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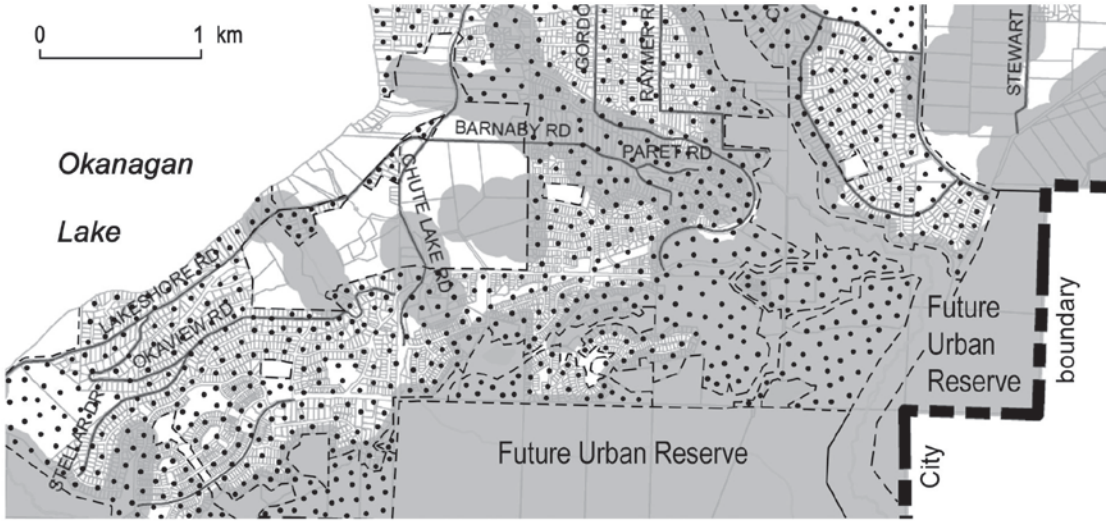

Western Geography

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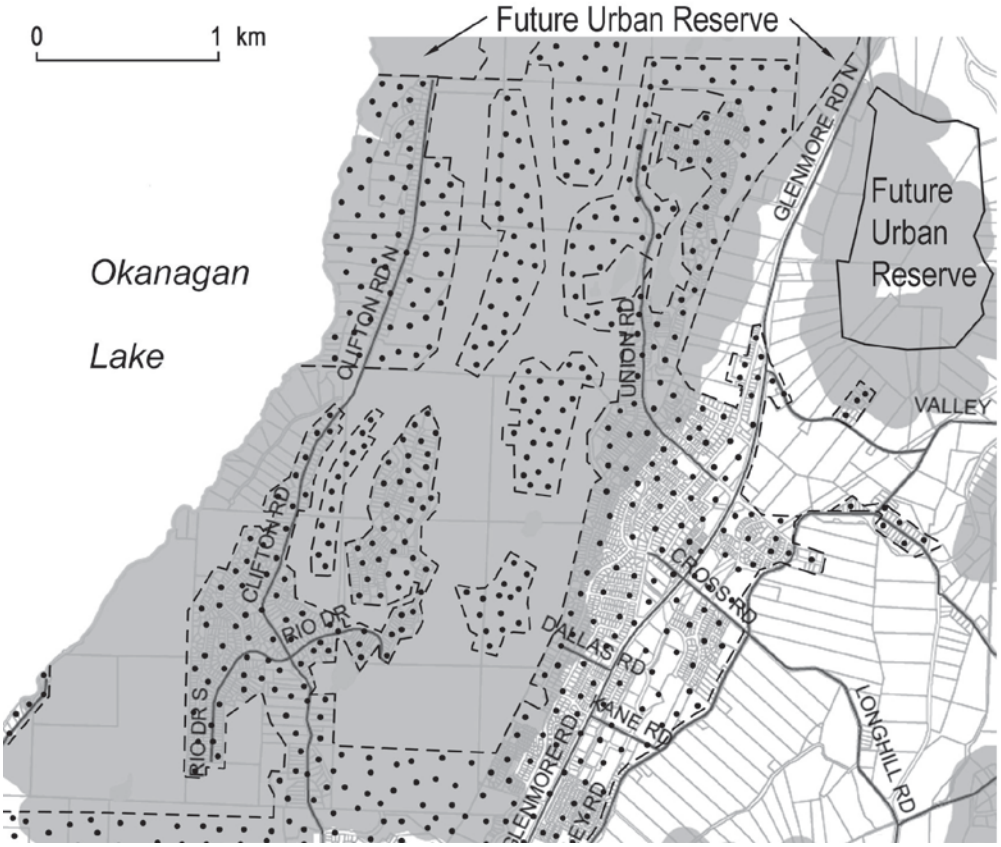

Western Geography – Editors' Note
Volume 23 – 2018

Another year has passed and another edition of Western Geography was produced. The majority of the articles presented in this volume represent student research presented at the Western Division, Canadian Association of Geographers (WDCAG) Conference co-hosted by Western Washington University and the University of the Fraser Valley in 2017.

The Editors would like to thank all the students and professors for submitting their work for consideration in this issue. Without the submissions, there would be no journal. Without the reviewers – quality suffers. Through the process of overseeing the development of the manuscripts, the editors can see the development of young scholars and feel the growth of the spirit of Western Geography.
We look forward to many submissions for Volume 24.

