In BRIEF

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Beneficial effect of trembling aspen on soil fauna communities in boreal forests

The presence of trembling aspen within black spruce-dominated stands has an influence on the abundance and composition of soil invertebrates as well as on soil physical and chemical properties. This is the key finding of a study conducted by Université de Sherbrooke and Canadian Forest Service researchers in three boreal forest stands in the Abitibi region.

Trembling aspen grows faster than black spruce and has a beneficial effect on the fertility of boreal forest soils. More specifically, the presence of trembling aspen has been linked to a decrease in forest litter thickness and soil moisture as well as an increase in the rate of soil processes.

In this study, it was determined that the relative abundance of trembling aspen in mixed aspen-black spruce stands, expressed in terms of basal area, has a positive effect on the diversity and abundance of soil invertebrates, such as earthworms, ants and snails. These invertebrates promote microbial activity in the soil and help to accelerate the main physico-chemical processes responsible for soil fertility, such as mineralization, thereby increasing the availability of nutrients for tree growth.

The presence of trembling aspen on some boreal forest sites may slow paludification (a process involving the accumulation of organic matter in a terrestrial environment), a phenomenon that limits forest productivity.

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Decline in boreal forest productivity

Photo: David Paré, NRCan

Researchers at the Canadian Forest Service and the Université du Québec en Abitibi-Témiscamingue have established a link between paludification and the gradual decline in the productivity of forest ecosystems in the Abitibi Clay Belt region. This phenomenon was studied in 23 black spruce forests at different stages of succession.

Paludification is a natural process that involves the continuous thickening of the layer of organic matter and is associated with poor drainage conditions. Feathermosses are gradually replaced by Sphagnum species, which grow fast but decompose very slowly. The accumulation of undecomposed organic matter leads to an increase in soil moisture and a reduction in soil temperature and nutrient availability. The process also causes tree roots to grow in the organic matter layer rather than in the mineral soil.

This research underscores the important role that forest fires play in maintaining the productivity of these ecosystems. Fire severity and frequency have a direct effect on the reduction of the thickness of the organic layer and therefore on forest productivity. The beneficial effect of forest fires may be greatly reduced on highly paludified sites with a high soil moisture content.

Fire suppression and forest harvesting methods designed to minimize disturbance of the organic soil layer appear to promote paludification and cause a decline in forest productivity. Forest practices that significantly disturb the soil organic layer could have a beneficial effect on productivity.

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Rove beetles as indicators of forest disturbance

Although little is known about rove beetles, they form one of the largest and most biologically diversified beetle families. There are more than 46,200 described rove beetle species in the world, and some 1,400 species have been recorded in Canada. Recent studies by Canadian Forest Service researchers suggest that rove beetles could be very good indicators of disturbances in boreal forests. These insects, which tend to be nocturnal and to prefer moist habitats, are abundant in the forest litter and are very sensitive to any disruption of their habitat. They seem to be widespread in Canadian forests. In a recent survey in the forests of northwestern Quebec, the researchers discovered that rove beetles made up 29% of the 757 beetle species collected.

A number of recent studies point to the importance of rove beetles in red spruce-dominated forests in New Brunswick and yellow birch-dominated forests in northwestern and southeastern Quebec. These insects are more difficult to identify than ground beetles, another family of insects that inhabit the forest floor. Rove beetles appear, however, to have a stronger affinity for forested habitats. Unlike ground beetles, rove beetles are not very common in the open habitat that characterizes disturbed forests.

The Canadian boreal forest is vast and highly diverse. Many of the rove beetle species that are present in the boreal forest have not yet been described, a step that is essential for assessing their potential as biodiversity indicators.

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Fewer nesting cavities
for Barrow's Goldeneye

Suitable nesting cavities for Barrow's Goldeneye are becoming increasingly rare in managed boreal forests. The lack of tree cavities may be a limiting factor for the eastern population of this species, which is considered at risk in Canada (status: special concern). Researchers at the Université du Québec à Montréal, the Canadian Wildlife Service and the Canadian Forest Service assessed the availability of suitable nesting cavities for this species in an area covering 1,500 km² north of the Saguenay Fjord in Quebec.

Barrow's Goldeneye uses abandoned Pileated Woodpecker cavities in dead trees for breeding; they also use non-excavated lateral or apical (chimney) cavities in large snags that are in an advanced state of decomposition. These two types of cavities are usually more abundant in old forests. Pileated Woodpecker abundance was virtually nil in the study area, which means that Barrow's Goldeneye is dependent on the availability of natural (non-excavated) cavities in that area. Only 0.2% of all the trees sampled contained a cavity considered suitable for this species. None of these suitable cavities had been excavated by a woodpecker; most were apical cavities.

Photo: Marie-Andrée Vaillancourt

The study area is characterized by extensively managed forests, with unharvested stands greater than 90 years old covering 20% of the total area; regenerating stands that have been harvested since the early 1980s make up the remaining 80%. Extensive timber harvesting has reduced the abundance of large dead trees.

To preserve a suitable habitat for Barrow's Goldeneye, it is important to use selection harvesting methods that maintain the structural conditions of remnant forests similar to those of old forests while favouring the presence of large live and dead trees.

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Natural tree mortality
in old-growth boreal forests

Researchers at the Canadian Forest Service and the University of Helsinki conducted a study in which they characterized standing dead trees in unmanaged old-growth boreal forests in the North Shore region of Quebec. The mortality of standing trees is an important natural phenomenon. This research is original in that it investigates mortality dynamics on a small scale in forests where the fire return interval is longer than the lifespan of the main species.

Photo: Louis De Grandpré, NRCan

The researchers studied the spatial patterns, rates and temporal variation of standing-tree mortality in three types of stands. In black spruce-dominated forests, standing dead trees showed predominantly clustered spatial patterns, regardless of tree size, whereas in balsam fir–black spruce-dominated forests and balsam fir-dominated forests, the spatial patterns were mainly random, although small dead trees tended to be more clustered than larger trees. Mortality rates varied over time, but some mortality was observed every year.

Standing dead trees help to maintain greater structural complexity in these boreal forests and increase wildlife habitat diversity. Knowledge acquisition from this research will support the sustainable management of these old forests by contributing to the establishment of retention targets for standing dead trees.

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Insect defoliators:
periodic disturbances in boreal forest ecosystems

Defoliating insects cause natural disturbances that are distinct from those caused by fire, windthrow or other disturbance agents. An insect outbreak is a more selective disturbance and the associated impact covers a greater area. In addition, the periodicity of outbreaks is often easier to predict, although it may be highly variable. To gain insight into these phenomena, Canadian Forest Service researchers conducted a comparative study of the ecology of four cyclic defoliators that are well known in Canada: spruce budworm, western spruce budworm, jack pine budworm and forest tent caterpillar.

To explain the periodicity of outbreaks, the scientists developed a model based on the close relationship between three factors: host plant availability, host-insect interactions and interactions between the insect and its natural enemies. Each factor changes randomly and is influenced by climatic variables and characteristics of the forest environment.

Insect outbreaks differ from forest fires, another major source of natural disturbance in boreal forests. With regard to fire disturbance, the probable time interval between two consecutive fires is calculated. Insect outbreaks occur on a more predictable, but more or less regular, cycle. Since insects have preferred hosts, their impact is selective. For example, spruce budworm attacks and damages balsam fir and spruce. Fire is much less selective.

Fire and certain forest management practices contribute to the homogeneity of boreal forests, which are characterized by large expanses containing only a few tree species. This homogeneity influences the spatial extent of the damage caused by insect outbreaks.

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