

## **7 Phenology and Performance of Mountain Birch Provenances in Transplant Gardens: Latitudinal, Altitudinal and Oceanicity--Continentality Gradients**

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### Description of the transplantation sites

#### *Melbu transplant garden (68°31 N, 14°43 E)*

The Melbu site is the most western and oceanic of the transplant garden sites. It is about 10 m above sea level (a.s.l.) and close to the seashore, but sheltered from the strongest westerly winds by a low hill ridge in the west. It is mostly rather wet and boggy and is an open site with just a few small scrubs of mountain birch. Melbu site is characterized by a very maritime climate with moderate summer temperatures (mean temperature 12 °C in July) and mild winters (mean temperature --1.5 °C in January), and a moderate yearly precipitation (about 1100 mm), most of it in the fall. Due to the strong winds and the immediate vicinity of the seashore, the area is exposed to salt precipitation. The snow cover is mostly sparse. The Melbu garden was established in 1992.

#### *Kilpisjärvi transplant garden (69°04 N, 20°46 E)*

The Kilpisjärvi site is about 130 km from the nearest coast. It is about 510 m a.s.l. and, hence, the highest of the transplant garden sites. It is situated in a mountain birch forest just below the tree line. It is characterized by a continental climate with moderate summer temperatures, a very short growing season, a harsh winter climate and a very low yearly precipitation (about 400 mm). The Kilpisjärvi garden was established in 1992.

#### *Pallasjärvi transplant garden (68°10 N, 24°E)*

The Pallasjärvi site is about 280 km from the nearest coast and, hence, the most continental site among the transplant garden sites. It is characterized by a continental climate with relatively warm summer temperatures, a low yearly precipitation, a short growing season, and a cold and stable winter. The Pallasjärvi garden was established in 1988.

#### *Kevo transplant gardens*

There are two transplant gardens near the Kevo Subarctic Research Station (69°45'N, 27°00'E) in Utsjoki: transplant garden 1 (lower garden) is situated at Utsjoki valley (about 100 m a.s.l.) and transplant garden 2 (higher garden) at the altitudinal birch forest line (about 280 m a.s.l.).

The summer temperatures are about 1--2 °C lower in the higher garden than in the lower garden. In addition to the difference in the altitudinal location, the gardens differ markedly in their soil fertility and moisture conditions. The lower garden is characterized by sandy and nutrient-poor soil, which is often also very dry, while the higher garden is characterized by nutrient-rich and moist soil. The dominant ground vegetation in the lower garden is composed of *Vaccinium vitis-idaea* and *Empetrum nigrum* ssp. *hermaphroditum*, while that in the higher garden is composed of *Vaccinium myrtillus* and *Cornus suecica*. The Kevo transplant gardens were established in 1974.

## Birch Material

The age of the birches used in the study varied among the transplant gardens. In the Kevo gardens the seeds were germinated in 1974 and the saplings were planted in 1977, while the material for the Melbu, Kilpisjärvi and Pallasjärvi gardens was germinated in 1991 and planted in 1992. The mother trees for the Kevo gardens came from different latitudes and altitudes in northern Finland (Table 7A), and the plants in the other transplant gardens originated from southern and northern Norway, northern Sweden and Finland, Iceland and Greenland.

Table 7A

Code of mother tree	Location of mother tree	Altitude (m a.s.l.)	Finnish coordinate system	Symbols used in Figs. 7.3, 7.5 and 7.7	Coordinates of the latitudinal subgroups
29	Rovaniemi, Napapiiri	155	73840 4485	□	66 30'--67
42	Kolari, Teuravuoma	150	74685 3610	△	67 15'--67 45'
43	Kolari, Ylläs	520	75014 3813	▲	
3/1	Kittilä, Pokka	305	75611 4434	◇	68 --68 30'
44	Sodankylä, Vuotso	275	75501 5019	◇	
67	Sodankylä, Kiilopää	410	75844 5198	◆	
67/1	Sodankylä, Kiilopää	400	75844 5198	◆	
64/1	Utsjoki, Kevo	85	77419 5004	○	69 30'--70
64/2	Utsjoki, Kevo	85	77419 5004	○	
040	Utsjoki, Kevo	95	77419 5004	○	
043	Utsjoki, Kevo	95	77419 5004	○	
045	Utsjoki, Kevo	85	77420 5005	○	
047	Utsjoki, Kevo	85	77420 5005	○	
049	Utsjoki, Kevo	85	77420 5005	○	
45	Utsjoki, Kevo	80	77420 5006	○	
M2	Utsjoki, Paddaskaidi	325	77619 4855	●	
M5	Utsjoki, Paddaskaidi	365	77592 4856	●	

## Phenology monitoring and growth measurements

Differences between the provenances at the five transplant gardens were recorded for plant survival, time of leafing (bud burst), foliage senescence (autumnal coloration) and leaf fall. Total height and base diameter measurements of the study trees are measured annually, but only data for certain years are given here.

## Melbu, Kilpisjärvi and Pallasjärvi gardens

Survival of the seedlings of each provenance was determined in 1994. The date of bud burst was monitored for each individual tree and the mean date was calculated for each provenance. Determination of autumnal coloration and fall of leaves was made on 10 September using the following scale: 0, all leaves green; 1, first signs of yellowing; 2, less than 25% of the leaves yellow; 3, 26--50% of the leaves yellow; 4, 51--75% of the leaves yellow; 5, 76--99% of the

## Supplementary material for Chapter 7

leaves yellow; 6, all leaves yellow; 7, <50% of the leaves fallen; 8, 51--75% of the leaves fallen; 9, 76--99% of the leaves fallen; 10, all leaves fallen.

### Kevo transplant gardens

The stage of leaf development for each tree was determined according to Holmgren and Tenow (unpubl.) at three different dates at the onset of the growing season. In mid-September, the phase of leaf senescence was determined by visually estimating the changes in foliage coloration. The following coloration scale was used: 0, leaves totally or nearly totally green (no marked chlorophyll disruption); 25%, leaves yellow--green (some chlorophyll disruption); 50%, leaves light-green (chlorophyll disruption clearly discernible); 75%, leaves slightly greenish (most of chlorophyll disrupted); 100, leaves totally or nearly totally yellow. Simultaneously with the determination of the changes in foliage coloration, the number of abscised leaves was estimated using the following scale: 0, no or few leaves abscised; 25%, some leaves abscised; 50%, about half of the leaves abscised; 75%, most leaves abscised; 100% all or nearly all leaves abscised. Based on the estimations of changes in foliage coloration and the number of abscised leaves, a foliage senescence index was calculated as follows: foliage senescence index = (yellowing-%/100)×(100-abscission-%) + abscission-%. The senescence index is thus a relative measure of chlorophyll disrupted (0--100%) in foliage on the observation date.