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Forest Condition Monitoring in Finland – National report

Photo: Jouni Hyvärinen

Intensive and continuous monitoring of forest ecosystems – Level II in Finland

By Päivi Merilä, Liisa Ukonmaanaho, Pekka Nöjd & Egbert Beuker

Current intensive monitoring plot network (2011–)

Since 2011, the number of intensive monitoring plots has been 14. The plots are located in Norway spruce (n = 7) and Scots pine (n = 7) forests in various parts of Finland (Fig. 2a, Table 1, pdf). Most observation plots are located in stands under conventional forest management. Two of the plots (Evo nr. 19, Lieksa nr. 20) also belong to the ICP Integrated Monitoring Programme, representing natural stands in catchment areas. A number of the plots are located close to background, air quality monitoring stations run by the Finnish Meteorological Institute.

Forest ecosystems are diversely monitored on these plots, with the aim of cause-effect analysis. Deposition of air pollutants, the cycles and leaching flux of nutrients, defoliation, abiotic and biotic damage, growth, nutrient status and understorey vegetation are among the attributes monitored (Table 2, pdf). Meteorological measurements are conducted in cooperation with the Finnish Meteorological Institute (Table 3, pdf).

The basic stand characteristics of ICP Level II plots are presented in Table 4, pdf.

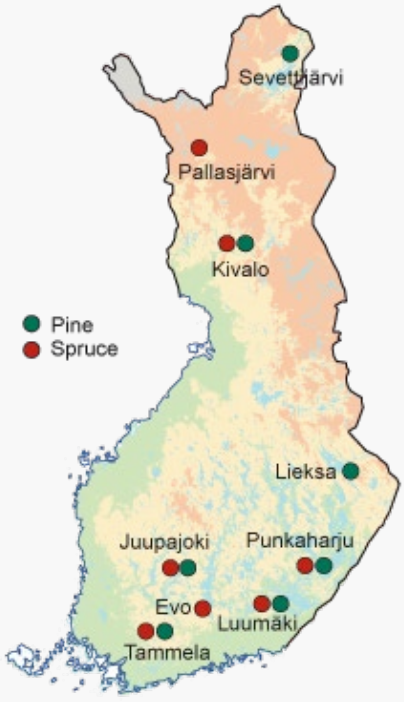

Figure 2a.The intensive forest monitoring plot network of forest ecosystems (ICP Forests Level II) in Finland in 2011–.

Earlier intensive monitoring plot networks (1997–2010)

Finland joined the intensive monitoring of forest ecosystems in 1995. By 1997, 31 intensive monitoring plots had been established in different parts of the country (Fig. 2b, Table 1, pdf): 27 of the plots on mineral soil sites and 4 on peatlands. Seventeen of the plots were located in Scots pine stands and 14 in Norway spruce stands. All the plots, except for the four Integrated Monitoring (ICP-IM) plots, were located in stands under conventional forest management. The IM plots represent natural stands in catchment areas. In 2005, two Norway spruce plots (nrs. 24 and 28) were replaced by two Silver birch plots (nrs. 32 and 33).

In the period 1995–1997, meteorological stations were installed at 12 Level II plots. The parameters measured were:

- Air temperature and humidity (within and above the canopy)
- Precipitation
- Wind speed and direction
- Total radiation and PAR radiation
- Soil temperature and moisture

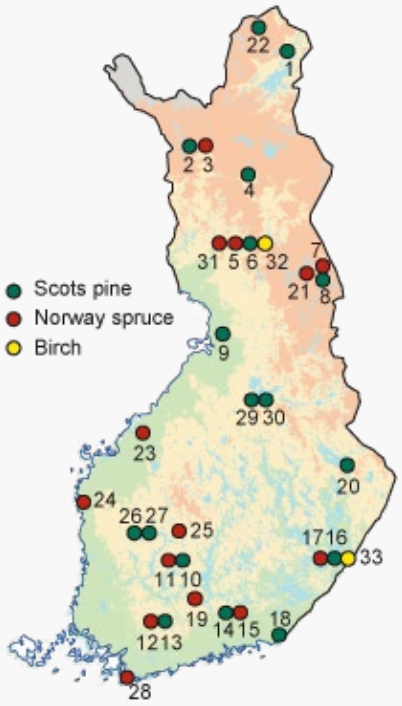

Figure 2b. Intensive forest monitoring network 1997–2008. For information on plotwise active periods see Table 1, pdf.

