” Swedish and Finnish meteorological stations (e-g when a temp and tempsum was reached) (Lindgren 1994). I also made a program where temp and tempsum for an arbitrary point in Finland and Sweden can be read. The Tsums of TEMPPRED correlate 0.999 to those of Skogforsk but are easier and more flexible to work with. It seems excellent for the need of the current project as it is based on the same compatible data for Sweden and Finland and its existence and potential usefulness is the major reason for me to accept the offer from Bengt to join the discussion. It would be fine if some of you could familiarize with my TEMPPRED web to evaluate if working in this way can be better than collecting new fresh data for some of the temperature related information.

It is possible I can find the original code and continue to work with that (to get more output than currently and to react on customers (yours) comments), but when I would like someone else able to train to manage it (probably EXCEL visual basic) for expanded use when I jump off and I would require that I thought it would be used to try this direction, which probably is difficult to convince me. As I remember, it was rather easy to work with.

## “Continentality”

The Oceans smoothens out the annual temperature variation. The difference between the hottest (usually July) and coldest (usually January) will be smaller close to the Oceans because of the Oceanic influence (that does not mean that the difference between these extreme temperatures is a good measure on continentality as latitude is more important than Oceans for the size of this measure). Another effect is a delay of the peak in summer temperature. The current comparison is limited to Sweden and Finland, the influence in climate variations caused by variable distance to the Oceans is limited. Even the Baltic and smaller lakes has a similar but more local influence. They are –opposite to Oceans - frozen in winter and as they heat up more in the summer and thus cool less and the temperature drops faster in autumn. The effects are more focused on the start and stop of the vegetation period which are more important parts of the trees lifecycle than the midwinter temperature when trees are dormant, and the variation in the measure will be larger within Sweden Finland than the relation with Oceans. I have suggested “close to coast” as a contra-indication for seed collection,
[http://daglindgren.upsc.se/Frotakt/Utredning.htm](http://www-genfys.slu.se/staff/dagl/Frotakt/Utredning.htm)
 this is a reason to include continentality for seed source, but rather in the form which is more sensitive to smaller waters that I suggest. Thus I suggest using the delay in peak summer temperature as a relevant measure for a plantation site and seeding source (as given for Swedish and Finnish stations in arbetsrapport 51).

## Tsum

Tsums are slightly different defined and the numeric values will be different. It is essential to make them compatible by calculating translations functions. It is usually linear translations and after that the correlations will be high for the Tsums calculated in different ways. Tsum should refer to a period and 61-90 is the logic base.

## Local provenance

Local is best and has fine-tuned to the site for millions of years (at least it feels so emotionally) or at least centuries and this is a general opinion both among many scientists and foresters. On the other hand field experiments say what is best for plantation. The field tests are not very reliable and accurate, therefore I suggest that transfers will be mainly based on field test experience, but will still include (weight in with a limited weight) an element of avoiding long transfers.

## Future expansion of “Planters guide”

Sweden and Finland together are dominatingly large for cultivated Scots pine on Northern Europe, the interest for adjusting and implementing the tool in all neighbors will be strong (Western Russia, Estonia, Latvia, Lithuania, Denmark and Norway). To make it compatible it is important that it does not rely on functions which may stray away when outside the Swedish-Finnish borders (e.g. non-linear longitude dependence may easily go amok). It is recommended testing that applied functions are reasonable near outside the borders.

I have during the last years pointed at some problems with Planter’s guide; I am uncertain how to canalize them. Should I write them here to expose the responsible to them?

## Global Warming

The most urgent need of a modification of Planters guide as I see it to be able to input plantation year and construct functions which consider global warming for that year, thus mainly dynamic instead of static heat sums.

## Reprints and sites

I made a general site “tree breeding tools”. [http://daglindgren.upsc.se/Breed\_Home\_Page/](http://www-genfys.slu.se/staff/dagl/Breed_Home_Page/) My intention is that this site will remain and be actively managed by me some years ahead, but one day it is probably suddenly lost.

 Within that site there are two sites for describing sites. The two most important characteristics are heat sum (“temppred”)

[http://daglindgren.upsc.se/Breed\_Home\_Page/Temperature/TEMPPRED\_Menu.htm](http://www-genfys.slu.se/staff/dagl/Breed_Home_Page/Temperature/TEMPPRED_Menu.htm)

 and DagL (Day Length)

[http://daglindgren.upsc.se/Breed\_Home\_Page/DagL/DAGL\_MENU.htm](http://www-genfys.slu.se/staff/dagl/Breed_Home_Page/DagL/DAGL_MENU.htm)

I also have had a lecture in Hann-Munde where I made a home-page which give links relevant to “Planters Guide”

[http://daglindgren.upsc.se/TREEBREEDEX/HannMunde\_MadridMeeting.htm](http://www-genfys.slu.se/staff/dagl/TREEBREEDEX/HannMunde_MadridMeeting.htm)

**Sending you reprints from me:**

A sad thing: I have started to throw away my old reprints. “Arbetsrapporter” from our department are not likely to be available at all much longer (a pity, my intention was that they should be available forever but forest science has changed and forever in our department now is much shorter than the life time of trees). However, I send the receivers of these documents (Seppo, Matti, Bengt, Torgny, Mats B and Tore) a set of the following reprints before throwing away the rest.

