SUSTAINABLE FOREST MANAGEMENT NETWORK
RÉSEAU DE GESTION DURABLE DES FORÊTS
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SFM Network
Research Note Series
No. 19

Considering climate change in sustainable forest management

by Craig R. Nitschke

"Appreciating the degree to which the environment has changed from the geological past through the historical past and into the present, highlights the inappropriateness of the notion of constancy"
--H. Shugart 1998

Highlights

- Foresters should be concerned about climate change.
- Most important is the response of forests to management and natural disturbance under the influence of climate change.
- Managers can reduce risks posed by climatic change by considering and integrating the potential impacts of climate change on natural disturbances into their management planning.
- Mitigative actions include fuel management, fire management, and modified silvicultural practices.

Tree Farm License 49 is the site of a multi-disciplinary research project lead by a team of researchers from the University of British Columbia Faculty of Forestry, in collaboration with Tolko Industries Ltd., and funded by the Sustainable Forest Management Network. TFL 49 is an area-based forest tenure in south-central British Columbia held by Tolko, a partner in the Sustainable Forest Management Network. The primary project objective is the development of a decision-support framework for sustainable forest management of TFL 49. This research note is one of a series stemming from the project.

Should we be concerned about climate change?

Yes. Climate change is predicted to have a large influence on our forests. Climate change may directly affect the functions of individual organisms, modify populations, affect ecosystem structure and function, and affect the distribution of ecosystems within landscapes. The impacts of climate change on timber values have the potential to influence productivity both negatively and positively, while the impacts on biodiversity could result in range shifts or local extirpation of species. Forests in British Columbia may shift upward in elevation, with some species disappearing from some of the biogeoclimatic zones, due to the lack of winter cooling for forest regeneration, increased sensitivity to spring frosts, and drought stress. An additional important consideration is that while zones may shift, the species composition of these zones may also change. More importantly, for managers, climatic change will influence the disturbance agents that continually threaten their management objectives.

What are some effects of climate change?

Western Canada may see warming between 2 and 5 °C with possible decreases in summer precipitation. These factors may lead to increased summer continental drying that could result in an increased risk of drought. The most important aspect of climate change to foresters is the response of forests to management actions and natural disturbance under the influence of climate change. Under certain management and natural disturbance conditions, climate change may influence the risk of a landscape to change. For example, the predicted continental drying could increase the frequency of fires that will facilitate the migration of vegetation by creating opportunities for fire-tolerant species and limiting regeneration of fire-intolerant species. Another example we are already seeing in British Columbia and the Yukon are the bark beetle epidemics that are occurring well outside of the historic ranges of both the mountain pine and spruce bark beetles, respectively.

Fires such as this one in the Okanagan in British Columbia may become more frequent due to increased drought conditions brought on by climate change. Photograph courtesy of Michael Feller, UBC Dept. of Forest Sciences.

The amount of forest area burned annually may increase by 25-50%, since it has been predicted that fire severity ratings may increase by up to 46% and the fire season length may increase by 28-29 days in west-central Alberta as a result of climatic change. As well, future fires in western Canada may be much larger and hotter than historically observed. It has been suggested that low to mid-elevation forests may be the most susceptible to the impacts of climate change if fire suppression is continued and current forests are not managed for fire disturbance. High elevation forests (> 1500m) may also be susceptible due to the affects of climatic change on fuel moisture conditions. Changes in fuel moisture conditions may lead to more severe fires initially, followed by a shorter fire interval which could have negative impacts for tree species that are susceptible to fire, in particular, spruce and subalpine fir. What this means is that fires in lower elevation forests are more "fuel-driven" then "moisture-driven", while in the higher elevation zones the opposite is predominantly the case. Managers need to consider fuel management to reduce the risk of severe fires. Decades of fire suppression have increased the fuel loads in stands, at all elevations, to the point where fires are now and will increasingly become "moisture-driven". Fire suppression and the decision not to engage in fuel reduction will certainly exacerbate the undesirable aspects of climate change.

