Tundra disappearing at rapid rate

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Forests of spruce trees and shrubs in parts of northern Canada are taking over what were once tundra landscapes--forcing out the species that lived there. This shift can happen at a much faster speed than scientists originally thought, according to a new University of Alberta study that adds to the growing body of evidence on the effects of climate change.

The boundary, or treeline, between forest and tundra ecosystems is a prominent landscape feature in both Arctic and mountain environments. As global temperatures continue to increase, the treeline is expected to advance but the new research shows that this shift will not always occur gradually but can surge ahead.

"The conventional thinking on treeline dynamics has been that advances are very slow because conditions are so harsh at these high latitudes and altitudes," said Dr. Ryan Danby, from the Department of Biological Sciences. "But what our data indicates is that there was an upslope surge of trees in response to warmer temperatures. It's like it waited until conditions were just right and then it decided to get up and run, not just walk."

Danby and Dr. David Hik, also from the Faculty of Science, reconstructed changes in the density and altitude of treeline forests in southwestern Yukon over the past 300 years. Using tree rings, they were able to date the year of establishment and death of spruce trees and reconstruct changes in treeline vegetation. The study is published in the "Journal of Ecology."

They found that a rapid change in response to climate warming during the early mid 20th century was observed at all locations. Treeline advanced considerably—as much as 85 metres elevation—on warm, south-facing slopes and tree density increased significantly—as much as 65 per cent—on cooler, north-facing slopes.

"The mechanism of change appears to be associated with occasional years of extraordinarily high seed production—triggered by hot, dry summers—followed by successive years of warm temperatures favourable for seedling growth and survival," said Danby.

Widespread changes to treelines could have significant impacts, says Danby. As tundra habitats are lost and fragmented, species and habitats are forced to move upwards as well. "The problem is that in mountainous areas you can only go so high so they get forced into smaller and smaller areas," said Danby.

These changes are of particular importance in these northern regions where First Nation people still rely heavily on the land, says Danby. Tundra species like caribou and sheep populations, which are important parts of that lifestyle, have declined across southwestern Yukon. As treeline advance, the reflectance of the land surface declines because coniferous trees absorb more sunlight than the tundra. This light energy is then re-emitted to the atmosphere as heat. This sets up a "positive feedback," the same process that is associated with the rapidly decaying Arctic ice cap.

"These results are very relevant to the current debate surrounding climate change because they provide real evidence that vegetation change will be quite considerable in response to future warming, potentially transforming tundra landscapes into open spruce woodlands," said Danby, who will also be participating in an International Polar Year project that will be examining treeline dynamics across the circumpolar

north.

Source: University of Alberta