



# Climate Change and Saskatchewan's Boreal Forest

A Saskatchewan Environmental Society Forestry Fact Sheet

The majestic boreal forest of Canada covers six million square kilometers spread over almost every Canadian province and territory. Canada's boreal forest is one of the world's last remaining intact forest ecosystems and forms two-thirds of Canada's total forest area.<sup>1</sup>

The boreal forest is significant for many reasons, including its vast storage of water reserves that are found in the form of wetlands and thousands of clear lakes and rivers. The boreal is adapted to cool northern temperatures and consists largely of evergreen conifers such as spruce and fir trees.

At least five billion of North America's birds live in the boreal forest including species such as hawks, owls, grouse, woodpeckers, finches, chickadees and jays. In fact, 30% of North American migratory birds depend on the boreal for the breeding habitat.<sup>2</sup> The boreal is rich with other wildlife as well; just some of the species include: moose, deer, beavers, porcupines, caribou, bears, wolves, cougar, lynx, and several species of fish.

The boreal forest is vitally important from an ecological standpoint as it filters our air and water and helps to moderate our climate by storing carbon in its soils and vegetation. In addition, Canada's boreal forest is also home to about 1.4 million people, including 600 First Nations communities.<sup>3</sup>

Forests are a major component of the Canadian economy: logging, oil and gas development, mining, hydro-electric power and even farming take place in Canada's boreal forest.

There are two central forces that shape and maintain the boreal forest: *disturbance* and *succession*. *Disturbance* in the boreal happens by fire, insect and storm activities, which create openings or clearings in the forest and occasionally remove tree stands over a large area. This benefits the forest by preserving diversity and enabling aging stands to evolve.

Once such an opening is created, *succession* happens. First, plants such as grasses and shrubs move into the clearing. Then these species are usually replaced by broad-leaved trees such as aspen and birch. Eventually spruce and fir trees succeed the earlier species. At any time throughout *succession*, *disturbance* may start the process anew.



## Is Canada's Boreal Forest at risk?

Unfortunately, more than half of the world's natural forests have been destroyed over the past 50 years.<sup>4</sup> More than 30% of Canada's boreal forest has already been allocated for industrial development, most of it since 1990.<sup>5</sup> Alarming, the pace of development is accelerating. Technological advances are making previously non-commercial forests accessible for harvest; and the search for oil, gas, minerals and hydro-electric power is moving further into once-remote territory.

In addition, at least one-third of the world's forests are in danger from global warming.<sup>6</sup> The cool boreal forest of North America is especially at risk. Scientists have already noted that the impacts of climate change on Canadian forests are expected to be largely detrimental. As well, many climate change models predict a dramatic shrinking of the boreal forest. Studies show that the forest in Saskatchewan may well be replaced by vegetation more typical of a grassland ecosystem by the end of the century. The effects of climate change are expected to create unprecedented levels of insect infestation and forest fire in the boreal forest. The warmer and drier weather in the summer is also expected to reduce tree growth and reproduction.

In June of 2003 the Standing Senate Committee on Agriculture and Forestry called for action to conserve Canada's boreal forest because it is "increasingly under siege".

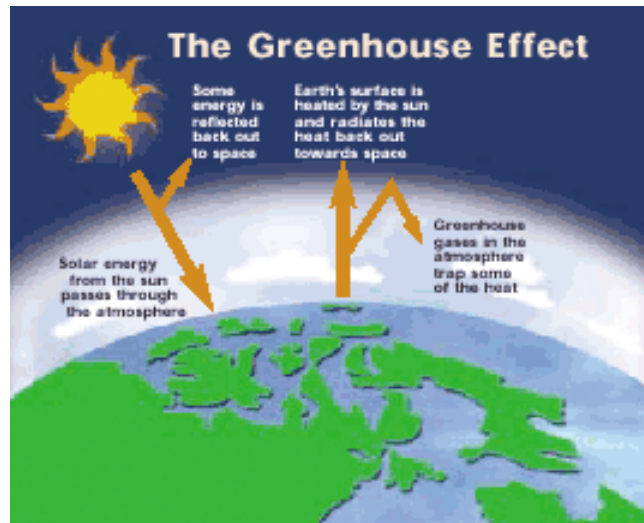
# Climate Change: What is it?

