**Status of Forest Genomics Research and Development in Canada**

Ilga Porth (porth@mail.ubc.ca)1

# ABSTRACT

Forest genomics represents a relatively recent field, and is often poorly understood both by the public and forest managers. Genomics in forestry, an expansion of forest biotechnology, seeks to develop generalized technologies for potential use in industrial plantations and/or natural forests. With such tools it is possible to address formerly intractable issues, such as complex traits dissection for conservation management purposes, improved use of forest trees as carbon sinks, feedstock for biofuels and “green chemistry” through deeper understanding and effective utilization of forests’ natural variation. Diverse end-users could benefit from genomics tools, for example, real-time detection and mapping of known and novel pathogens along with risk assessments to protect forestry nurseries and natural forests from invasive pathogens and reduce economic losses associated with forest diseases. The past has seen c.123 million CAN$ investment in forest genomics research. Here, we attempted to identify research priorities and their economics analyses, by (a) developing robust typology of forest sector genomics research relevant to Canadian application, (b) categorizing each initiative for its application potential (commercial; non-commercial, *i.e.* ecological/social; length of time from real application), and (c) demonstrating with silvicultural gain, insect resistance, and wood composition themes the application of modeling and economic analysis.

# Introduction

Forests have an important economic, ecological and social value. Forest trees contribute substantially to global carbon uptake, are an integral part of complex ecosystems, and provide benefits for human wellbeing in the recreational sector. Canadian forests are important for the Canadian economy [forest sector contribution of $19.8 billion% to the Canadian gross domestic product (GDP) in 2013, (Anonymous 2012)] but also for global carbon cycle as Canadian forests - concomitantly containing substantial untouched stands - constitute roughly 10% of the earth’s forests (400,000,000 hectares) (Aukema et al. 2009; Rank and Associates 2013). Therefore, healthy Canadian forests are of paramount importance locally and globally. Through the past decade, the Canadian forest sector has faced strong structural and deep cyclical challenges (low cost competition; digital media; reduced demand through global economic downturn) as well as enormous environmental challenges (major insect devastations in both Eastern and Western Canada by spruce budworm, emerald ash borer, and the mountain pine beetle, respectively, affecting 28,000,000 hectares of forest land between 2009-2010 alone) and resulting in 30% reduction to GDP contribution since 2007 (Rank and Associates 2013) and over 130,000 job losses (Kumagai et al. 2010).

Canadian forests are mostly publically owned and therefore are subject to public forest policy with its regulations, legislation and directives. Another characteristic of Canadian forests is slow growth resulting in long rotation cycles of up to 70 years. Hence, an improvement in selection gains for productivity, wood quality and other value-added characteristics, climate adaptability, insect and pathogen resistance along with shortening tree breeding cycles by genomics-informed early selection of superior genotypes with such advantageous trait characteristics would significantly benefit tree breeding programs through increased forest