At the locations Kivalo, Punkaharju, Tammela and Pallasjärvi two or three Level II plots for different tree species were situated close to each other. For these locations, the data from the meteorological stations at one of the plots were used for all plots at that particular location. After the Närpiö plot was closed, the meteorological station was moved to the birch plot in Kivalo. In 2010 and 2011, the meteorological stations were run down and meteorological data for all remaining Level II plots will be obtained from nearby stations of the Finnish Meteorological Institute.

Four of the intensive monitoring plots were established on drained peatland (nrs. 26, 27, 29, 30; active in 1997–2007). The sites were originally wet, sparsely stocked pine mires that represented the most typical drained peatland site types in Finland. The peat in these site types has a low mineral nutrient status, but usually relatively high nitrogen reserves. As this may result in an unbalanced nutrient status in the tree stand, two of the four plots have been fertilized. The four plots were located at two locations in Finland, with a pair of unfertilized and fertilized plots at each location. Three of the plots were established in long-term spruce provenience trials (nrs. 25, 28, 31).

In 2009, in the beginning of EU Life+ funded FutMon project the number of intensive monitoring plots was reduced to 18 plots in order to carry out a similar intensity of monitoring on all the plots (Fig. 2c, Table 1, pdf). Since 2011 the number of intensive monitoring plots has been 14 (Fig. 2a, Table 1, pdf).

The design of the observation plot and location of the sub-plots

The observation plots proper consist of three sub-plots and a surrounding mantle (sub-plot 4) (Fig. 3, below). The sub-plots are square in shape (30 x 30 m). A 5–10 m wide strip has been left between the sub-plots for possible future use in special studies and for additional sampling. Sampling methods that may have a detrimental, long-term effect on the soil or stand, e.g. soil sampling, deposition and soil water collection, needle and litter sampling etc., are concentrated on one sub-plot. One of the other two sub-plots is reserved for vegetation studies, and the other for tree growth measurements.

The centre point of the observation plot, the corners of the sub-plots and

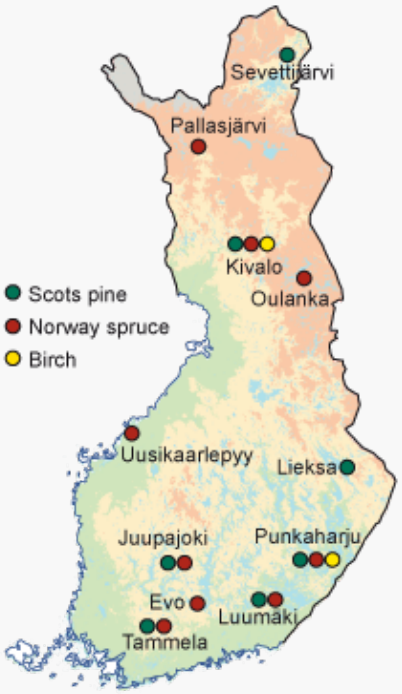

Figure 2c. The intensive forest monitoring network of forest ecosystems in Finland in 2009–2010 (ICP Forests/EU Life+ FutMon).

the outer edge of the mantle area have been marked with wooden posts. The mantle is surrounded by a buffer zone. The width of the mantle and buffer zones varies from 10–30 m.

Basic stand measurements and mapping

All the trees on the observation plot have been numbered at a height of 1.3 m on the side of the tree facing the centre point.

The following parameters have been recorded or measured on each tree: tree species, canopy layer, diameter at 1.3 m, tree height, and length of the living crown. The measurements have been performed on the trees on sub-plots 1–3 and those located in the mantle area (sub-plot 4). Twenty additional trees representing different diameter classes have been selected and numbered on the buffer zone (sub-plot 5). In addition to the above measurements, bark thickness has been measured and increment cores taken at 1.3 m height for determining earlier growth and tree age. The forest site type has also been determined.

The location and elevation of all the trees on the observation plots have been mapped using a tachymeter. The exposition and gradient of each sub-plot have also been determined. Care has been taken during the fieldwork to avoid causing unnecessary trampling of the ground vegetation or other forms of damage. Wooden walkways have been laid on the sub-plot used for collecting deposition and soil water.