A natural system called the “*greenhouse effect*” regulates the temperature on Earth. The atmosphere traps and holds the sun’s heat near the planet’s surface, just as the glass in a greenhouse traps and holds the sun’s warmth inside. Without the *greenhouse effect*, the sun’s heat would escape and the average temperature on Earth would make our planet much too cold to sustain life. The *greenhouse effect* is created by “greenhouse gases”, such as carbon dioxide (CO<sub>2</sub>), methane(CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O) trapped in Earth’s atmosphere. Human activities, particularly the burning of fossil fuels, have resulted in unprecedented quantities of greenhouse gases being released into the atmosphere. These gases intensify the natural *greenhouse effect* and raise global temperatures.

Carbon Dioxide(CO<sub>2</sub>) is the main contributor to the warming of the planet. Excess CO<sub>2</sub> in the atmosphere comes from the burning of fossil fuels, such as driving our cars and using coal-fired electricity generation. Methane (CH<sub>4</sub>) is produced naturally when vegetation is digested or rotted without the presence of oxygen. For example, large amounts of methane are released by anaerobic breakdown in garbage dumps and from the digestive tracts of grazing cattle. Nitrous oxide (N<sub>2</sub>O) also occurs naturally in the environment, the levels are being increased as a result of the use of chemical fertilizers in agriculture. Since 1850, CO<sub>2</sub> levels have increased by 25%, CH<sub>4</sub> levels by 100% and N<sub>2</sub>O levels by 15%.<sup>7</sup>

As a result of the rapid and significant rise in greenhouse gas emissions, world wide temperature increases are expected to happen at a rate that is 15-30 times faster than temperature increases have ever occurred before.<sup>8</sup> Since the Industrial Revolution, humanity has caused the same increase in temperature in 150 years as has been caused by natural forces over a period of over 19,000 years.<sup>9</sup> In particular, the last two decades were the warmest on record.<sup>10</sup> The world’s top climate scientists believe that average global temperatures will continue to rise significantly. In Saskatchewan we could see average increases of three to six degrees Celsius by the end of the 21<sup>st</sup> century.<sup>11</sup> As the northern regions of the globe are expected to be hardest hit, Canada’s increase in temperature is predicted to be more than three times the global average.<sup>12</sup> Although a “few degrees” rise in

temperature may seem insignificant, the rise in global temperature will drastically alter the *climate*. “Climate” refers to the average meteorological conditions, which include temperature, precipitation, and wind patterns, amongst other variables. In effect, the increase in global warming means that we can expect to see and indeed already have witnessed worldwide changes to the weather.



The increased release of greenhouse gases from energy use is not the only contributor to climate change. For example, in 1994, while six billion tonnes of carbon were dumped into the atmosphere from the burning of fossil fuels, the destruction of forests through logging or conversion to agriculture resulted in another two billion tonnes of carbon being released from storage in wood and soil.<sup>13</sup> Researchers have noted that the severe alteration or loss of our boreal forests will continue to speed up the rate of climate

change. Historically, changes in climate have occurred at a slow enough pace that ecosystems have been able to adapt without major disruption. However, there is strong evidence that climate change will accelerate during the coming century at rates beyond our historical ability to adapt.

Responsible forest management, complete with improvements in the productivity of manufacturing methods, better utilization of unused by-products and less “waste” during and after harvesting, can move the forest industry toward the goal of sustainable management for all of Canada’s forests. Forest certification offers an effective tool for achieving this goal.

## What is the Kyoto Protocol?

The Kyoto Protocol is an international agreement signed in 1997 by more than 160 countries to take action on climate change. Under the terms of the agreement, industrialized countries agreed to reduce their collective emissions of the six most important greenhouse gasses to 5.2% below 1990 levels by the period 2008-2012. While Canada has committed to reduce its own greenhouse gas emissions to 6% below their 1990 levels, scientists have made it clear that we need to reduce global emissions by over 50% to stabilize atmospheric concentrations – Kyoto is therefore just a small but important first step.

# Climate Change: What are the Impacts?

Scientists from all over the world agree that climate change will have a significant effect on life. Globally, we can expect to see large-scale disruption of forestry, agriculture and fisheries; extinction of plant and animal species on land and in oceans; changing rainfall patterns; loss of huge tracts of coastal land under rising seas as polar ice caps melt and the oceans expand; and serious adverse effects on human health.

The projected change in climate will also bring unprecedented changes in precipitation and wind patterns and increased weather variability from year to year. We can expect to see severe winds, hail, snow and ice storms, droughts in some areas, with an increase in flooding in other areas, as well as overall lower lake and river levels.