The Editors,
Craig Coburn, University of Lethbridge
Tom Waldichuk, Thompson Rivers University

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Forests, fire histories, and futures of Columbian and Rocky Mountain forests, western Canada

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Abstract: *Throughout the past few decades, shifting perspectives on fire management have led to the recognition that disturbance by fire is critical in maintaining ecological resilience in fire-adapted forests and grasslands. Long-term fire histories provide important information for land and resource managers seeking to understand the controls on wildfire dynamics in western North America. In this paper we summarize fire history research that has recently been undertaken in the Canadian Cordillera. Using proxy records to reconstruct fire activity and vegetation change, these studies shared the overarching goal of identifying factors that control long-term fire regimes. A further aim was to identify how human activity has measurably altered various aspects of fire regimes. Looking to the future, these studies highlight the need to continue integrating information about local fire regimes and historical land-use activities when developing responsible fire and resource management strategies and identifying conservation priorities.*

Introduction

During the Holocene in western Canada, forest compositions, structures, and disturbance regimes have varied in response to biotic and abiotic processes. Paleoecological records of the post-glacial range expansion of conifers have shown that trees typically migrated from southern refugia early in the Holocene as climate and dispersal limitations were overcome (McLeod et al. 1997). Climatic conditions suitable for forest reestablishment likely emerged between 17,000 and 14,000 yr BP (McLeod and MacDonald 1997) and most arboreal species reached their post-glacial extents by ca. 8000 BP (MacDonald 1989; Pisaric et al. 2003). Climatic and dispersal constraints controlled forest compositions at a large scale, and modern species assemblages established by the mid-Holocene, ca. 5000 - 4500 yr BP (Luckman et al. 1986; MacDonald 1989; Beaudoin et al. 1990; Hebda 1995; Gavin et al. 2006; Courtney Mustaphi et al. 2014b). Throughout several millennia, human occupation and land use have co-evolved with the development of western forest systems.

The recent histories of western forests are characterized by the steadily increasing influence of human activities on forest composition, extent, and disturbance regimes. These forests have been particularly influenced by the use of fire by Indigenous peoples (Barrett et al. 1982; MacLaren 2007), European settlement and colonial forestry activities (Troup 1932; Brownstein 2016), and industrial forestry and modern management (Keane et al. 2002; Munteanu et al. 2015). At present, several additional pressures are being exerted on these and

forests including global climate change impacts (Flannigan, Krawchuk, et al. 2009; Krawchuk et al. 2009), and an increasing human population and a more complex wildland-urban interface (WUI) (McGee 2007), and differing land and resource management perspectives. Understanding the socio-ecological dynamics of these forests is crucial to developing evidence-based and outcomes-oriented management plans and objectives (Arno et al. 2000; Bergeron et al. 2004) to optimize the natural capital benefits to community economic development (Markey et al. 2005), conservation, and non-pecuniary values.

Fire histories and management in western Canada

Fire protection policies were initiated in Canada in the early 20th century, spurred by a series of severe fire seasons that occurred in the late 1890s and early 1900s (Flannigan, Stocks, et al. 2009). The development of modern firefighting technologies has enabled a significant reduction in the overall extent and severity of wildfires in many parts of western Canada since the European settlement era (Tande 1979; Cochrane 2007; Dinh 2014). While intense suppression efforts were on-going throughout the 1900s, the ecological consequences of those same activities were largely overlooked due the gradual nature of their emergence (Keane et al. 2002). Wildfire is an important ecological process in the western forests of North America. It is crucial for maintaining landscape heterogeneity (Rhemtulla et al. 2002; Chavardès et al. 2016), biogeochemical cycling (McLauchlan et al. 2014), disruption of pests (Axelson et al. 2010), and is important for the success of certain taxa (e.g., Pinus albicaulis; Tomback et al. 2001; Moody 2006). Accordingly, fire suppression in western landscapes has contributed to changes in forest stand composition and structure, transformed wildlife habitat, and has altered nutrient and water cycling (Keane et al. 2002). Further, increasing fuel loads as biomass accumulates in unburned areas (Bowman et al. 2013) and thickening of woody plants in rangelands that are not subject to frequent, low-intensity burning, increase the likelihood of hazardous fires occurring that are difficult to control. The risk of large and severe wildfires is also amplified by the effects of on-going climate change. Longer, and thus more severe fire seasons are expected for the interior and southern Cordillera of western Canada as temperatures continue to rise (Wang et al. 2015). As the fire risk grows, traditional management (suppression) activities are likely to become "ecologically and economically unsustainable" (Bowman et al. 2013).

In the past several decades, the ecological consequences of long-term fire suppression have emerged, and land and resource managers have begun to recognize the integral role of wildfire in maintaining healthy forests and grasslands (MacLaren 2007; Flannigan, Stocks, et al. 2009; Theberge et al. 2015). Attitudes have begun to shift towards more sustainable fire management policies (e.g., prescribed fire, forest thinning, allowing fires to burn unimpeded when possible), and so too has the information used to guide decision making processes. A series of ongoing projects with the primary aim of identifying biotic and abiotic factors that have historically been important drivers of local-regional fire regimes in the Canadian Cordillera. By providing a better understanding of the processes that influence wildfires over various spatial and temporal scales, these studies can provide a

scientific basis to inform on-going land and resource management, conservation, and fire control policy throughout the region.