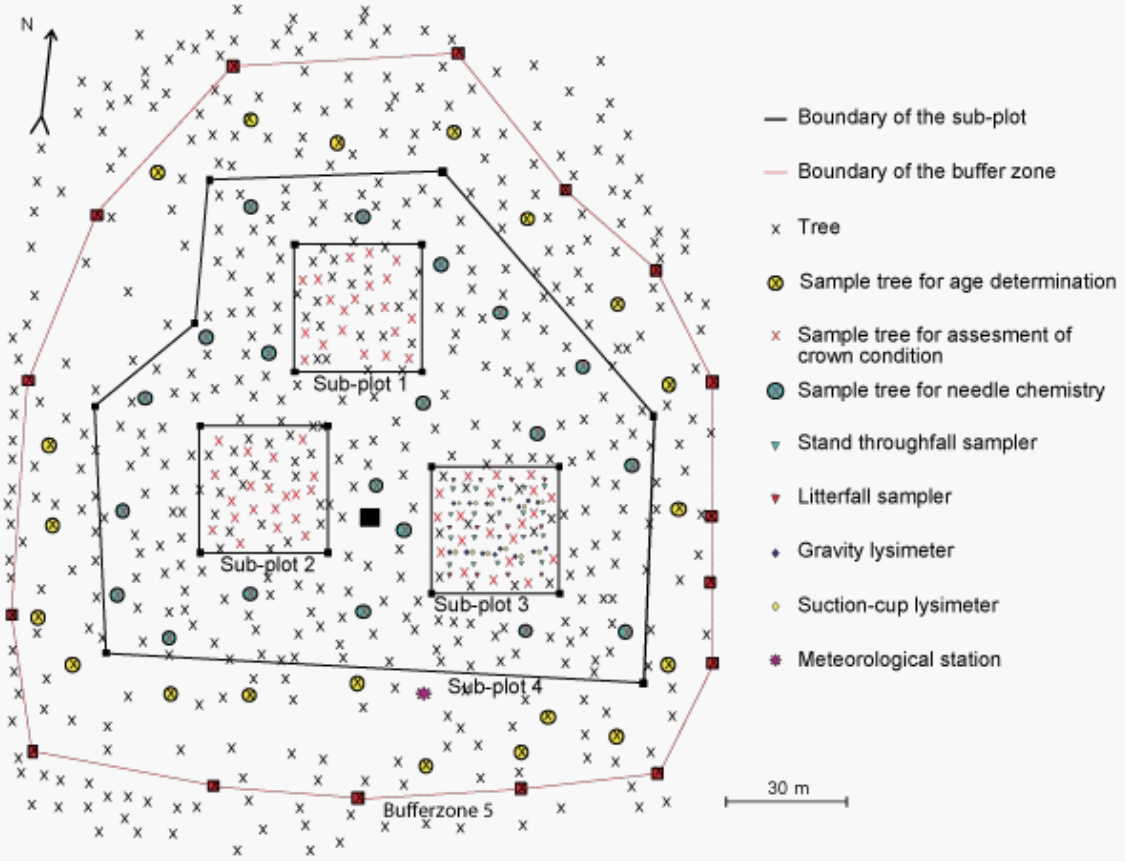

Figure 3. The Finnish design of the intensive monitoring plots (ICP Forests Level II) and location of the sub-plots.

References

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Table 1. Overview of the intensive monitoring network of forest ecosystems in Finland. The plots under active monitoring are in bold.

Plot number	Plot name	Tree species	Established	Terminated	Active 2011–
1	**Sevettijärvi**	**Scots pine**	**1995**		**X**
2	Pallasjärvi	Scots pine	1995	2008	
3	**Pallasjärvi**	**Norway spruce**	**1995**		**X**
4	Sodankylä	Scots pine	1995	2007	
5	**Kivalo**	**Norway spruce**	**1995**		**X**
6	**Kivalo**	**Scots pine**	**1995**		**X**
7	Oulanka	Norway spruce	1995	2007	
8	Oulanka	Scots pine	1995	2007	
9	Ylikiiminki	Scots pine	1995	2007	
10	**Juupajoki**	**Scots pine**	**1995**		**X**
11	**Juupajoki**	**Norway spruce**	**1995**		**X**
12	**Tammela**	**Norway spruce**	**1995**		**X**
13	**Tammela**	**Scots pine**	**1995**		**X**
14	Lapinjärvi	Scots pine	1995	2007	
15	Lapinjärvi	Norway spruce	1995	2007	
16	**Punkaharju**	**Scots pine**	**1995**		**X**
17	**Punkaharju**	**Norway spruce**	**1995**		**X**
18	Miehikkälä	Scots pine	1995	2007	
19	**Evo**	**Norway spruce**	**1999**		**X**
20	**Lieksa**	**Scots pine**	**1999**		**X**
21	Oulanka	Norway spruce	1999	2010	
22	Kevo	Scots pine	1999	2007	
23	Uusikaarlepyy	Norway spruce	1996	2010	
24	Närpiö	Norway spruce	1996	2004	
25	Vilppula	Norway spruce	1997	2007	
26	Ikaalinen	Scots pine	1997	2007	
27	Ikaalinen	Scots pine	1997	2007	
28	Solböle	Norway spruce	1997	2004	
29	Pyhäntä	Scots pine	1997	2007	
30	Pyhäntä	Scots pine	1997	2007	
31	Kivalo	Norway spruce	1998	2007	
32	Kivalo	Silver birch	2005	2010	
33	Punkaharju	Silver birch	2005	2010	
34	**Luumäki**	**Scots pine**	**2009**		**X**
35	**Luumäki**	**Norway spruce**	**2009**		**X**