An example closer to home is the expected reduction in the size of glaciers and snow pack in the Rocky Mountains of Alberta and British Columbia which consequently means less water flowing through the rivers in Saskatchewan. This extreme variability of climate is predicted to be unlike what farmers, the forest industry and rural communities have faced before.

The potential effects of climate change on Canada's forests are numerous and alarming. Likely changes include:

- major changes in forest growth and survival
- conversion of tree species and dislocation of ecosystems;
- increased shoot damage and tree mortality due to winter thaws;
- increased risk of forest fires and insect outbreaks;
- increased damage to forests due to extreme weather events.

Climate change studies conclude that warmer temperatures will seriously change the boreal forest by shifting the climatic zone suitable to boreal species northward by several hundred kilometers. A movement of this magnitude may reduce the amount of forest in Canada by up to 80%.<sup>14</sup>

The northward shift would create a net loss of 100 million hectares of land climatically suited to the boreal forest in Canada. The expected rates of change are extraordinary and are well beyond the migration rates previously recorded in earth's history.<sup>15</sup>

The boreal forest in Saskatchewan could be replaced with grassland ecosystems. It is estimated that each degree Celsius rise in temperature in North America is likely to translate into a potential shift in ecosystem range of 100–150km.<sup>16</sup>

While it has been suggested that the boreal forest could expand further north into the tundra as temperatures increase, such an expansion would be restricted by the differences in topography and inability of the soil to adapt quickly enough to the changing climate to be suitable to the boreal plant species. The result is that the northern edge of the boreal does not shift northwards, while the southern edge of the boreal begins to transition into more grassland-like ecosystems. Consequently, there is an overall loss of the Saskatchewan boreal forest.

A major agent of change to the boreal forest will be fire. Scientists are predicting an increase in frequency and severity of forest fires as much as 40-50%, primarily due to warmer temperatures and reduced precipitation.<sup>17</sup>

Although the thought of an increase in fire is very stressful, it must be remembered that wildfire is a natural part of the boreal forest life cycle. Fire releases mineral nutrients and establishes the right conditions for seeds of certain plant species to germinate. Animals such as moose and woodpeckers also depend on forest fires for the specific habitat it creates.

Climate change will exert a major stress on forest ecosystems. We will see significant changes in Saskatchewan's boreal forest, including increased mortality of some tree species and reduced rates of growth. The warmer climate and longer growing season may increase tree growth in the short-term, but it is known that the lack of available precipitation will eventually stunt this growth and offset any potential future benefits.

Scientists caution that stands of trees that began growing under the present climate may not naturally regenerate following harvest in the changing climate. Flowering, pollination, seed formation, germination and competitive success of the seedlings are processes particularly sensitive to climate.

The forest may become less productive and more difficult to renew after disturbances - a development that argues for a conservative approach toward allocation of timber for harvest. Apparent surpluses of timber based on our present calculations may disappear. Careful and anticipatory planning is desperately needed in order to mitigate and adapt to climate change.



## Solutions: Reducing Our Emissions

To respond to the challenges of climate change we must first reduce our greenhouse gas emissions. Reducing emissions is the most fundamental action required to cope with climate change. Energy efficiency and conversion from fossil fuel use to appropriate renewable energy sources are the key strategies to accomplish this task.

As one of the world's highest per capita energy users, Canada is more than able to reduce its greenhouse gas emissions. Unless countries are prepared to actively promote methods of reducing emissions, the problem will continue to grow.

As a province, we need to continue to support alternative energy sources such as wind power. SaskPower, the provincial energy utility, has 26 wind turbines that create just over 17 megawatts of electrical capacity - and intends to increase wind power generation to 22 megawatts by December 2003. This is enough to power 9000 households.<sup>18</sup>

There is tremendous potential to reduce greenhouse gas emissions by replacing fossil fuel electricity generation with cleaner sources that contribute less to climate change. Furthermore, improving efficiency and practicing conservation will result in reduced energy demand.

Greenhouse gas emissions can be reduced by using our vehicles less frequently and more efficiently. Efficiency is accomplished by maintaining vehicles in good working condition, reducing speed, and turning engines off when not in use. Such steps also reduce overall operating costs and extend the life of vehicles.

