Climate Change and West Kootenay Ecosystems

G. Utzig, R.F. Holt, H. Pinnell and C. Pearce

Introduction

Between 2010 and 2012, local forest practitioners, scientists and other stakeholders assessed the vulnerability of ecosystems in the West Kootenays to the changing climate (see Figure 1). The project was lead by local scientists with funding from the BC Future Forest Ecosystem Scientific Council (FFESC).

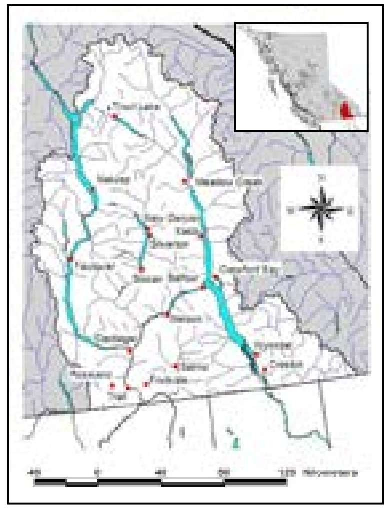


Figure 1. Study area.

Projected Changes in Seasonal Climate

The results from seven climate projections were summarized to examine the potential changes over the next forest rotation. Climate models estimated that by the 2080s mean temperatures in winter, spring and fall may warm by between 2 to 5^{o}C, and in summer by 3 to 7^{o}C. Seasonal precipitation was projected to increase by 10-25% in the winter, spring and fall, while summer may remain unchanged, or decreased by up to 30%. All the projections pointed to increased summer moisture stress.

Bioclimate Envelope Modeling

Three climate scenarios were selected for more detailed bioclimate envelope modeling . All three scenarios projected bioclimate envelope shifts that reflect decreasing moisture availability at mid and lower elevations – with scenarios differing only in the magnitude of change. At the lowest elevations in the southern portion of the study area, shifts from Interior Cedar-Hemlock (ICH) bioclimate envelopes to grassland-steppe envelopes are consistently predicted. At the upper elevations the results were more variable, with one scenario projecting an upward shift of existing ICH envelopes, another tending to more coastal transition ICH/CWH (Coastal Western Hemlock), and the third showing a shift to Ponderosa pine savanna envelopes, with limited ICH/CWH envelopes at the highest elevations. All of the scenarios projected virtual elimination of Engelmann Spruce-Subalpine Fir (ESSF) and parkland/woodland envelopes (see Figure 2).

The current locations of bioclimate envelopes that are projected for the study area in the 2080s, are presently found as far south as Colorado, west to coastal BC, and north to Alaska. This surprising range of projections points to the complexities of how seasonal climate combinations will shift, and highlights that displacements to species' ranges required to keep pace with climate change may not be a simple move from south to north.

Results from modeling of tree species' ranges project northerly and upslope expansions of drought resistant and fire tolerant species' envelopes, and significant decreases in the occurrences of upper elevation species' envelopes.

Fire Impacts

Regression analysis was used to examine the historical interaction between annual area burned and climatic variables such as spring and summer maximum temperatures and summer precipitation. The resulting relationships were then applied to climate projections to estimate potential future changes in annual area burned. The regressions projected steadily increasing area burned for all of the study area and all climate scenarios, although there is uncertainty in the magnitude of the increases. The minimum projected increases in average area burned for the 2050s are 3 to 5 times greater than the area burned during the reference period (1961-90), with average increases of 15 to 300 times.

