

# Are Trees Invading The Arctic?

Circumpolar treeline research by the IPY core project PPS Arctic



*Fieldwork in*

*Northern Norway: recording and mapping stand density, tree recruitment and age structure of Scots pine stand close to treeline. Photo: A. Hofgaard*

## **Are trees invading the Arctic?**

**The 'expected' answer to this question is 'Yes': but is this really true?**

The expectation is based on some rather simple models that relate the position of the treeline to the local climate. In its simplest form, the idea is that it is too cold for trees to exist north of the present-day treeline, so a warming climate ought to produce a northward advance of the trees. However, nature responds in a complex manner to changing climate or other environmental changes – where temperature, precipitation, snow distribution, wind, soil conditions, tundra and forest fires, insect outbreaks, browsing, thawing permafrost and land use all interact – and the existing models are almost certainly too simplistic. Until now, there has also been very little hard evidence for an advance of the treeline. The few studies that have been carried out represent a very small fraction of the huge area covered by the transition zone between the boreal forest and the tundra.



*Fieldwork in*

*Northern Norway: recording and mapping conifer recruitment in the treeline zone. Photo: A. Hofgaard*

**Project Rationale:**

Expansion of tree distribution into the current arctic tundra will have –

- ecological consequences through e.g. changes in species distribution and abundance
- socioeconomic consequences through changes in traditional living conditions
- climatic consequences through feedback to the arctic and global climate. Forest is darker than tundra and will absorb more solar radiation, leading to more warming, with possibly subsequent further expansion and the creation of a positive feedback cycle; the warming effect by forest vs. tundra, counted as energy per square metre, is similar to the effect of a doubling of CO<sub>2</sub> in the atmosphere.



*Fieldwork in Northern Russia:*

*mapping of fire disturbed forest area in the treeline zone for satellite image ground truthing. Photo: G. Rees*

To answer the 'simple' question 'Are trees invading the Arctic?' there is a need to face the complexity of causes, responses and feedbacks surrounding any change of the Arctic treeline zone. And perhaps even more important 'What will the consequences be for the Arctic environment and societies?'

These are the central questions that the IPY core project PPS Arctic has set out to study, highlight and describe, both from a scientific perspective and through interaction with stakeholders and the general public. Our perspective needs to be circumpolar, and the PPS Arctic project group consists of over 110 researchers and graduate students, studying sites in Alaska, Canada, Norway, Sweden and Russia. The circumpolar perspective has been enormously helped by the structure and organisation of the IPY.

**Three main questions integrate our work:**

- Is the Arctic treeline zone moving; and if so, in what direction and where?
- What controls the position and structure of the Arctic treeline zone?
- What are the ecological and social consequences of changes in the position of the zone?

We are using fieldwork ecological and socioeconomic methods, airborne and satellite remote sensing, and historical data from aerial photography. We have been actively collecting data from more than 30 sites around the Arctic since 2007, and data collection will continue into 2009.



*Hemi-photos are used in analyses of variation in tree cover density across the treeline zone. Photo: I. Mathisen*

**Results and legacy of PPS Arctic:**

The PPS Arctic project will outlast the period of the International Polar Year. One reason for this is that it has a very strong focus on research by PhD and Master's students, with more than 40

graduate students involved in the project. Most of these are only half-way through their research, so it is too early to be sure about the overall pattern or to identify comprehensive results representing the circumpolar perspective. However, we can already see some preliminary patterns:

- The influence of climate is seen strongly at all sites even if this is complicated by differences in regional land use pattern.
- Responses differ between different climate regions; between coastal and continental regions of the circumpolar north; and according to the dominant tree species.
- We see examples of advancing, retreating and stationary treeline zones across our study sites, but the advancing zones are dominant.

PPS Arctic will leave a long-term legacy, even after the present generation of graduate students has completed its work. This will include the newly generated scientific knowledge and understanding, giving a 'snapshot' of the treeline zone in the early 21st century, but also an extensive network of study sites across the Arctic at which long-term monitoring programmes can be established. We have developed standardised measurement methods which can be used in the future.

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**Visit our website <http://ppsarctic.nina.no> for contact details and more information.**

*On February 25th 2009, the IPY Joint Committee will release a report on 'The State of Polar Research'. In the lead-up to this event, major IPY research projects are releasing information for the press, and making themselves available for media enquiries. A wide range of projects will be profiled reflecting the diversity of IPY. For more information, please visit*

*[http://www.ipy.org/index.php?ipy/detail/feb09\\_projects/](http://www.ipy.org/index.php?ipy/detail/feb09_projects/) or contact Rhian Salmon ([ipy.ras@gmail.com](mailto:ipy.ras@gmail.com))*