Table 2. Monitoring activities on the Level II plots network in Finland.

Survey	Number of plots				Frequency
	2013–	2011–	2009–2010	1997–2008	
Deposition	12	14	18	12–17	Continuous
Soil Solution	12	14	18	12–16	Continuous (snow-free period only)
Litterfall	12	14	18	12–17	Continuous
Meteorology	12	12	16	10–12	Continuous
Tree increment (girth bands)	12	14	18		Continuous
Phenology	2	6	8	2–8	Spring and autumn
Tree condition	14	14	18	31	Annual
Foliar chemistry	14	14	18	31	Every two years
Tree growth	14	14	18	31	Every 5 years
Ground vegetation	14	14	18	31	Every 5 years
Soil condition	14	14	18	31	Every 10 years

Table 3. Climatological parameters for the locations of the Level II plots. Values are 30 year mean values for the period 1981–2010 (Venäläinen et al. 2005).

Plot nrs.	Location	Annual mean temperature sum dd	Annual precipitation mm	Annual total radiation MJ m^{-2}
1	Sevettijärvi	658	379	2497
3	Pallasjärvi	708	484	2672
21	Oulanka	836	501	2938
5, 6, 32	Kivalo	920	513	2911
20	Lieksa	1116	595	3187
23	Uusikaarlepyy	1158	475	3199
10, 11	Juupajoki	1173	625	3234
19	Evo	1247	581	3336
12, 13	Tammela	1313	601	3351
16, 17, 33	Punkaharju	1348	528	3279
34, 35	Luumäki	1395	566	3476

Table 4. The basic stand characteristics of ICP Level II plots (measured during 2009–2010).

Plot nr.	Name	Main species	Stems ha^{-1}	Stem volume $m^3\ ha^{-1}$	Basal area $m^2\ ha^{-1}$	Arithmetic mean height m	Mean diameter cm weighted with basal area	Thinning year during 1995-2010	Stand age	Cajanderian forest type*
1	Sevettijärvi	Pine	350	82	14	11	28		210	UVET
3	Pallasjärvi	Spruce	1107	82	15	10	16		150	HMT
5	Kivalo	Spruce	1648	153	25	11	16	2006	80	HMT
6	Kivalo	Pine	1748	197	27	14	15	2008	65	EMT
10	Juupajoki	Pine	378	240	22	23	28		90	VT
11	Juupajoki	Spruce	852	419	38	21	26	2006	90	OMT
12	Tammela	Spruce	663	360	33	22	26		70	MT
13	Tammela	Pine	619	306	29	22	25		70	VT
16	Punkaharju	Pine	741	362	32	24	24	2005	90	VT
17	Punkaharju	Spruce	370	435	34	28	35	**2010	80	OMT
19	Evo	Spruce	1258	711	58	20	32		180	OMT
20	Lieksa	Pine	371	260	25	21	33		140	EVT
21	Oulanka	Spruce	1197	145	21	9	24		180	HMT
23	Uusikaarlepyy	Spruce	848	443	39	23	26	2006	65	OMT
32	Kivalo	Birch	867	130	18	15	18		55	HMT
33	Punkaharju	Birch	1037	169	18	19	16		25	OMT
34	Luumäki	Pine	625	103	14	14	19		60	CT
35	Luumäki	Spruce	678	284	28	19	27		75	MT

*Cajander, A.K. 1949.
**only dead trees removed