Ongoing research in the Columbia and Rocky Mountain forests

There have been multiple studies published on the postglacial and recent histories of forests in southeastern British Columbia and western Alberta (Table 1; Figure 1). These include lake sediment studies of subfossil plant remains and dendrochronological studies of tree rings to examine how the forests evolved over time and to understand the long-term environmental processes. By analyzing ecological proxies preserved in the sediment deposited on lake bottoms, lake sediment analysis has been used to examine interactions between Holocene climate, infrequent high severity fires, and vegetation changes (Gavin et al. 2006; Hallett et al. 2006; Courtney Mustaphi et al. 2013; Davis et al. 2016; Stretch 2016). Using information gleaned from the tree-ring records of dead and living trees, dendrochronological studies have used fire scars and forest-stand establishment dates to reconstruct spatially explicit fire histories at the centennial scale. These studies have informed us of how stand age structures emerge following fire events, and combining extensive fire scar sampling with stand-ages has permitted analyses of mixed-severity fire regimes (Nesbitt 2010; Greene 2011; Marcoux et al. 2013; Marcoux et al. 2015). The influence of climate on pest and disease cycles remains an important focus and there are emerging paleoenvironmental tools for examining these dynamics over long time periods (Daniels et al. 2011; Morris, Courtney Mustaphi, et al. 2015; Morris, McLauchlan, et al. 2015).

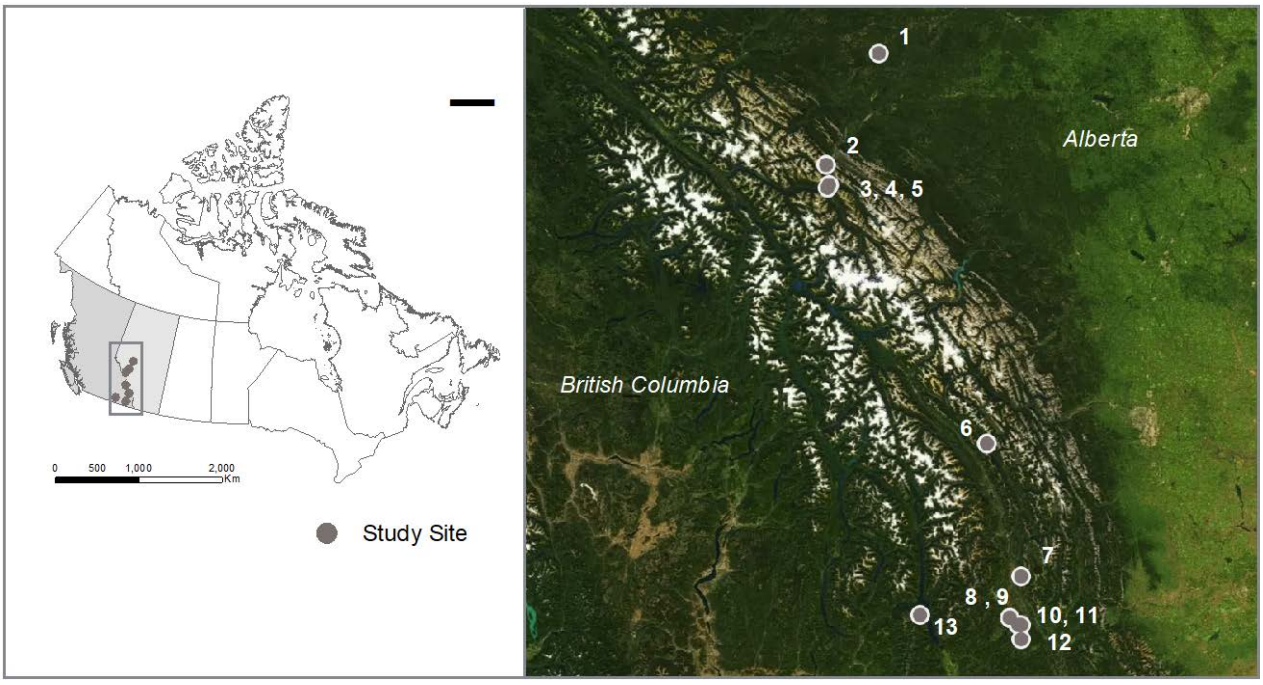

Figure 1 Several fire history studies have recently been completed in the Canadian Cordillera of Alberta and British Columbia, Canada (see Table 1 for corresponding references).

Table 1 Location of fire history studies and primary methods used (**[n]** Corresponds to study sites in Figure 1).