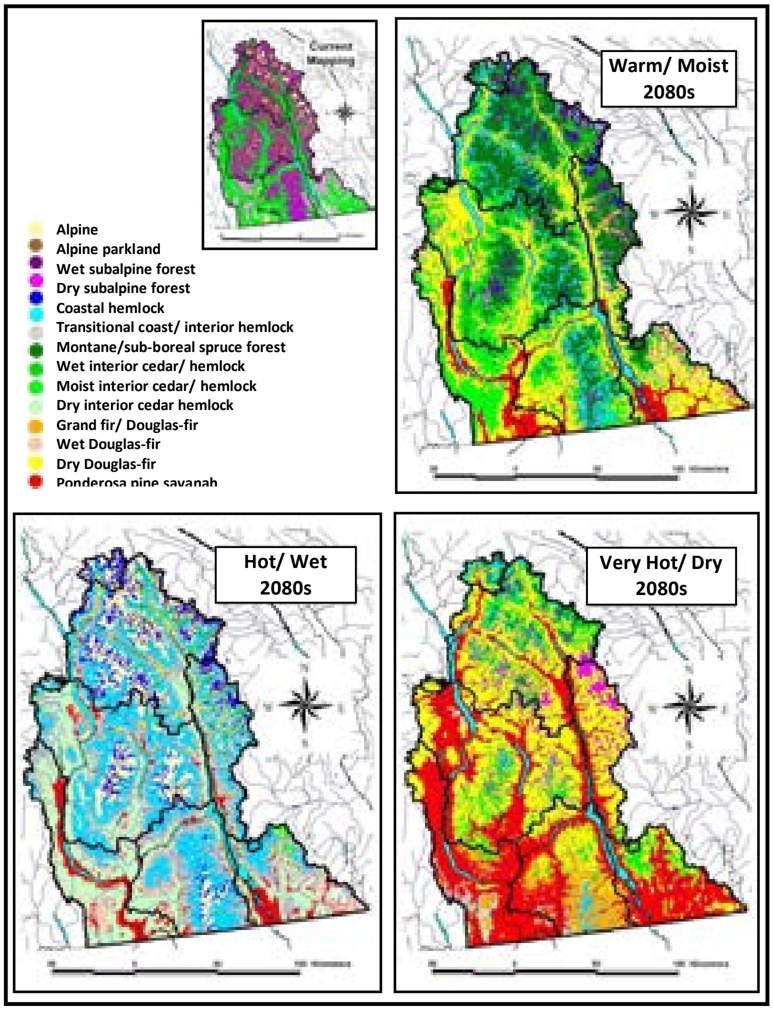


Figure 2. Potential shifts in bioclimate envelopes.

Insects and Pathogens

Climate change may affect forest health in many ways. Summer drought and late frosts can stress trees, thereby increasing their susceptibility to insects and pathogens, while changes in seasonal temperature and precipitation regimes can also affect insect and pathogen life cycles. Available evidence suggests that climate change may already be contributing to increased outbreaks of various bark beetles and defoliators. Rusts, foliar diseases and root disease may also increase with climate change.

Vulnerability and Resilience

The project used a vulnerability assessment approach and resilience theory concepts to assess the significance of climate change impacts on ecological systems. Lower elevations in the northern portion of the study area were assigned the highest vulnerability ratings due to projected shifts in natural disturbance regimes from rare to frequent stand-replacing fires. These may be catastrophic regime shifts, due to a local lack of seed source for trees appropriate to the new climate and disturbance regimes. In contrast, the highest elevation portions of the study area had the lowest vulnerability ratings, because the regime shifts may occur as gradual upslope range extensions and forest infill. In areas such as mid-elevations in the north, where vulnerability assessment results across the three scenarios provides ratings ranging from low to very high, determination of appropriate management actions becomes an even more difficult task.

