Past, current, and future forest harvest and regeneration management in Interior Alaska boreal forest: adaptation under rapid climate change

Miho Morimoto and Glenn P. Juday

Alaska's boreal forest is mostly ecologically intact, and primarily a stand replacement disturbance-driven system. Wildfire and insect damage or mortality are the dominant disturbances, with forest harvest affecting an area equal to only 3.9% of area burned. These characteristics provide a unique opportunity to identify natural ecological processes as a basis for adaptive management. However, the boreal forest is now going through profound changes due to human activities, primarily climate change. Boreal Alaska has experienced a greater amount of warming than forest regions in lower latitudes, thus forest management needs to implement adaptive management sooner than elsewhere. This study offers adaptive management approaches using 40 years of forest harvest and regeneration management by synthesizing the expert knowledge and practices of the past, and applying scientific knowledge to meet the needs and challenges of today. Forest harvest management in boreal Alaska is low-input and concentrated near road systems. Compared to wildfire, forest harvest disturbances are much smaller in size and are highly concentrated near roads. In the managed area where fire suppression is most active, harvesting can improve forest health, recoup economic values, and reduce fire risks as forests continue to age. Forest harvest removes or depletes habitat for some plant and wildlife species and creates habitat for others. Properly designed harvest activity, including habitat retention, can minimize loss of essential ecological services, such as landscape and structural diversity. Forest harvesting also reduces structural and species diversity within-stand, when compared to wildfire. Post-harvest regeneration follows a similar successional pattern to that seen following fire. Post-harvest regeneration has been largely successful based on the Alaska state regeneration stocking standard, particularly following clearcutting and site preparation, despite a limited amount of planting. Forest harvest management needs to be adjusted according to overall goals and to timing of white spruce seed crops, then monitored and adjusted as managed area expands to avoid negative cumulative effects especially for wildlife. Adaptive management in boreal Alaska is particularly necessary because regeneration failure is likely soon due to warming. We offer some potential adaptation approaches: (1) maintaining current species, (2) maintaining forest landscape of any species, and (3) allowing biome conversion from forest

to shrubland or grass land. The first option requires identifying new sites and regions that will experience sustained or enhanced growth potential – e.g. higher elevations, less exposed aspects, locations further west. We have identified some of these geographic areas based on ecological growth criteria. In addition, adaptive migration of populations to more suitable sites might be necessary, which requires physiological and genetic studies to find the best adapted populations, and monitoring growth and health of existing post-harvest regeneration. The second option requires initiating genetic studies to find the most adaptable tree species from other geographic regions. For the last option, exploring potential of native species not previously present in Alaska would be a priority. These approaches balance conservation and sustainable use, while sustaining ecological resilience, ecological functions and services. Successful management will require flexibility and adaptation based on feedback from monitoring and research.