Paleolimnology		
Methods	*Study Area*	*Reference*
Palynology, macroscopic charcoal, sedimentology	Columbia Mountains, southeastern B.C.	Courtney Mustaphi (2013); Courtney Mustaphi and Pisaric (2013); Courtney Mustaphi and Pisaric (2014); Courtney Mustaphi et al. (2015) [13]
Macroscopic charcoal morphologies	Pyatts Lake, Rocky Mountain Trench, southeastern B.C.	Courtney Mustaphi and Pisaric (2014) [8]
Diatoms, biogenic silica, Chl *a*, sedimentology	Jasper National Park, AB; Hinton Wood Products Forest Management Area, Hinton, AB	Gall (2016) [5]
Dendrochronology		
Methods	*Study Area*	*Reference*
Fire scars, tree ages, stand structure	Jasper National Park (north of townsite), AB	Chavardès (2014); Chavardès and Daniels (2015) [2]
Fire scars	Southern Rocky Mountain Trench, southeastern B.C.	Cochrane (2007) [7]
Fire scars, species distributions	Joseph and Gold Creek Watersheds, East Kootenay Mountains, B.C.	Da Silva (2009) [10]
Fire scars	Jasper National Park (townsite), AB	Dinh (2014) [4]
Fire scars, tree ages, geospatial analysis, disturbance classification	Darkwoods, South Selkirk Natural Area, southeastern B.C.	Greene (2011); Greene et al. (2014) [9]
Fire scars, tree ages, stand structure	Kootenay Valley, Kootenay National Park, B.C.	Kubian (2013) [6]
Fire scars, tree ages	Nelson, B.C.	Nesbitt (2010) [12]
Fire scars, tree ages, stand structure, disturbance classification	Joseph and Gold Creek Watersheds, East Kootenay Mountains, B.C.	Marcoux et al. (2013; 2015) [11]
Multiple Proxies		
Methods	*Study Area*	*Reference*
Fire scars, tree ages, macroscopic charcoal, palynology, sedimentology	Jasper National Park (townsite), AB	Davis et al. (*in press*) [3]
Fire scars, tree ages, stand structure, macroscopic charcoal, sedimentology	Hinton Wood Products Forest Management Area, Rocky Mountain foothills, Hinton, AB	Stretch (2016); Stretch et al. (2016) [1]

The information about local-regional fire regimes is notable and has wide ranging implications for the development of policy around wildfire and resource management. In the montane ecoregion of Jasper National Park, dendrochronological analyses have been used to examine the recent fire histories using stand establishment data and

records of fire events preserved in fire scars (Dinh 2014; Chavardès and Daniels 2016; Davis et al. 2016). These fire histories have helped to reveal the extensive influence of humans on the fire regime in Jasper. Chavardès and Daniels (2016) found evidence of a significant decrease in fire activity since the onset of fire suppression era and an overall homogenization of the forest system studied. Dinh (2014) saw a similar decrease in fire activity in the latter half of the 20th century in Jasper, as well as a shift in the seasonality of fire events. They attribute this shift from early season to late season fires to the relocation of Indigenous peoples, who used regularly used fire as a land management tool, from the park in 1910 (MacLaren 2007; Dinh 2014). Many of the impacts of modern fire suppression are now widely documented (e.g., homogenization of forest system, reduction in overall fire activity, loss of grassland extent, change in seasonailty of surface fires; Rhemtulla et al. 2002; Dinh 2014; Chavardès and Daniels 2016; Davis et al. 2016), such that the reintroduction of wildfires to this protected landscape has emerged as an important and on-going conservation issue in Jasper (Parks Canada Agency 2015). Fire management is a challenging process in Jasper and other protected areas in Canada. Disturbance by wildfires is required in order to maintain "ecological integrity", a federally mandated objective of national parks, but this must be balanced with the need to protect human life, infrastructure, and recreational opportunities for visitors (Theberge et al. 2015).

Further south, in southeastern British Columbia, several tree-ring studies have been conducted to investigate various aspects of the local fire regimes. Working in the Joseph and Gold Creek watersheds, Da Silva (2009) found evidence of reduced fire activity and landscape homogenization in their 33 study plots. Taken together, it is suggested that this has set up the conditions for the increased risk of large, high-severity fires occurring at the region's wildland-urban interface. Working in the same watershed areas, Marcoux et al. (2015) used dendrochronological techniques to identify the type of fire regimes characteristic of the surrounding forest. Their research determined that a significant portion of the study area is typified by mixed-severity fire regimes, where fires of differing severities overlap spatially. Until recently, the extent of mixed-severity fire regimes in the Canadian Rocky Mountains has been largely overlooked (Marcoux et al. 2013), a significant oversight given the species diversity and complex forest structures associated with the regime type (Arno et al. 2000). Accurately identifying the variability of a fire regime is a necessary step for developing fire management plans that reflect typical frequency, size and severity of fires in a given area. Finally, in their study area in Rocky Mountain trench near the Purcell Mountains, Cochrane (2007) identified a decline in fire activity in the contemporary suppression era compared to the period of European settlement when fire activity was at its modern peak. Notably, they also found significant variability in fire activity between study plots, suggesting that a single, overarching fire management prescription would be unsuitable for the area.

Long-term records of climate, vegetation composition, and fire history have now been developed for many areas of the western Cordillera using lake sediment analysis (Courtney Mustaphi and Pisaric 2013; Courtney Mustaphi and Pisaric 2014b; Davis

et al. 2016; Gall 2016). Focusing on longer time scales than tree-ring analysis, these studies have revealed important interactions between fire activity and local-regional environmental conditions. Working in the Columbia Mountains of southeastern British Columbia, Courtney Mustaphi and Pisaric (2013) developed 5000 yr fire histories for three lakes in the region, and found that local factors such as slope aspect, as well as top-down factors, such as regional climate, were important in determining the frequency of fire events over time. Further, their work has also identified forest biomass to be an important driver of fire activity, such that biomass and fuel accumulation can serve as a triggers of fire activity (Courtney Mustaphi and Pisaric 2014b). Long-term fire histories such as these are rich sources of information for developing fire management strategies that are based on emulating the historical range of variability (HRV) in disturbance regimes (Davis et al. 2016). An HRV approach to fire management involves reintroducing fire in a manner that is reflective of the general fire regime of the area (Keane et al. 2009). Information derived from lake sediment cores about the type and frequency of wildfires can be used as baseline data during conservation efforts in fire-suppressed landscapes.

