

Ecological Narrative and Vulnerability Summaries for the Kamloops Future Forest Strategy (1st Approximation)

General Climate Trends Across the TSA

Introduction

This general trends document was designed to help streamline the discussion in the ecological narratives for each TSA subzone. By stating once in this document the trends, objectives and interpretations that are common for the entire TSA, they will not need to be repeated over and over in the ecological narratives. This document also acts as a good introduction to the ecological narratives by providing some context.

2008 to 2050 (relative to 1960-90)

Temperature

- Mean annual temperature - increase by 1 to over 3 degrees (consistent across subzones)
 - Mean temperature of the warmest month - increase by 2 to 6 degrees (relatively consistent).
 - Extreme minimum temperature – increase by 3 to 5 degrees (relatively consistent).
 - Mean temperature of the coldest month – increase by about 2 degrees (relatively consistent).
 - NOTE: Modellers more comfortable with temperature trend forecasts.
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Precipitation

- Mean annual precipitation will increase by 3 – 4% (sometimes as low as 2% and as high as 5%)
 - Summer precipitation will generally decline by 1 – 10%.
 - Precipitation in the Fall, Winter and Spring will generally increase.
 - More rain in winter with precipitation as snow declining by 2 to 23% (variable between subzones).
 - NOTE: Modellers more uncertain with precipitation trend forecasts. However, increased temperatures are expected to somewhat reduce winter snowpack and increase summer drought.
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2050 to 2080 (relative to 1960-90)

Temperature

- Mean annual temperature - increase by 3 to over 7 degrees (varies by subzone)
- Mean temperature of the warmest month - increase by 2 to 10 degrees (varies by subzone).
- Extreme minimum temperature – increase by 5 to 10 degrees (varies by subzone).
- Mean temperature of the coldest month – increase by about 2.8 to 3.5 degrees (slight variation between subzones).
- NOTE: Modellers more comfortable with temperature trend forecasts.

Precipitation

- Mean annual precipitation will increase by 4 – 8% (varies by subzone)
- Summer precipitation will generally decline by 1 – 20% (varies by subzone).
- Precipitation in the Fall, Winter and Spring will generally increase.
- More rain in winter with precipitation as snow declining by 1 to 40% (highly variable between subzones).
- It is expected that a significant portion of precipitation may occur in severe weather events,
- NOTE: Modellers more uncertain with precipitation trend forecasts. However, increased temperatures are expected to somewhat reduce winter snowpack and increase summer drought.

Cycles

- El Nino Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) climate cycles are expected to continue to affect short term climate and weather.
 - ENSO events persist for 6 – 18 months while PDO events seem to persist for 20-30 years (less is known about PDO)
 - We appear to be in transition from a “warm PDO” cycle since the late 70’s to a cool phase – but this is not clear, as it seemed to shift back and forth – cool to warm again in 2002 / 03.
 - If we are in a cool PDO phase, climate will generally be moderated by cooler / wetter winters and springs in BC.
 - La Nina in the cool phase will make climate even cooler and wetter, while El Nino will have the opposite impact.
 - A switching into a warm PDO phase (2020 – 2030?) could exacerbate impacts of climate change.
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Mature Lodgepole pine

- It is assumed that mature lodgepole pine presence in all stands will cease to exist in a significant manner within the next few years.

Other Vegetation

- Studies in Europe along a latitude gradient in Europe suggest that accumulated temperature explained much of the variation in seed production and viability. The impact of warming on sexual reproductive traits of forest herbs will be mostly positive for spring-blooming plants and negative for late summer blooming plants.

Tree Growth

- Climate change will extend the growing season. It varies by subzone but may be as much as a week or two at either end. It has been suggested in temperate and boreal European forests that this will increase photosynthesis and net primary production in trees, especially with higher CO₂ concentrations.
 - In moist to drier subzones growth will be mostly influenced by drought and the summer heat:moisture index.
 - In wetter subzones in the Kamloops TSA anticipated increase in mature tree growth due to milder temperatures, increased growing season, and continued high to moderate moisture inputs may be a bit simplistic. Improvement in growth may be less than expected.
 - A longer growing season may not necessarily be warmer, and it is possible that an advance in spring dates and a delay in autumn may be of minor importance to trees physiologically. Spring-time changes (e.g. bud-burst date) may be easy to see but relatively unimportant to tree growth.
 - Weather conditions in the heart of the growing season may be more important to productivity than an earlier bud-burst. A significant dry period in the summer will still have an impact on growth.
 - Also, as general climate moves out of sync with the normal phenological cycles of dormancy and frost hardiness, periodic unusual weather patterns may have a significant impact on vigor and growth of trees, especially younger stands. A generally warmer early winter may put stands at risk of damage if followed by a late winter deep cold period and the chilling requirements for most trees are already satisfied with growth tissues already reactivated.
 - There are still questions regarding increased incidence of insects and disease that are challenging to answer.
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General Data Uncertainty