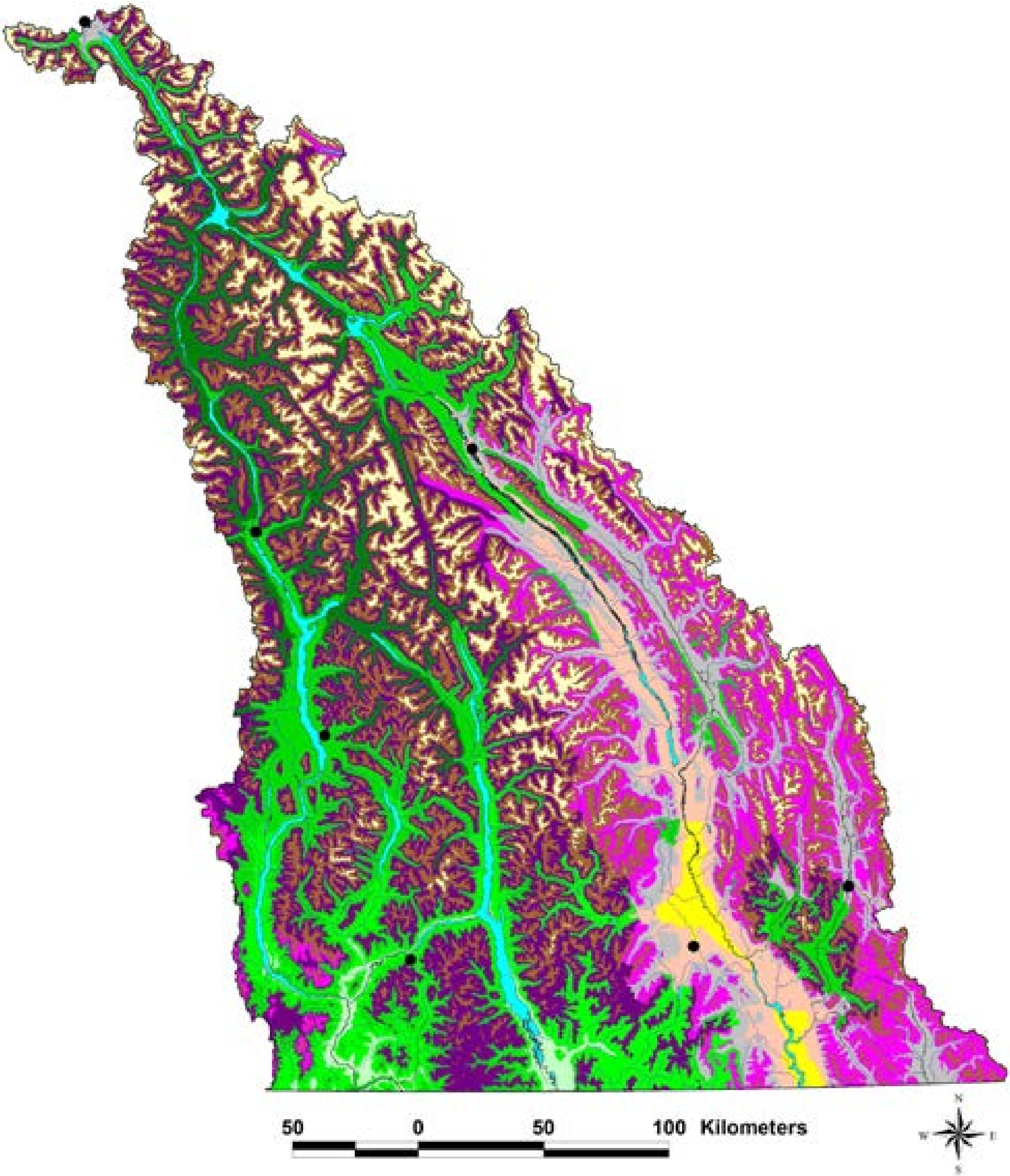
Adaptation Options: Barriers and Opportunities

Project participants utilized projected climatic and ecosystem change data to explore adaptation options and new approaches to decision-making in a series of 5 workshops. Potential adaptation measures were identified at multiple management scales, for various themes such as regeneration, stand tending, transportation infrastructure and habitat supply. Participants also recognized barriers to moving forward, such as the lack of funding, lack of government leadership, and the regulatory framework. Seeking "no regrets" solutions through building ecosystem resilience and active adaptive management were recognized as potential management opportunities.