Combining information from lake sediment records with dendrochronology offers an opportunity to understand factors of the wildfire regime over multiple spatial and temporal scales (Davis et al. 2016; Stretch 2016; Stretch et al. 2016). For example, in the Hinton Wood Products Forest Management Area (FMA) in the foothills region of west-central Alberta, Stretch (2016), combined records of macroscopic charcoal preserved in lake sediment with dendrochronological sampling of the surrounding forest. The results of their research provided evidence of a mixed-severity fire regime in the region. Furthermore, they demonstrated that traditional methods of classifying fire events are biased against the detections of mixed-severity fires (Stretch 2016). This information can now be used to inform management strategies during resource extraction in the forest management area. Listed as being at high to extreme risk of wildfire, the Hinton Wood Products FMA is currently being harvested using silviculture practices that attempt to mimic natural disturbances, such as wildfire (Hinton Wood Products 2010; Stretch 2016).

Conclusions and Future Directions

The need for science for to inform restoration activities is significant in degraded ecosystems worldwide (Suding 2011). Paleoecology, which includes lake sediment and tree-ring analyses, presents an opportunity to determine baselines and ecosystem variability and to inform conservation strategies (Froyd et al. 2008). There remain new opportunities for emerging techniques to further enhance our understanding about historical fire regimes. In particular, opportunities exist to advance methods of analysis to glean new information from both tree-ring and lake sediment proxy data. For example, examining the morphology of charcoal particles preserved in lake sediment offers insights into vegetation structure (open versus closed forests), fire regimes (severity, burned area), or charcoal taphonomy (transport and deposition) to the lake system over time (Courtney Mustaphi et al. 2014a). Further, in recognition of the need to understand ecological processes at multiple spatial and temporal scales, opportunities exist for further integration of lake sediment analyses with tree-ring sampling. Tree-ring

analyses offer relatively short-term (hundreds of years) fire histories at a high temporal and spatial resolution, whereas lake sediment analysis provides information about climate, vegetation, and fire over long time periods (thousands of years) at a low resolution. Combining these techniques in a single fire history study helps to overcome the limitations imposed by each proxy type (e.g., Davis et al. 2016; Stretch 2016).

Overall, improvements in the techniques used to collect and analyze proxy data have made a significant amount of information available regarding the recent and long-term history of fire regimes in western Canada. One area of fire history research in particular that deserves further attention is in identifying approaches for integrating the cultural, economic, and societal values of western forests with the type of information derived from tree-ring and lake sediment analyses. The most thorough classifications of the historical fire regime are of little socio-ecological value if the information cannot be translated to management or restoration activities. Fire and land management goals differ significantly depending on the stakeholders involved in the decision making process. For example, the fire history information required by protected area managers is used to help reintroduce fire in a way that reflect the historical range of variability in the fire regime of the area, whereas the aim of resource managers is to continue harvesting activities in a manner that emulates disturbance by fire. Accordingly, the associated costs (economic, ecological, and societal) of prescribed burning or reducing suppression efforts will be viewed differently in protected areas (e.g., national or provincial park) relative to a timber extraction context. Identifying the objectives of management activities from the outset will remain an essential consideration for future fire history studies in the Canadian Cordillera.

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Reduction of wildland-urban-interface fire risk in Kelowna, Canada

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Abstract: *This study investigates the trajectory of wildland-urban-interface (WUI) fire risk over the period 2004-15 in two neighbourhoods of Kelowna BC, and evaluates progress in risk reduction following the disastrous Okanagan Mountain fire of 2003. Results show that WUI fire risk is increasing, partly because of an increase in wildfires but mostly because of rapid residential expansion into WUI areas. Recommendations by the provincial government to reduce the WUI fire risk in Kelowna following the 2003 and earlier WUI fire disasters in the province have been only partially implemented. Instead, emphasis is being placed on largely voluntary measures by the development industry and individual homeowners to reduce risk. To halt the increase in risk, such voluntary measures need to be blended with strategies such as mandatory use of less combustible building materials in new construction, land-use and roadway planning focused on fire risk reduction, and mandatory programs to reduce ignitability in older neighbourhoods.*

Introduction

Human settlement of wildland-urban-interface (WUI) areas (McKee et al., 2004; Smith, 2013; Wildfire Management Branch, 2013) has transformed wildfires into a significant hazard in Canada in recent decades (Pyne, 2007). This is especially so in British Columbia (BC) with its mountainous terrain, large expanses of coniferous forest, and dry summers (Omi, 2005; Pyne, 2007). The high level of hazard was illustrated dramatically by the WUI fires of 2003 in BC which were the largest and most intense, expensive, and destructive wildfires in the province's history (Pyne, 2007).

While much research on the social science aspects of WUI fire hazard occurred in North America in the 1980s and early 1990s, interest in the human dimensions of this hazard waned in the decade following (Cortner and Field, 2004). This hiatus creates the need today for a more current understanding of WUI fire hazard and risk reduction strategies in the context of changing social values, increased awareness of the issues, and new policy initiatives (Cortner and Field, 2004). The need for risk reduction research that can be translated into management actions is all the more urgent as the level of risk from WUI fires increases due to changes in population distribution, expansion of cities, and encroachment of residential housing into WUI areas (Natural Resources Canada, 2012).