Models used

- These are the most complex models in use, consisting of an AGCM (atmospheric global circulation model) coupled to an OGCM (oceanic global circulation model). Some recent models include the biosphere, carbon cycle and atmospheric chemistry as well. AOGCMs can be used for the prediction and rate of change of future climate. They are also used to study the variability and physical processes of the coupled climate system.
- Global climate models typically have a resolution of a few hundred kilometres. Climate projections from the Met Office Hadley Centre make use of the HadCM2 AOGCM, developed in 1994, and its successor HadCM3 AOGCM (the one used in the Kamloops TSA), developed in 1998. Greenhouse-gas experiments with AOGCMs have usually been driven by specifying atmospheric concentrations of the gases, but if a carbon cycle model is included, the
- AOGCM can predict changes in carbon dioxide concentration, given the emissions of carbon dioxide into the atmosphere. At the Met Office Hadley Centre, this was first done in 1999. Similarly, an AOGCM coupled to an atmospheric chemistry model is able to predict the changes in concentration of other atmospheric constituents in response to climate change and to the changing emissions of various gases. Further information is available on: some aspects of ocean simulation in HadCM3 (thermohaline circulation, ventilation, vertical mixing), decadal variability in the ocean of HadCM3.

Modelling Uncertainty

- All the ranges in the general trends exist for several reasons:
 - First, no one is sure about future scenario for global carbon emissions so we have used booked scenarios – one high emission / high change scenario (A1F1) and one low emissions / low change scenario (B1).
 - We also paired the low change scenario with a model that deals with a number of climate processes in ways that moderate their impact (PCM). This provided us with what we thought would be the most optimistic bookend of the future if you want a low degree of change. We paired the high change scenario with a model that deals with a number of climate processes in ways that provide for hotter drier summers (Hadley). This provided us with our pessimistic bookend for the future if you do not want to see lots of change.
- The GCM Models used in the 2007 4th IPCC assessment differ considerably in their estimates of the strength of different feedbacks in the climate system, particularly cloud feedbacks, oceanic heat uptake and carbon cycle feedbacks, although progress has been made in these areas. Also, the confidence in projections is higher for some variables (e.g. temperature) than for others (e.g. precipitation), and it is higher for larger spatial scales and longer time averaging periods.

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- Modellers are more uncertain with precipitation trend forecasts. However, increased temperatures are expected to somewhat reduce winter snowpack and increase summer drought.
 - Note: We are learning more about climate change all the time. The shrinkage of the polar ice caps in 2007, and now in 2008 were not just surprising to scientists, but “very alarming”(Arcticnet 2008). This is one example of a biofeedback mechanism that global climate modellers may have underestimated.
 - Large-scale ocean circulation changes beyond the 21st century cannot be reliably assessed because of uncertainties in the meltwater supply from the Greenland ice sheet and model response to the warming.
 - Projections of climate change and its impacts beyond about 2050 are strongly scenario- and model-dependent, and improved projections would require improved understanding of sources of uncertainty and enhancements in systematic observation networks.
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Ecosystem Dynamics

- The dynamic nature of ecosystems makes predictions about future conditions challenging at best. A number of conditions could come together – perfect synchronicity of weather conditions at key developmental times for an insect generally not even thought of as a concern, vulnerability of host trees and perhaps one of two other factors and we are blindsided by an epidemic we couldn’t predict that changes the whole picture for the subzone.
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Tree Species Suitability

- Tree species suitability to the shifting climate envelopes in the Kamloops TSA are educated guesses at best. Many of these climate envelopes would be unique. BC foresters will have little experience with them. Introducing new species now to anticipate conditions decades from now is also a challenging endeavour. There many questions about different species growing under different conditions that will require monitoring, more analysis, species and provenance testing over time to resolve. Targeting new species on sites where there is a high likelihood of survival and persistence both now and over time is the best strategy for now.
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