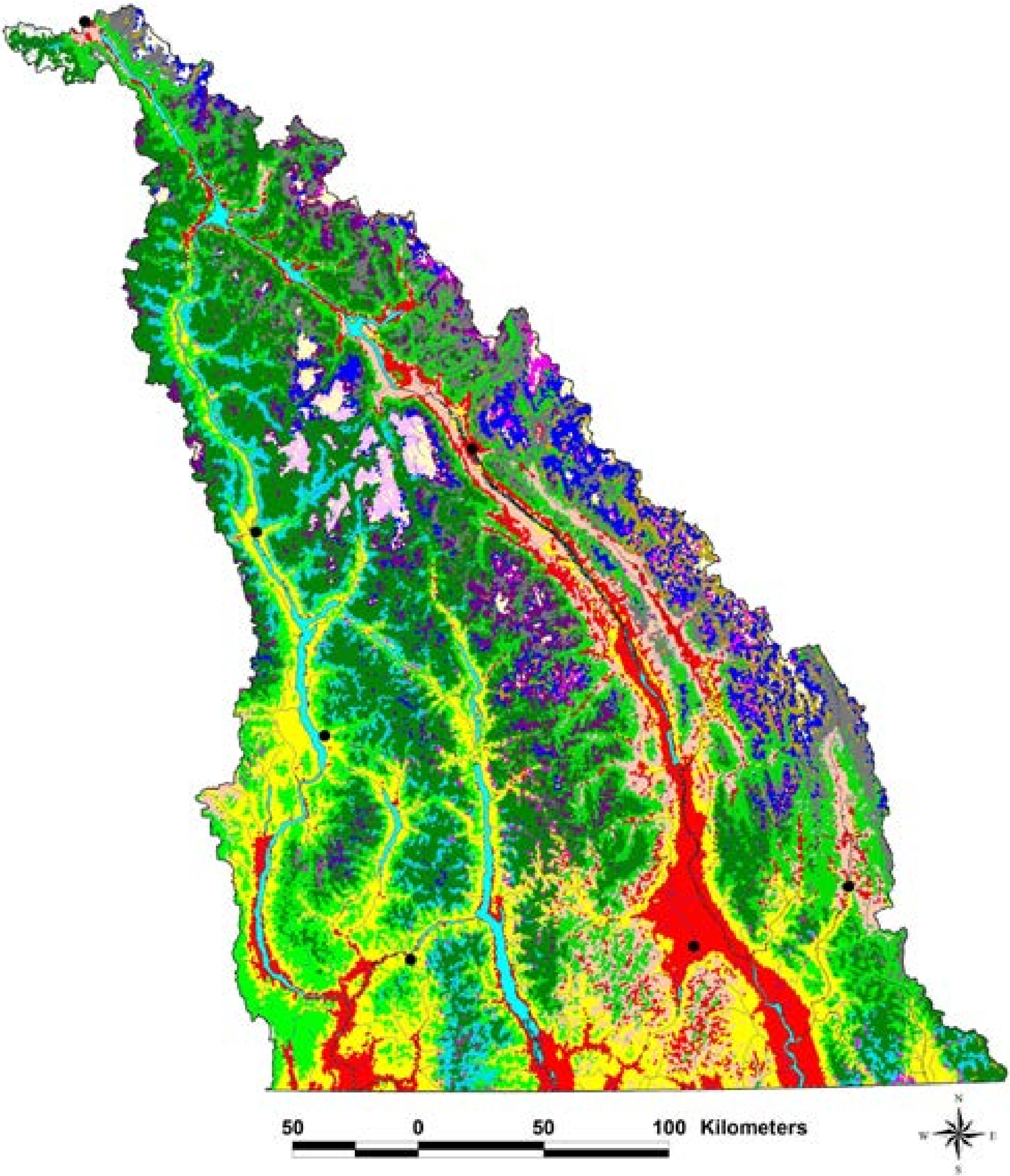
This project provides a foundation for local adaptation, but much work remains. Barriers need to be addressed – especially those that promote inaction today - and feedback from further research and monitoring must be incorporated into ongoing activities. A series of detailed reports are available at www.kootenayresilience.org .


