New study reveals unexpected relationship between climate warming and advancing treelines

13 August 2009

A new study reveals that treelines are not responding to climate warming as expected. The research, the first global quantitative assessment of the relationship between climate warming and treeline advance, is published in *Ecology Letters* and tests the premise that treelines are globally advancing in response to climate warming since 1900.

Treelines are the elevation or latitudinal limits where trees are capable of growth or survival and are considered to be early indicators of climate warming because they are constrained primarily by cold temperatures. Summer temperature is widely considered to be the primary control of treeline formation and maintenance, whereas winter temperatures have previously been considered less critical because of the insulative effects of snow. This study reveals how winter warming has overturned this prevailing view.

"Average temperatures have risen over the last century, with a more pronounced and rapid change at high altitudes and latitudes", said Ms. Melanie Harsch from the Bio-Protection Research Centre in New Zealand. "Within these zones, treelines are thought to be more temperature sensitive and so the rise in summer temperatures should result in an advance of treeline position."

Harsch and her co-authors conducted a multivariate meta-analysis, using a global dataset of 166 treeline sites with temperature data taken from the closest climate station to each site. The team used this data to analyse treeline advance throughout the 20th century and consider the contributing factors to that advance.

The team found that only 87 of the 166 sites (52%) had advanced while simultaneously the mean annual local temperatures had increased at 111 of the 166 sites at an average rate of 0.013?C a year (or 1?C in 77 years). Of the remaining sites, 77 (47%) remained stable and only two (1%) had treelines that receded. Both of the receding sites showed evidence of disturbance, indicating that regardless of form, location or degree of temperature change experienced over the last century, treeline positions have either advanced or remained static.

"Surprisingly these results reveal that treelines are not universally responding to climate warming by advancing, as expected," said Harsch, "However they demonstrate the importance of temperature on treeline advance over other factors such as disturbance, latitude, scale, elevation and distance to the ocean; none of which demonstrated strong relationships with the probability of treeline advance."

Another surprising result of this study was the association with winter, rather than summer, warming. These results provide no evidence of the prevailing view that high altitude and latitude treelines are controlled only by summer temperatures. Instead they show that treelines are more likely to advance at sites that had warmed during the winter months. It is known, at least in northern latitudes that climate-associated changes in winter conditions are on average more extreme than changes in summer conditions.

"These results show that treelines are responding to warming, but are not consistent in that only half of the sites showed signs of advance despite most sites experiencing warming. Several studies on plant species' responses to climate warming have shown mixed results and this study provides a possible explanation - both winter and summer conditions control treeline position," concluded Harsch. "Our expectations of response depend

upon which factors are limiting the current treeline distribution. Where summer temperature is the primary limiting factor we can expect to continue seeing advance, but at other sites treeline advance is unlikely to occur until other limiting factors are first lessened."

Source: Wiley (news : web)