This study investigates the trajectory of WUI fire risk and adoption of risk reduction measures in Kelowna BC, the largest community to be impacted by the disastrous 2003 WUI fire season described below. Many Canadian communities, including Kelowna, have become proficient in responding to WUI fires during the emergency phase, and some investments in modification of the fire system (forest fuel reduction etc.) have been made in recent

years. However, we contend that most WUI communities fall short in terms of designing urban growth to be more fire resistant and therefore less exposed to WUI fire disasters. As noted by the Association of BC Forest Fire Professionals (2005), "from a policy perspective in BC, [the province] is putting significant emphasis on managing suppression response, but only a limited emphasis on managing wildfire risk" (p. 8). Most proactive measures to reduce WUI fire risk in these communities are predicated on the responsibility of individual homeowners and the development industry (Dotto et al., 2010), through voluntary measures to create fire-resistant zones around dwellings. There is rarely any discussion of the roles and responsibilities of government and other agencies regarding adaptive strategies such as land-use planning, use of wider buffer zones around WUI communities, and regulations—rather than simply guidelines—requiring fire-resistant building materials (Smith, 2013).

The objectives of this study are to (1) employ the risk equation outlined below as a framework for assessing the trajectory of WUI fire risk in Kelowna, and (2) evaluate the adoption of the key recommendations of the report examining the response to the disastrous WUI fires of 2003 in BC (Office of the Auditor General, 2004). In this way we hope to provide some insights into WUI fire risk in a city that is expanding rapidly into WUI areas, and whether largely voluntary risk reduction measures can be effective.

Fire Hazard in the WUI

Near human communities, the ecosystem benefits of wildfires (Pyne at al., 1996; Omi, 2005; Pyne, 2007) are usually overshadowed by the hazard created, especially in WUI areas. The level of risk from this hazard can be evaluated by consideration of the typical risk equation $R = P \times E \times V$ where R is the level of risk, P is the probability of wildfire in the WUI area, E represents the elements at risk, and V is the vulnerability of those elements (Smith, 2013). McKee et al. (2004) illustrate how such a risk equation can be applied to thinking about fire risk in WUI areas. An increase or decrease in any one of the components of this equation has the effect of altering the risk level. For example, the United States' Federal Emergency Management Agency (2006) illustrates that the highest risk from WUI fires occurs when there is high fire danger (high P) and a high level of development in the hazard area (high E), and vulnerability of that development is increased by factors such as flammable roofing materials (Gill et al., 2013) and limited access and egress routes (high V).

The probability of wildfires in Canada is expected to increase in future, largely because of anthropogenic climate change (Gillett et al., 2004; Girardin and Mudelsee, 2008). In BC, the length of the summer wildfire season has increased on average by one to two days per year since 1980, and the annual area burned and cost of fighting wildfires are both expected to rise in the future (Ministry of Forests, 2009). The southern interior of the province is expected to experience the most significant increases in fire indices (Haughian et al., 2012). Furthermore, water-stressed and drought-prone areas, such as the Okanagan Valley in which Kelowna is situated, are particularly prone to the increased frequency and intensity of severe weather events which create wildfire conditions (Cohen and Kulkarni, 2001). Therefore, it appears almost certain that in Kelowna, P in the risk equation will increase markedly in the future (Belliveau et al., 2006), even though this may

be disguised by large year-to-year fluctuations in fire weather.

The WUI area poses a significant wildfire hazard in many regions of the world, particularly those with a marked dry season, extensive wildland vegetation such as forest and brush, and encroachment of low-density suburbs into these vegetated areas (Gill et al., 2013; Smith, 2013). In BC the high level of hazard in WUI areas arises for two main reasons. First, decades of successful fire suppression have allowed tree stand densities to increase and vegetation to accumulate, increasing the availability of fire fuels. Second, an increasing number of people choose to live in WUI areas of the province, which places more residents in hazardous areas (Strelioff, 2002). Concerns regarding the WUI fire hazard in BC have been expressed by Strelioff (2002) and in numerous earlier reports including the Ministry of Forests (1987; 1998) and Emergency Management British Columbia et al. (2002). However, only some of these reports' recommendations to mitigate the hazard have been adopted. As a result, 2003 became the worst year on record for wildfires in the province, particularly with respect to damaging WUI fires (Office of the Auditor General, 2004).

Any detailed assessment of the risk associated with WUI fires requires a more precise definition of the WUI than is typically found in discussions about fire hazard. The WUI has been variously described as:

> *The area where houses meet or intermingle with undeveloped wildland vegetation. (USDA and USDI, 2001)*
>
> *An area in and adjacent to a neighbourhood or community where the immediate or secondary effects of a wildland fire threaten at-risk values and will be a serious detriment to the area's overall health and vulnerability. (Summerfelt, 2003 p. 7)*
>
> *That geographical area where structures and other human development meets or intermingles with wildland or vegetative fuels. (International Code Council Inc., 2012)*
>
> *Any area where combustible wildland fuels are found adjacent to homes, farm structures, and other outbuildings (Firesmart Canada, 2013).*

The geographical point where the diverse values of the wilderness and urban development meet. In the interface, structures and vegetation are sufficiently close that a wildfire may spread to structures or a structural fire may ignite trees and vegetation. (Wildfire Management Branch, 2015)