Fuel consumption varies widely among vehicles and should be a consideration when purchasing a new car or truck. In fact, the "thirstiest" sport utility vehicle, according to the 2000 Natural Resources Canada's *Fuel Consumption Guide* guzzles more than three times as much gasoline as the most fuel-efficient car.<sup>19</sup>



Automakers are now making more fuel-efficient vehicles. The focus is on more efficient engine designs, lightweight materials, alternative fuels, hybrid electric vehicles and fuel cells.

Another major area for efficiency improvements is in the forest industry itself. As an industry, it can do a great deal to promote energy efficiency in areas such as site preparation, logging, transportation to mills and markets, manufacturing processes, as well as reducing emissions resulting from decomposition and recycling of wood waste.

In Saskatchewan, at its Prince Albert Pulp and Paper plant, Weyerhaeuser Canada has converted an existing recovery boiler into a wood waste boiler, thereby reducing their need for natural gas and electricity. This has enabled Weyerhaeuser plant to achieve almost complete energy self-sufficiency, eliminated waste wood and dramatically reduced greenhouse gas emission. The project has reduced yearly natural gas usage up to 70% and reduced purchased power requirements up to 50 percent. As an added bonus, energy efficiency leads to a competitive advantage using measures that are relatively low-cost with a short pay-back period.<sup>20</sup>



**A**lthough our priority is to reduce our greenhouse gas emissions, we must also acknowledge that the climate is already changing and we have no choice but to adapt to new conditions. With drastic changes expected in the way ecosystems function, particularly in Saskatchewan forests, we will have to be aware of the resulting impacts on the economy in the following ways:

- changes in timber supply and values;
- potential loss of non-timber forest resources;
- dislocation of parks and natural areas; and
- increased land use conflicts.

Senator Nik Taylor of the 2003 Standing Senate Committee on Agriculture and Forestry noted that “we can and must develop strategies that can ensure the survival of our threatened boreal forest while still enhancing traditional forest use and preserving economic and industrial benefits...because there are no quick fixes and many of the actions we must take may have a substantial transition period, the window of opportunity for preserving all of the values offered by the boreal forest is closing rapidly. We must put our words into action very soon indeed.”<sup>21</sup>

As communities, forest land managers, First Nations and others concerned about Saskatchewan’s forest begin to grapple with the impending impact of climate change, the one common ground they will recognize is that there are no easy solutions. Many questions exist about how to adapt to climate change in a way that is social, environmentally and economically acceptable.

Climate change will cause an increase in intensity and frequency of fire in the boreal forest. One adaptation strategy may be to target forest fire suppression on areas of high economic or social value, while in other areas allowing fire to run its course. This may be a very practical option, as continued escalation in wildfire is expected to overwhelm the ability of fire management agencies to respond to all occurrences.

Past forest management practices by Saskatchewan Environment (SE) have attempted to exclude fire from the landscape. Now SE acknowledges the beneficial role that fire plays in ecosystems. In its new policy “Fire and Forest Insect and Disease Management Policy Framework”, SE states that they will not attempt to eliminate fire from ecosystems, but rather to suppress wildfires that threaten critical values, and also to introduce fire, if needed, to maintain or restore ecosystem health.

While fire prevention programs will continue to be important, more emphasis will be placed on the beneficial role of fire and forest insects and diseases in ecosystems.<sup>22</sup>

*FireSmart* forest management is one of the tools for adapting to fire. *FireSmart* is a program that strategically integrates fires and forest management activities to reduce the overall flammability of forest landscapes through actions such as harvest scheduling, cut-block design, reforestation and stand tending. This type of management includes increasing the use of prescribed burns to minimize fuel loading.<sup>23</sup>

In their new forest policy, Saskatchewan Environment has recognized that we will witness an increase in both domestic and non-native forest insect outbreaks. Management of these populations will have to be unique for each insect and disease and based on “public consultation, sound science, and adaptive management”. In some circumstances, natural insect infestations in Saskatchewan forests will have to be tolerated in order to avoid exposing the public and ecosystem to excess amounts of pesticides.

