PHD IN FOREST ECOLOGY

Impact of white pine blister rust and spruce budworm on the natural regeneration: Multi-disturbance experiments

Context: The cover and extent of pure and mixed pine forests in northeastern North America has significantly declined across their historic range, primarily as a result of changes in fire regime, unsustainable forest management practices, and increased tree mortality due to introduced pathogens. To address the decline of this ecologically and economically important ecosystems we propose a comprehensive research program aimed at developing an ecosystem-based sustainable forest management strategy (such a management approach is now mandatory in Québec) to preserve mixed, and pure white (Pinus strobus L.) and red pine (Pinus resinosa Ait.) forests at the northern limit of their distribution. Our project is centred on the idea that emulating natural disturbance regimes of these forests should be a part of commercial forestry practices. In this way forest management will recreate conditions resembling those in natural forests and maintain their composition, structure, biological diversity and ecological functions. Mixed pine forests of Eastern Canada exhibit high biodiversity due to their wide range in age and structural diversity. They are an important source of timber for the forest industry, and are of significant economic, cultural and spiritual values for indigenous communities. Indeed, the call to restore white pine forests has been recently voiced by the Kitcisakik Algonquin community of western Quebec. Under the future climate, projected increases in the frequencies of wildfires and insect outbreaks may exacerbate their decline. Large knowledge gaps in our understanding of how pine forests will respond to future climate variability hinder development of conservation strategies.

Objectives and Methodology: This project will examine how natural disturbances (spruce budworm outbreaks, and white pine blister rust) and forest management practices affect (a) the regeneration response of white and red pine, (b) the structure and composition (trees, shrubs, and understorey / ground vegetation) of stands in forests dominated by these species, and (c) seedbed type and frequency. We will quantify how these dynamics differ among naturally-disturbed, undisturbed, and managed stands.

In order to develop sustainable ecosystem-based management strategies for white and red pine forests, the framework must include the limiting or contributing effects of other significant natural disturbances such as white pine blister rust and spruce budworm outbreaks, which may become more common under projected climate change. Based on the lack of multi-disturbance interaction research, we will investigate the role of natural and anthropic disturbance to adapt forest management practices in a climate change context. White pine blister rust in North America is caused by *Cronartium ribicola* J.C. Fisch., and is a destructive disease that has contributed to the decline / degradation of white pine stands. *Ribes* spp. act as an alternate host, thereby allowing the disease to spread among trees; direct spread from tree to tree is not possible. This relationship led to the implementation of costly eradication programs aimed at reducing / eliminating *Ribes* spp., in regions with white pine in the United States, however they proved unsuccessful. Due to these findings, rather than attempting to examine how to manage *Ribes* spp., our field approach instead will be to examine the presence / density of *Ribes* spp. and the prevalence of the disease in burned, undisturbed, and managed stands, in order to establish stand-level biotic and abiotic factors that limit presence. An experimental design located in Pinus stands of Témiscamingue will be used for assessment of both the presence of white pine blister rust and *Ribes* spp., as well as the frequency of occurrence / density. Management strategies and interventions should target pine stands where *Ribes* spp. are absent, in order to improve success and minimize losses of investments. Therefore, the current spruce budworm (*Choristoneura fumiferana*) outbreak is affecting our study area. Spruce budworm is the main defoliator of conifer trees in the North American boreal forest, affecting extensive areas and causing marked losses of timber supplies, and principally target balsam fir, white spruce and black spruce. Its occurrence in mature white and red pine stands with a dense understory of white / black spruce and / or balsam fir may be beneficial for

the natural regeneration and recruitment of these species by removing competitors from the understory. In the longer term, it will also reduce the amount of ladder fuels (composed mainly of spruces and fir), thereby favouring the propagation of surface rather than crown fires, and contributing to the maintenance of pines. Recent insect outbreak events provide the opportunity to study the vulnerability of regeneration to spruce budworm defoliation, and to assess the capacity of forest management to emulate this natural disturbance. We will examine the effects of such insect outbreaks on tree mortality, stand structure, soil properties, light availability, seedling defoliation and stocking in disturbed stands, and compare it to undisturbed, burned, and managed stands.

Keywords: natural disturbances, sustainable forest management, insect outbreaks, forest ecology, regeneration, silviculture, climate change.

Required profile:
- Education: Master's degree in ecology or forestry with an interest in natural disturbances and silviculture effects in a context of sustainable forest management in the face of climate change.
- Requirements: Driver's license, ability to work in a multidisciplinary team and to carry out field work in remote locations. Skills in statistical analysis and scientific communication will be taken into account in the selection process. We are looking for a dynamic, autonomous, responsible and motivated person. The applicant has to be systematic and accurate, in combination with a curious and critical approach, be good at cooperation and at the same time able to work independently.
- Equity, diversity and inclusion (EDI's principles): Priority will be given to candidates from under-represented groups (aboriginals, ethnic and visible minorities, LGTBI+, women).

Start date: Summer 2021

Location: The study sites will be located in the Opémican National Park and Temagami area (Témiscamingue). The student will be based at the Forest Research Institute (IRF; https://www.uqat.ca/programmes/irf/) at the Amos campus of the Université du Québec en Abitibi-Témiscamingue (UQAT). The IRF is dynamic, multicultural and international and provides a quality environment for students to develop their research, with 12 professors and more than 60 graduate students working on very diverse topics such as forest dynamics, silviculture, genetics, biodiversity, ecophysiology and sustainable forest management. IRF students also benefit from professional development resources and opportunities (scholarships, participation in conferences, workshops) offered by the Centre for Forest Research (www.cef-cfr.ca). In addition, the student will be a member of the cold forest international research group (https://forets-froides.org/), the Chair in Sustainable Forest Management (http://chaireafd.uqat.ca/) and will actively collaborate with our partners (Minister of Forests, Wildlife and Parks (MFFP), Resolute Forest Products, University of Quebec in Chicoutimi, Rayonier Advanced Material - RYAM Forest Management and Canadian Forest Service (CFS)). As part of this project, the student will also have the option of completing internship funded with our collaborators in CERFO.

Financial support: $21,000 annual scholarship for 3 years.

Supervision: Miguel Montoro Girona (https://bit.ly/34LfttX) and Yves Bergeron (https://bit.ly/2L157l6)

Project collaborators: Tadeusz Splawinski (UQAT); Nicole Fenton (UQAT); Igor Drobyshev (UQAT); Sylvie Gauthier (NRCan); Jonathan Boucher (NRCan); Pascal Pelchat (MFFP); Thibaut Petry, (SEPAQ); Yan Boucher (MFFP); Mathieu Bouchard (MFFP); Guy Lessard, (CERFO); Michael Hoepting (Canadian Wood Fibre Centre).

To apply: Are you ready to begin your Ph.D. on this fascinating topic? Send (1) your CV including contact information of three references, (2) a cover letter outlining their academic background and research experience, as well as (3) a academic transcript to Miguel Montoro Girona (miguel.montoro@uqat.ca) and Yves Bergeron (yves.bergeron@uqat.ca). Review of applications will start on February 15, 2021 and continue until the position is filled.

A professional adventure in the great boreal forest awaits you!

Links:

- City of Amos : https://amos.quebec/
- Aiguebelle National Park : https://www.sepaq.com/pq/aig/
- MRC-Abitibi : https://mrcabitibi.qc.ca/
- Abitibi-Témiscamingue Tourism : https://www.abitibi-temiscamingue-tourism.org/

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