Such relatively simple definitions of the WUI do not address the multifaceted nature of interfaces. A typical or 'interface' WUI exists where a well-defined boundary between structures and wildland fuels exists along roads or back fences, and wildland fuels do not extend into the developed area (Weatherford, 2002; Radeloff et al., 2005; Stewart et al., 2007; Mell et al., 2010; Emergency Management BC, 2013; Firesmart Canada, 2013). An 'intermix' or 'mixed' WUI is characterized by isolated homes, subdivisions, infrastructures and small communities that are scattered within a wildland area. Wildland fuels extend around and within the developed area (Weatherford, 2002; Radeloff et al., 2005; Stewart et al., 2007; Mell et al., 2010; Emergency Management BC, 2013; Firesmart Canada, 2013; Morrow et al.,

2013; Smith, 2013). An 'occluded' WUI occurs where islands of wildland vegetation, in parks or other open spaces, occur inside a largely urbanized area (Weatherford, 2002; Mell et al., 2010; Emergency Management BC, 2013). 'Rural' WUI areas consist of small clusters of structures, for example ranches, farms, resorts, logging camps and mines, inside extensive areas of wildland vegetation (Weatherford, 2002). This last type is not considered in the current study even though rural WUI areas near Kelowna face a significant fire threat.

Implicit in all of these definitions of the WUI is the inclusion of three components with imprecise and variable operational definitions: human presence, the fire characteristics of the wildland vegetation, and a buffer distance that represents the potential for wildfire effects to extend from the edge of the wildland vegetation into built-up areas (Stewart et al., 2007). Human presence as it relates to WUI fire risk can be measured in a variety of ways. At a national scale, housing density may be the metric most closely related to the size and growth of the WUI (Radeloff et al., 2005; Stewart et al., 2007). At neighbourhood scales where residential lot sizes are generally reasonably uniform, the number of residential structures is probably a suitable measure of the elements at risk (*E* in the risk equation in section 2). In the current study, the problem of defining the fire characteristics of the wildland vegetation is largely absent because the vegetation consists entirely of flammable coniferous forest and grassland. The buffer width over which the effects of wildland fire are felt is commonly defined as the distance over which a golf ball hit from a porch will fly and the distance over which flames or burning embers can reach a structure (Summerfelt, 2003; Stewart et al., 2007). These definitions describe a buffer width of anywhere from 10 to 200 m (Summerfelt, 2003). However, in windy conditions, burning embers can ignite spot fires many kilometres ahead of a fire front (Protection Branch, 2003; Victorian Bushfires Royal Commission, 2010; Gill et al., 2013; Smith, 2013). In North America the maximum spotting distance in windy conditions is typically regarded as 2-2.4 km (California Fire Alliance, 2001; Radeloff et al., 2005; Stewart et al., 2007; Morrow et al., 2013) although slightly greater distances are occasionally employed (e.g. 3.2 km in Theobald and Romme, 2007). WUI areas can also be defined onthe basis of sophisticated assessments of fire and ember exposure (Mell et al., 2010; Maranghides and Mell, 2013).

Study Area

Kelowna is situated in the Okanagan Valley in the southern interior of BC, Canada (Figure 1). A semi-arid climate (mean annual precipitation 345-414 mm; Environment Canada, 2014), summers with daytime high temperatures often exceeding 30°C (Environment Canada, 2014), and extremely high evaporative losses provide ideal weather for summer wildfires. Seventy-two percent of the remaining natural areas within the city are composed of open grassland or open stands of *Pinus ponderosa* (Diamond Head Consulting Ltd., 2011). These provide fuel for fast moving, low intensity ground fires which can carry fire to adjacent, more flammable closed stands of *Pinus ponderosa*, *Pinus contorta* var. *latifolia* and *Pseudotsuga menziesii* var. *glauca*. These stands of evergreen coniferous trees inside and adjacent to the city pose by far the greatest fire hazard (Diamond Head Consulting Ltd., 2011). Many of these trees have in recent years been killed by an

outbreak of pine beetle, leaving highly flammable standing dead trees that require removal.

Population growth and urban development have significantly increased Kelowna's exposure to WUI fires in recent years. Over the decade 2001-2011 for example, the city's population increased by 22% to 117,300 (City of Kelowna, 2013). Because the city is situated in a narrow valley surrounded by high-elevation plateaus (Figure 1), land suitable for development is scarce. Furthermore, 40% of the remaining undeveloped land within the city boundaries is agricultural land protected from urban development. The lack of valley-bottom land for development combined with rapid population growth and the amenity values associated with the city's periphery have resulted in expansion of the city onto surrounding heavily forested hillsides in the south, east and northwest (Figure 1).

