

PPS Arctic - Circumpolar Treeline Research during IPY From Model Predictions to Site-Based Knowledge

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The IPY core project *PPS Arctic* is a circumpolar research program focusing on the southern border of the Arctic with its transition zone into shrub and tree dominated regions (i.e. the circumpolar tundra-taiga interface; TTI). The project is composed of individual national and bilateral projects jointly focusing on causes and consequences of TTI changes.

The circumpolar boreal forest is expected to move northward. As a result, a larger proportion of the earth's surface area may become darker and thus absorb more heat. Through feedback mechanisms, change of this nature could have a major impact on global climate. The *PPS Arctic* project examined the dynamics of this zone. The predominant assumption is that a warmer climate will cause the forest to advance steadily northward. Preliminary results from our project, however, do not confirm such an assumption outright.

The TTI location corresponds to a combination of historic and recent climate and disturbance regimes. The zone is expected to respond rapidly to climate warming by tree and shrub advance, with ecological, socioeconomic and climatic consequences at local to global scales. However, the predicted advance is based on simple models that neglect ecological constraints and time-lags. The zone is diverse and complex, and cannot be expected to respond in a homogeneous manner throughout geographical regions. During the past years and decades a large number of projects have begun to reveal a varied pattern of response to recent environmental changes, challenging the assumption of a common, simplistic, rapid northward and elevational forest advance. A detailed circumpolar analysis awaits further results, but at a coarse global scale far from all study sites show recent advance. Responsiveness is linked to both the structure of the zone and its geoclimatic location. Advance appears to prevail in some alpine areas and regions affected by moist air masses but not all, while some latitudinal treeline regions dominated by dry arctic air show stationary or retreating behavior. Large herbivores such as reindeer can dominate the dynamics of the zone at region- and species-specific levels by modifying recruitment, survival and growth of trees. Herbivore-driven or other disturbance-driven modification of expected climate-driven tree expansion emphasizes the need to consider changes in grazing regimes and other perturbations (e.g. tundra- and forest fires, wind, insects, permafrost alternation) along with climate change, to avoid misleading interpretations regarding rates of climate-driven encroachment.

Comprehensive project results representing the circumpolar perspective are not yet available as these will be based on publications and theses by over 60 graduate students. However, some preliminary patterns are evident:

- The influence of climate is seen at most sites even if this is complicated by differences in regional land use pattern.
- Responses differ greatly between different climate regions; between coastal and continental regions of the circumpolar north; and according to the dominant tree species.
- Examples of advancing, retreating and stationary forest-tundra zones are seen across study sites. Advancing zones seem to be dominating, but the rate of change does not confirm modeled predictions.