Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy
of

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MSc (University of Victoria, 2011)
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“Disturbance Dynamics in West Central British Columbia: Multi-Century Relationships of Fire, Western Spruce Budworm Outbreaks and Climate”

Department of Geography

Thursday, April 13, 2017
1:30PM
David Turpin Building
Room A144

Supervisory Committee:
Dr. Daniel Smith, Department of Geography, University of Victoria (Supervisor)
Dr. Olaf Niemann, Department of Geography, UVic (Member)
Dr. Brad Hawkes, Fire Research Officer with Natural Resources Canada (retired), Canadian Forest Service, Pacific Forestry Centre (Outside member)
Dr. Thomas Veblen, Department of Geography, University of Colorado (Additional Member)

External Examiner:
Dr. Donald Falk, School of Natural Resources & the Environment, University of Arizona

Chair of Oral Examination:
Dr. Emmanuel Hérique, Department of French, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

Future climate changes will alter disturbance regimes worldwide with important implications for many ecological and social systems. In west central British Columbia, Canada, fire and insect disturbances have shaped the historic character of Douglas-fir (*Pseudotsuga menziesii* var. *glauca* Beissn. Franco) dominated forests. However, since AD 1900 fire suppression and other forest management practices have led to denser forests and conifer encroachment into grasslands. Considering climate changes in interior British Columbia are expected to result in warmer and drier conditions, understanding the influence of climate on forest disturbances is crucial for land managers tasked with both mitigating the effects of disturbance and promoting resilience in forest ecosystems. This research focused on developing multi-century, annually-resolved records of fire and western spruce budworm outbreaks to evaluate: the historic climate conditions related to these disturbances; the influence of grassland proximity on disturbance-climate relationships; and, whether western spruce budworm outbreaks were related to fire activity.

At the landscape scale, a detailed study in the Churn Creek Protected Area revealed spatially variable stand structure and fire-climate relationships at a low elevation forest-grassland ecotone over the interval AD 1600 to 1900. This finding suggests the site was characterized by fires of mixed-severity dominated by frequent, low-severity, fires related to positive antecedent moisture conditions punctuated by widespread fires of moderate to high severity related to intervals of persistent drought. At the regional scale, the influence of interannual climate variability and large-scale patterns of climate variability (e.g. El Nino Southern Oscillation) was evaluated using new and existing records of fire history and multiple climate pattern reconstructions. Regional fire activity was shown to be significantly related to interannual climate variability, and no consistent patterns between regional fire years and the individual phases or phase combinations of large-scale patterns of climate variability were detected. The findings suggest that the spatial expression of large-scale climate patterns translates into weak and undetectable terrestrial effects related to fire activity in this region. The influence of grassland proximity on disturbance history was investigated using site-level and regional tree-ring reconstructions of western spruce budworm outbreaks and fire activity based on four sites adjacent to grasslands and four sites not adjacent to grasslands between AD 1600 and 1900 (fire) and 1600 and 2009 (western spruce budworm). Fires affecting grassland proximal sites were more frequent than fires occurring in forests not adjacent to grasslands, and the character of western spruce budworm outbreaks was generally consistent among all sites. Fire activity was related to both warm, dry and cool, wet conditions in the fire year and/or year(s) preceding the fire depending on proximity to grasslands, suggesting climate conditions associated with both fine fuel growth and drying are key determinants for fire activity. The initiation of western spruce budworm outbreaks was significantly related to drought and this relationship was enhanced at sites adjacent to grasslands. At the site-level and regional scale, no consistent association was found between the initiation of western spruce budworm outbreaks and fire years indicating the historic interaction between these disturbances is weak or non-existent.

Understanding the variability in fire-climate relationships and patterns in forest structure has important implications for fire and grassland management in west central British Columbia. This study provides forest managers and policy makers with essential historical information on variable disturbance-climate relationships and mixed-severity fire activity, crucial prerequisites for the effective management of these complex ecosystems.