

Warming climate may cause arctic tundra to burn

March 5 2008

Research from ancient sediment cores indicates that a warming climate could make the world's arctic tundra far more susceptible to fires than previously thought. The findings, published this week in the online journal, *PLoS ONE*, are important given the potential for tundra fires to release organic carbon – which could add significantly to the amount of greenhouse gases already blamed for global warming.

Montana State University post-doctoral researcher Philip Higuera is the lead author on the paper, which summarizes a portion of a four-year study funded by the National Science Foundation.

Higuera and his co-authors examined ancient sediments from four lakes in a remote region of Alaska in and around Gates of the Arctic National Park to determine what kind of vegetation existed in the area after the last ice age, 14,000 to 9,000 years ago.

By looking at fossilized pollen grains in the sediment cores, Higuera and his co-authors determined that after the last ice age, the arctic tundra was very different from what it is now. Instead of being covered with grasses, herbs, and short shrubs, it was covered with vast expanses of tall birch shrubs.

Charcoal preserved in the sediment cores also showed evidence that those shrub expanses burned – frequently.

“This was a surprise,” Higuera said. “Modern tundra burns so infrequently that we don't really have a good idea of how often tundra

can burn. Best estimates for the most flammable tundra regions are that it burns once every 250-plus years.”

The ancient sediment cores showed the shrub tundra burned as frequently as modern boreal forests in Alaska – every 140 years on average, but with some fires spaced only 30 years apart.

Higuera’s research is important because other evidence indicates that as the climate has warmed in the past 50 to 100 years, shrubs have expanded across the world’s tundra regions.

“There is evidence of increasing shrub biomass in modern tundra ecosystems, and we expect temperatures to continue to increase and overall moisture levels to decrease. Combine these two factors and it suggests a greater potential for fires,” Higuera said. “The sediment cores indicate that it’s happened before.”

The world’s high latitude tundra and boreal forest ecosystems contain roughly 30 percent of the planet’s total soil carbon. Currently, much of the carbon is locked in permafrost. But a warming climate could cause the permafrost to melt and release its carbon stores into the atmosphere where it would contribute to the greenhouse effect.

“Vegetation change through an increase in shrub biomass and more frequent burning will change a great deal of the carbon cycle in these high latitudes,” Higuera said. “We don’t fully understand the implications, except that it’s reasonable to expect that carbon that was previously locked up could enter the atmosphere.”

The paper is the first in a series Higuera expects to publish from his field work. Future papers will examine how climate, vegetation, and fire regimes have interacted over the past 15,000 years in the region.

Citation: Higuera PE, Brubaker LB, Anderson PM, Brown TA, Kennedy AT, et al (2008) Frequent Fires in Ancient Shrub Tundra: Implications of Paleorecords for Arctic Environmental Change. PLoS ONE 3(3): e0001744. doi:10.1371/journal.pone.0001744

Source: Public Library of Science

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