University of Victoria | Graduate Studies

Notice of the Final Oral Examination for the Degree of Master of Science

of

EMILY CAMERON

BSc (Queen's University, 2009)

"Ecological impacts of roads in Canada's north"

School of Environmental Science

Friday, September 25, 2015
9:00AM
David Turpin Building
Room B247

Supervisory Committee:
Dr. Trevor Lantz, School of Environmental Studies, University of Victoria (Supervisor)
Dr. Brian Starzomski, School of Environmental Studies, UVic (Member)

External Examiner:
Dr. Karen Harper, Environmental Studies, Dalhousie University

Chair of Oral Examination:
Dr. Michael Masson, Department of Psychology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Arctic ecosystems are experiencing rapid changes as a result of climate warming and more frequent natural and human-caused disturbances. Disturbances can have particularly large effects on high-latitude ecosystems because their structure and function is controlled by strong feedbacks between environmental conditions, vegetation, and ground thermal regime. My MSc. research uses fieldwork and broad-scale GIS data to investigate post-disturbance ecosystem recovery along roads in two permafrost zones (discontinuous and continuous). In the first of two case studies, I focussed on tall shrub proliferation along the Dempster Highway at the Peel Plateau, NT. To explore the drivers of tall shrub proliferation and quantify shrub expansion in this region of continuous permafrost, greyscale air photos (1975) and Quickbird satellite imagery (2008) were used to map landcover change within a 1.2km buffer next to the road and inside a buffer 500m away from the road. Extensive tall shrub proliferation in the study area indicates that warming air temperatures and disturbance both facilitate vegetation change in tundra environments. My findings also indicate that accelerated shrub expansion adjacent to the road was caused by increased soil moisture. Tall shrub proliferation adjacent to the road occurred at lower elevation sites characterized by wetter soils with thicker organic layers. Areas that resisted tall shrub encroachment were located at higher elevations and had drier soils with thin organic layers. These observations also support previous work that illustrates that tall shrub expansion next to the highway promotes strong positive feedbacks to ongoing shrub growth and proliferation.

In a second case study I examined ecosystem recovery in an area of discontinuous permafrost 30 years after construction and abandonment of a winter access road in Nahanni National Park Reserve. Ecosystem recovery was studied by comparing disturbed (road) and undisturbed (adjacent to the road) sites in spruce muskeg, black spruce parkland, deciduous forest, and alpine treeline terrain. Field data showed that disturbances to discontinuous permafrost terrain can lead to large and persistent changes to ecosystem composition and structure. In spruce muskeg, permafrost thaw triggered by road construction dramatically increased soil moisture and facilitated a transition from spruce muskeg to sedge wetland. At alpine treeline the removal of stabilizing vegetation and organic soil during construction slowed subsequent ecosystem recovery. These findings are consistent with resilience theory that predicts that changes to key environmental factors will increase the likelihood of regime shifts. In terrain types where disturbance fundamentally alters ecosystem processes, the management of disturbance impacts in NNPR will be extremely difficult. Overall, this thesis contributes to our understanding of effects of disturbance on vegetation and abiotic conditions, and provides insight into the future of high-latitude ecosystems in a warmer climate with increased disturbance.