

Timing of plant phenophases since 1752 in the boreal forest environment

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Global warming and climate change will significantly affect on forest environment in northern latitudes. There is the strong evidence that increase of early spring and late autumn temperatures will have impacts on growth and growth cycles. In Finland the Finnish Forest Research Institute (Luke since 2015) established in 1996 National Phenological Network to study changes of phenophases all over the country representing southern, middle and northern boreal forest zones. Continuous detailed scientific monitoring includes eleven forest plant species and it forms an excellent basis to evaluate responses of forest vegetation in respect to climate change. Monitoring is done together with Universities and other Institutes.

Prior to the establishment of the Finnish National Phenological Network observations has been made solely based on volunteers since 1752. This citizen-science data is very important to analyze phenophases together with the results of the National Network. The long-term data since 1752 shows e.g. an advancement in the onset of *Prunus padus* flowering by five days per 100 years and correspondingly three days in the rowan (*Sorbus aucuparia*). The latest results of the Finnish National Network (1996 – 2014) fits well to this long term trend.

In the Finnish National Phenological Network we have monitored phenophases of forest species throughout the growth period, focusing on nine forest tree species and two dwarf shrubs. The results can be followed in real time at: <http://www.metla.fi/metinfo/fenologia/index-en.htm>. We have observed big differences in phenophases between southern and northern boreal zone. Onset of downy birch leafing happens one month later in the north compared with southern boreal zone. Coming into leaf has clearly occurred earlier during the research period since 1996 in the northern boreal zone compared with southern boreal zone. This indicates the response of climate change. The timing of leaf colouring and leaf fall was observed remained almost constant in the southern boreal zone. Effective temperature sum is important for the timing of the bud burst.

The timing of phenological phenomena of forest vegetation, berry and seed crops reflects information about the response of the forest environment to the changes in the environmental factors. The global warming will be at its most powerful in the northern latitudes and this phenomenon is predicted to become increasingly more powerful in the future. Study of the regional differences will yield information about the changes in the northern limits of distribution of different plant species, and these changes can significantly affect the quantitative proportions of plant species. These changes, in turn, have an indirect impact on the entire ecosystem and the sources of livelihood relying on it. Phenological monitoring is nowadays more important than ever especially in boreal regions, where spring temperatures are elevated. Compilation and documentation of observations on plant phenophases play a key role in working out the rate of global climate change. To utilize citizen-science data together with the scientific monitoring will be discussed in the conference.