Alpine
Alpine parkland
Boreal low elevation
Wet subalpine forest
Dry subalpine forest
Coastal mountain hemlock
Coastal western hemlock
Transitional coast/ interior hemlock
Wet montane/ sub-boreal spruce forest
Dry montane/ sub-boreal spruce forest
Wet interior cedar/ hemlock
Moist interior cedar/ hemlock
Dry interior cedar/ hemlock
Grand fir/ Douglas-fir
Wet Douglas-fir
Dry Douglas-fir
Ponderosa pine savannah
Grassland/ steppe

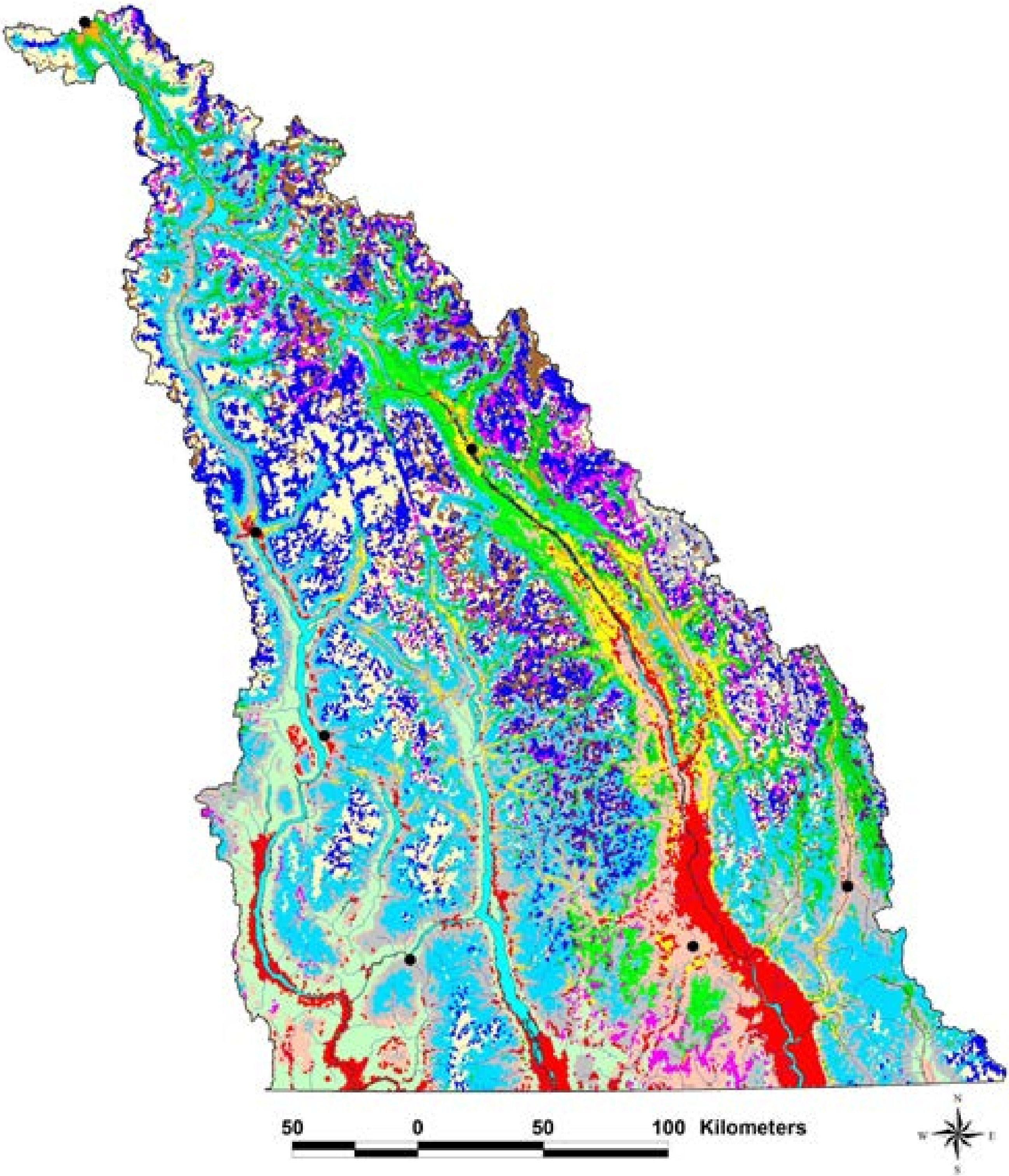
Current Biogeoclimatic Zones of the Basin



Projected future for 2080s with warm moist scenario



Projected future for 2080s with hot wet scenario



Projected future for 2080s with very hot dry scenario