Assessing drought impacts on western Canadian aspen forests

Climate Impacts on Productivity and Health of Aspen (CIPHA)


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References


An emerging science issue for the 21st century:
Is climate change leading to global increases in drought-induced forest decline?

Global overview led by Craig Allen, US Geological Survey

• Increasing concerns about decline of aspen forests across western North America
• Major causes of aspen decline
  - Drought
  - Tent caterpillar defoliation
  - Spring thaw-freeze events
  - Wood-boring insects
  - Fungal pathogens

Major role in carbon sequestration by Canada’s forests

• Increasing demand for wood products
• Expanding urban development on the edge of boreal forest

Trembling Aspen (Populus tremuloides)

- Most widespread tree in North America
- 2 billion tonnes of aspen biomass in the Canadian boreal forest
- Important both ecologically and commercially
- Major role in carbon sequestration by Canada’s forests
- Increasing concerns about decline of aspen forests across western North America

Highlights of results from the CIPHA study

- The drought of 2001-2002 was the worst in over a century across a large area.
- Massive aspen mortality resembling fire impacts was recorded across drought-affected portions of the aspen parklands in Saskatchewan & Alberta.
- The drought led to a collapse in the net increment of aspen biomass across the region based on tree-ring analysis & annual monitoring at 350 CIPHA plots (Hogg et al. 2008).
- A spatial analysis showed 45 million tonnes of dead biomass across the 110,000 km2 survey area where the drought was most intense (Michaelian et al. 2013).
- Regionally, stem damage by wood-boring insects increased following the drought.

Methods for assessing drought impacts on aspen forests

CIPHA ground plot network

Tower-based monitoring of CO2 uptake & release

Aerial survey of dieback

Remote sensing

Mapping aspen mortality using coarse-grained imagery (Hogg et al. 2010)

Mean aspen forest oxygen exchange at 144 CIPHA plots across western Canada

Incidence of wood-boring insects at 144 CIPHA plots

Changes in the CIPHA forest carbon balance

• The 2001-2002 drought has had a major impact on aspen forests in western Canada including massive dieback & mortality along the transition zone between the boreal forest and the prairie grassland.

• Regionally, this drought led to a 30% decrease in aspen productivity.

• Mortality increased following the drought and has remained high for many years following the end of the drought.

• The results are consistent with recent studies showing impacts of drought on NPP & multi-species tree mortality across large areas of the North American boreal forest.

• This work shows the value of using a multi-scale monitoring approach for early detection & reporting of climate-related impacts that have emerged as a concern for forests in many parts of the world

CIPHA web site at http://cfs.nrcan.gc.ca/projects/124

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