To reduce the impact of insects and disease on tree populations, forest managers can consider techniques such as: controlled burns, partial cutting or thinning to increase stand vigour and lower the susceptibility to attack; and sanitation cuts that remove infected trees. Careful monitoring will be required as some of these practices can increase vulnerability to other pests.<sup>24</sup>



## Solutions: Changing Forestry Practices

Climate change is likely to have significant impacts on the production level of the forest industry. We need to act now to implement precautionary management and strategies to deal with potential problems. In order to safeguard Canada's boreal forest, we must establish an interconnected network of large-scale protected areas and conservation lands. The remainder of the landscape must be managed with sustainable development techniques based on criteria developed by third party, independent sustainable forest certifiers such as the Forest Stewardship Council (see the SES factsheet titled "Achieving Sustainable Forest Management")

Options for adapting forestry practices in the field are various. Some forest industry representatives are promoting fast-growing tree species as a climate change adaptation strategy. The presumption is that faster-growing hybrid tree species will be better able than our native species to provide the forest industry with fibre to meet market demands. However, this will do little to protect and maintain the boreal forest. It is more beneficial to enable the forest to maintain its slower growing, native species as these trees will accumulate more carbon over time, which helps to off-set climate change impacts.

Another way to attempt to adjust to a changing climate would be to intervene aggressively by planting non-native or genetically-modified tree seedlings that are likely to be better suited to the future climate than natural regeneration. However, such measures are fraught with difficulty. There are practical limitations in implementing such measures across a forest of the scale of the Canadian or even the Saskatchewan boreal forest, and the costs of intervening at such a large scale would likely be prohibitively high. Additionally, there are environmental concerns with the implications of constructing an artificial environment and the additional displacement that this may cause to the native flora and fauna, already under stress as a result of climate change.

When managing forests that have already been harvested, one adaptive strategy may be to lengthen the rotation age (i.e. the time between cuts) from 80 to 100 years. This change in timing results in a 60% increase in the amount of forest 60 years or older, a beneficial move since older forests store carbon better than younger forests which helps to reduce the impacts of climate change.<sup>25</sup> As well, maintaining an older forest provides for more opportunities for wildlife habitat, recreation, and employment in industries such as eco-tourism.

Existing forests are moderately resistant to climate variability, however it is the forest regeneration phase that will be most susceptible to the changed climate. Thinning or selectively removing suppressed, damaged or poor quality trees may help to increase light, water and nutrients available for the remaining trees.



The Saskatchewan forestry industry may need to consider relocation of mills and operations to keep hauling distances within profitable limits. This may require the future closure of an established industry at a present site with its eventual move closer to the sources of wood supply. However because of thin soil development in areas

located on the Canadian Shield, there will be a limit to how far the northern boundary of the boreal forest could potentially move.

In addition to conventional forestry, climate change will significantly affect the non-timber values of the boreal, such as wildlife habitat, recreation, soil conservation, pollution reduction and water management. These values must all be taken into account as future plans for the forest are developed.

Decisions being made today are too often based on the false assumption that the climate will remain relatively stable throughout a forest's life. Saskatchewan forest utilization and preservation developed under past climatic conditions, and we will need to adapt our thinking to include the very real and dramatic changes in climate which will shape our future forests.

## Solutions: Strengthening Parks & Protected Areas

**H**ow will we manage Saskatchewan's parks considering the impacts of climate change?

Effective adaptation to climate change over the long-term will require plant and animal species to migrate and relocate to areas better suited to them. Since human developments resulting in forest fragmentation restrict migration, it will be especially important to establish large, intact protected areas in the boreal forest. These areas must be linked by wide-cross-country travel corridors.

Once the native flora and fauna have started their migration northwards, species from warmer climates will begin to introduce themselves into areas that were once boreal forest. This will further stress other components of the ecosystem. In some circumstances it will be most appropriate to allow adaptations to occur autonomously, in a natural and un-managed way. In other circumstances it may be most appropriate to undertake adaptations in a planned, proactive manner, for example, using targeted tree regeneration, and protection strategies. One thing is certain, protected areas as we now know them will change considerably.