Lindgren D & Raymond A C 1987. Förflyttning av tallprovenienser i Sverige. Inst för skoglig genetik och växtfysiologi. SLU. Arbetsrapport 18. (Arbetsrapport 22)

Raymond, A C & Lindgren D 1986. A model for genetic flexibility. Dept of Forest Genetics and Plant Physiology. Swedish University of Agricultural Sciences. Report 6:159-178. I thought I had reprints and I thought we had also a whole symposium which contains more information Lindgren D (editor) 1986. Provenances and forest tree breeding for high latitudes. Dept of Forest Genetics and Plant Physiology. Report 6. (SLU library should have it). But I was wrong, few copies (I do not live at a department which is very keen on preserving the link to the past and old information). But it resulted in a scientific paper: Raymond A C & Lindgren D 1990. Genetic flexibility. A model for determining the range of suitable environments for a seed source. Silvae Genetica 39:112-120, which is retrievable by the library system. I had only five copies. I distribute these five copies and one Copy of the Kempesymposium.

Note that these two studies demonstrate the uncertainty of the data points (performance of a provenance at a site) in the Eiche trial!

Lindgren D. 1994. When do temperature events take place in Sweden and Finland? Swedish University of Agricultural Sciences. Department of Forest Genetics and Plant Physiology. Progress Report 51:1-38. (A bad copy is on my web). Even here I thought I had a number of copies but they were very few.

The latest publication following up the ideas about width and flexibility of transfers and regeneration materials with focus on Scots pine in Sweden I started to develop with Carolyn is
Lindgren D & Ying CC 2000. A model integrating seed source adaptation and seed use. New Forest 20: (1) 87-104. But this I guess is easy to retrieve from the library system should you wish so.

Also about temperature and their annual variations in northern Sweden:

Lindgren D, Lindgren K, Odin H & Eriksson B 1989. Temperaturen under vegetationsperioden i norra Sveriges skogsland 1933-1988. Institutionen för skoglig genetik och växtfysiologi, Sveriges Lantbruksuniversitet. Arbetsrapport 30.

Well what we learn by this is that it is an easier world in the future when things are saved by .pdf for ever on many places. I give priority to Mats first when getting complete packages as he seems the spider of analyses.

Attachment (bioclimatic variables focused attention on for international work):

**7. Do you usually work with the following variables from Worldclim/Bioclim? YES/NO**

|  |  |  |
| --- | --- | --- |
|  | YES | NO |
| average monthly mean temperature |  |  |
| average monthly minimum temperature |  |  |
| average monthly maximum temperature |  |  |
| average monthly precipitation |  |  |

**Bioclimatic variables derived from the previous ones (please see** [**http://www.worldclim.org/bioclim.htm**](http://www.worldclim.org/bioclim.htm) **for any details if necessary)**

|  |  |  |
| --- | --- | --- |
|  | YES | NO |
| BIO1 = Annual Mean Temperature |  |  |
| BIO2 = Mean Diurnal Range (Mean of monthly (max temp - min temp)) |  |  |
| BIO3 = Isothermality (P2/P7) (\* 100) |  |  |
| BIO4 = Temperature Seasonality (standard deviation \*100) |  |  |
| BIO5 = Max Temperature of Warmest Month |  |  |
| BIO6 = Min Temperature of Coldest Month |  |  |
| BIO7 = Temperature Annual Range (P5-P6) |  |  |
| BIO8 = Mean Temperature of Wettest Quarter  |  |  |
| BIO9 = Mean Temperature of Driest Quarter |  |  |
| BIO10 = Mean Temperature of Warmest Quarter |  |  |
| BIO11 = Mean Temperature of Coldest Quarter |  |  |
| BIO12 = Annual Precipitation |  |  |
| BIO13 = Precipitation of Wettest Month |  |  |
| BIO14 = Precipitation of Driest Month |  |  |
| BIO15 = Precipitation Seasonality (Coefficient of Variation) |  |  |
| BIO16 = Precipitation of Wettest Quarter |  |  |
| BIO17 = Precipitation of Driest Quarter |  |  |
| BIO18 = Precipitation of Warmest Quarter |  |  |
| BIO19 = Precipitation of Coldest Quarter |  |  |
| any other derived variables or indices (please specify) |  |  |