An example of climate change impacts

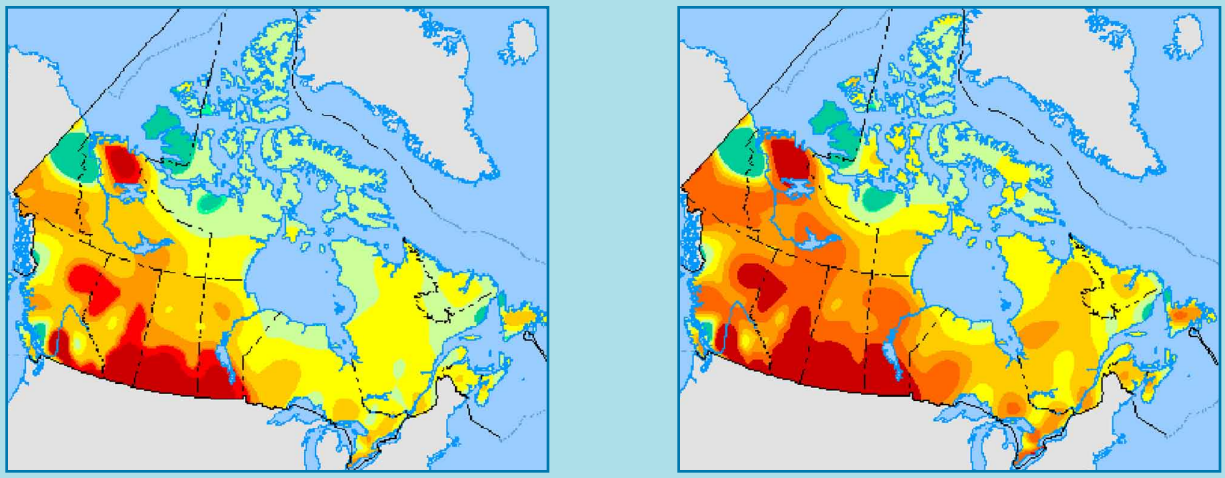
To illustrate the magnitude of the impact climatic change can have on a landscape let's look an example from a ponderosa pine ecosystem in the western USA (see Allen and Breshears 1998). Prolonged drought increased the susceptibility of ponderosa pine in the landscape to bark beetle attack. Continuous beetle attack reduced the ponderosa pine forest cover on this landscape from 38% to 17% over a five-year period. With the removal of the pine overstorey, and the persistently drier conditions, ponderosa pine could not regenerate. However, both piñon and juniper successfully regenerated. The ability of piñon and juniper to out-compete the ponderosa pine during the drier climate allowed these woodlands to increase by 21% and fill the niche formerly occupied by the ponderosa pine. By 1998, the landscape had still not returned to its original state, due, in part, to the suppression of fires during and after the drought. This

provides an excellent example of how rapid climatic change can affect ecosystems through altering disturbance severity and how ecosystems can maintain themselves in the absence of disturbance. The important point that managers should draw from this example is the decision to use fire suppression as a management tool, which facilitated the change in and maintenance of the vegetative communities.

What can managers do?

Ecosystems are inherently complex, as are the impacts of climatic change. However, managers can reduce many of the adverse risks posed by climatic change by considering and integrating the potential impacts of climate change on natural disturbances into their management planning. By including potential climate change impacts into management plans, managers can use adaptive management frameworks to adjust their landscape-level planning if and when they are faced by the consequences of rapid climatic change. So, what can managers do and how can they integrate climate change into their planning?

Incorporating climate change into management should be approached through using risk analysis. Analysing the potential impact of disturbances under climate projections is an important and necessary starting point (see maps below). Understanding the spatial distribution of risk on their landscapes can allow managers to focus their resources on potential problem areas. From this, informed mitigation and adaptation decisions can be made. As a manager you need to ask yourself, "what can I do today to reduce the risk of climatic change?" Managers need to understand that by undertaking mitigation they are adjusting management and providing flexibility to adapt to change when necessary. Using the resilience that is built in ecosystems is a cost effective mitigation strategy but for this to be successful you need to manage the risk posed by natural disturbance, particularly fire. Mitigation actions that should be implemented today are fuel management (reducing the amount of fuel reduces the threat of severe fires that can affect large areas); replace fire suppression with fire management (use fire as your fire suppression mechanism); and increase the use of silvicultural practices to reduce competitive stresses within stands. For example, the use of commercial thinning can reduce the affects of periodic



Forest fire severity across Canada for the period 1980 to 1989 (left) and 2090 to 2099 (right). Areas with high predicted fire severity are indicated in red, those with moderate severity in light orange and yellow, and those with low predicted severity in greens. As can be seen, by the end of this century, it is estimated that areas with extreme fire danger levels will expand and the fire season will further lengthen, due to climate change. Warming impacts may also include more frequent and severe fires, shorter growth periods between fires, proportionally younger stands, and a decrease in the carbon storage of northern Canadian forests. Managers can use these projections to undertake mitigation now. Maps courtesy of Natural Resources Canada.

droughts on stands, reduce the susceptibility of stands to bark beetle attack, and also reduces fuel loads in forest types that are overly sensitive to stand maintaining fires.

For more information

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Links and further reading

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Coordinating editor: R. D'Eon
Graphics & Layout: K. Kopra

ISSN 1715-0981