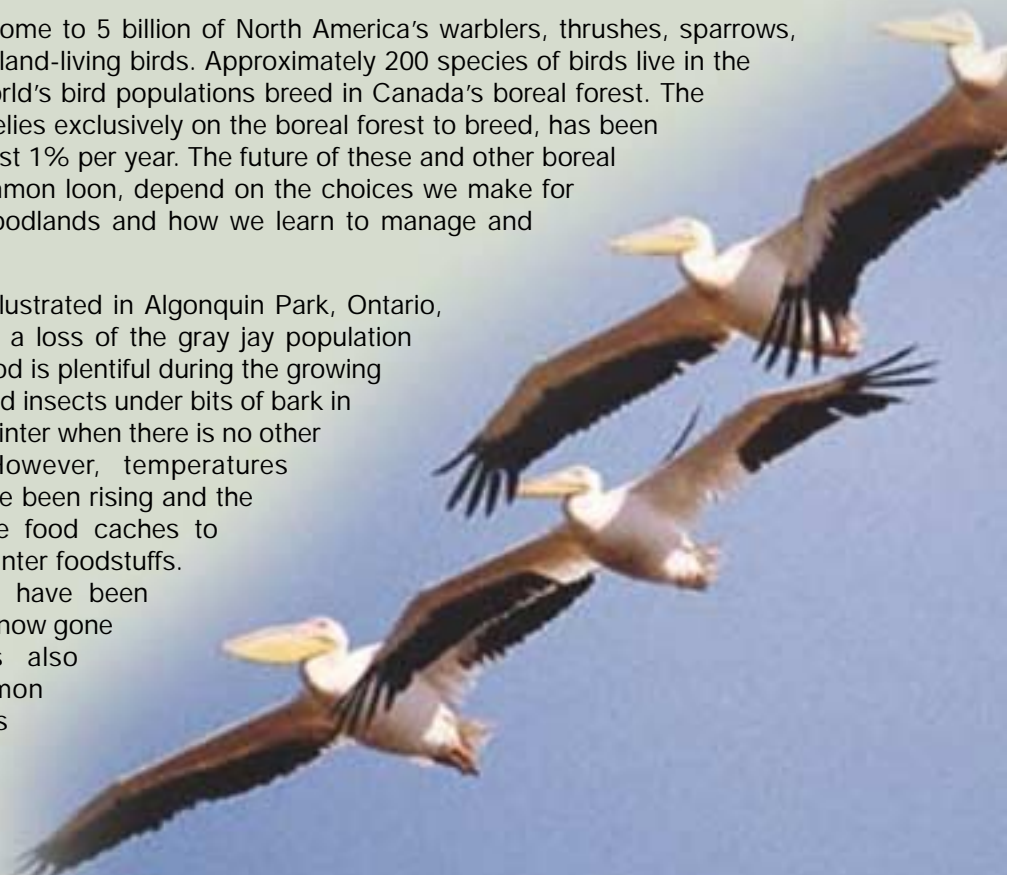


### CLIMATE CHANGE & BIRDS

Studies show that the fate of much of the continent's bird life depends on the future of the vast boreal landscape.

The Canadian boreal forest is home to 5 billion of North America's warblers, thrushes, sparrows, hawks, woodpeckers and other land-living birds. Approximately 200 species of birds live in the region. More than half of the world's bird populations breed in Canada's boreal forest. The white-throated sparrow, which relies exclusively on the boreal forest to breed, has been declining in populations by almost 1% per year. The future of these and other boreal forest species, such as the common loon, depend on the choices we make for conserving boreal lakes and woodlands and how we learn to manage and adapt to climate change.

A foreboding example can be illustrated in Algonquin Park, Ontario, where naturalists have reported a loss of the gray jay population due to climate change. When food is plentiful during the growing season, gray jays store seeds and insects under bits of bark in order to have provisions in the winter when there is no other source of food available. However, temperatures throughout the past decade have been rising and the milder weather has caused the food caches to spoil, leaving the jays without winter foodstuffs. As a result, nesting sites that have been occupied for several years have now gone empty. This phenomenon is also becoming increasingly common among other animals. Scientists are convinced that this decline in populations is related to climate change.



# How You Can Help

The extensive research conducted on climate change indicates that the boreal forest of Saskatchewan is destined for dramatic changes. To safeguard the forest, we must do what we can to prevent further climate change by reducing our use of fossil fuels and participating in energy conservation measures. In addition, we will need to become educated on the expected land use changes as a result of climate change in order to have the proper context for decision-making in the Saskatchewan boreal. As the Standing Senate Committee on Agriculture and Forestry determined..."The Committee does not want to sensationalize the issue [of climate change] and needlessly scare the public; nevertheless, we would be remiss if we

were to ignore the clear message from witnesses that Canada is soon likely to face much greater changes than it has experienced in the last hundred years. It is valid to be concerned about the future."<sup>26</sup>

Forest-dependent communities will be at risk from the changes in forests and the forestry industry. Rural communities must diversify their economies to make them less vulnerable to the effects of climate change. Policy-makers and forest managers have a responsibility to bring the message to rural Canada that climate change is real and that it is time to start thinking about our vulnerabilities and ways to increase our resilience.



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- <sup>24</sup> Ibid.
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