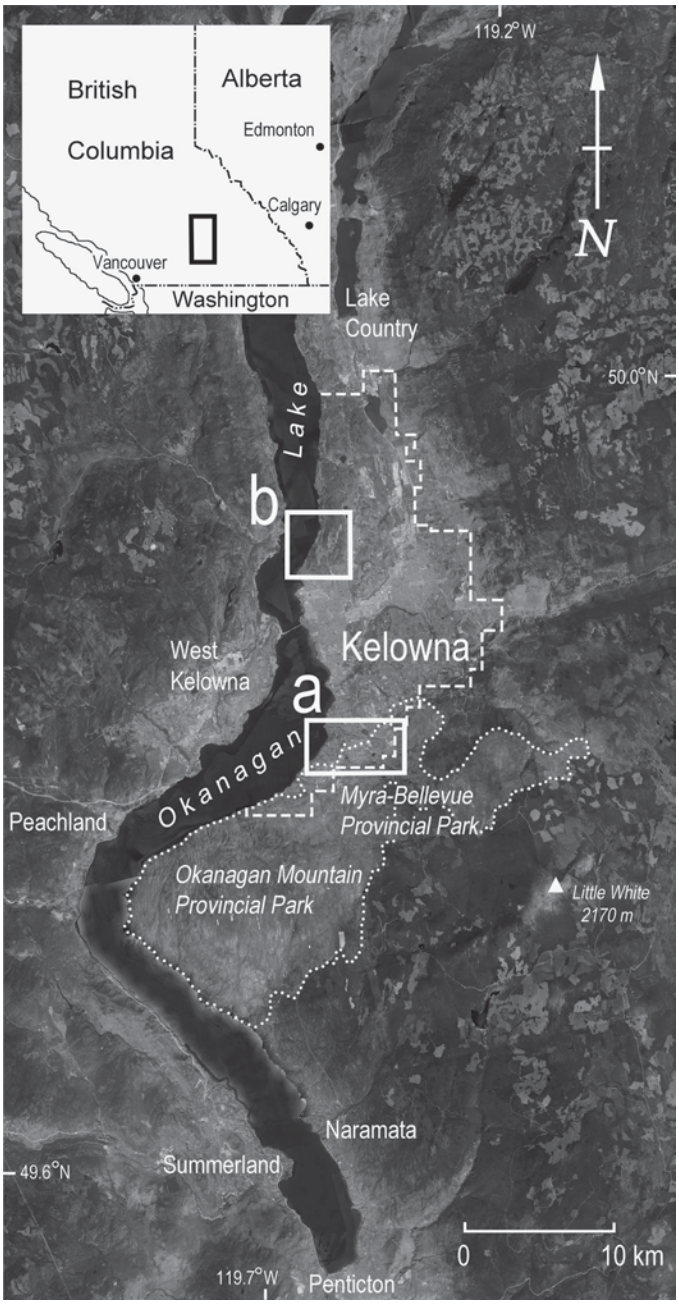

Figure 1. Study areas: (a) Upper Mission. (b) Glenmore Highlands. The dashed line indicates the boundaries of Kelowna and the dotted line the area burned by the 2003 OM fire. Source image: Google earth, Landsat.

2003 Okanagan Mountain Fire Disaster

The BC fire season of summer 2003 saw 2,500 wildfires, 45,000 people evacuated, and 334 homes destroyed, with a total economic impact of over CAD 700 million (Office of the Auditor General, 2004). The Okanagan Mountain (OM) fire in Kelowna that year was the most significant WUI fire in BC history. Triggered in mid-August by a lightning strike along the southwest

shoreline of Okanagan Mountain Provincial Park (Figure 1), and aided by large fuel loads dried out by a severe drought in Okanagan Mountain and Myra-Bellevue Provincial Parks (Freake and Plante, 2004), the fire had a week later destroyed 239 homes along the southern boundary of Kelowna and resulted in the evacuation of more than 33,000 residents (City of Kelowna Emergency Services, 2013). The OM fire was finally extinguished by cooler, wetter weather in October 2003 after burning over 25,000 ha of forest (Figure 1).

Shortly after this disaster, a provincial review team named the Filmon Commission was tasked by the BC government to evaluate the overall response to the 2003 fires in the province and to make recommendations for reducing WUI fire risk in future fire seasons. Many aspects of the WUI fire hazard were covered by the review including forest management, emergency preparedness and planning, firefighting, operation of emergency centres, evacuations, resettlement, and post-emergency recovery. The findings and recommendations in the Filmon Commission report (Office of the Auditor General, 2004) were directed at all levels of government as well as individual actors involved in WUI fire risk reduction in BC.

Methods

The risk equation described earlier in this paper is employed as the conceptual framework for this study. The probability of a WUI fire (*P*) is not the focus of this study but is reviewed briefly above to provide a sense of how it might affect the total risk *R*. The focus in this study is on the elements at risk (*E*) and their vulnerability (*V*). Residential structures are the focus of *E* because it is almost exclusively residential areas that are exposed to WUI fire hazard in Kelowna. The risk to residential structures provides a good indication of the risk to human life (Gill et al., 2013) and can in a crude way also reflect the potential for other less easily measured disaster impacts such as economic losses and disruptions to community routines and services.

First, residential structures in the WUI were analyzed to see if *E* in the risk equation is increasing because of changes in the extent of the WUI and number of structures within it. Two areas of the city were selected for this portion of the study: the Upper Mission and Glenmore Highlands (Figure 1). The Upper Mission has experienced a dramatic surge in re-building and new development following catastrophic damage there from the 2003 OM fire. The Glenmore Highlands represent an area with a combination of old and new development in a forested area that has no recent history of fires. The changing nature of *E* was analyzed by first examining designated WUI fire hazard zones and areas of current and future residential development. A detailed spatial analysis of changes in the WUI was then carried out by measuring changes in the length of the wildland-vegetation edge in the two study areas, using high-resolution Google Earth imagery from 2004 and 2015. Occluded interface areas, described above, were included in the wildland-vegetation edge if they are connected to extensive forested areas outside the city by corridors of wildland vegetation or consist of significant hills with extensive wildland vegetation.

The mapped wildland-vegetation edge in 2004 and 2015 was then used to construct a 200 m wide interface zone where exposure of structures to the effects of WUI fire is greatest, as described above. A 200 m buffer width was chosen because it represents the

outside limit of the most commonly conceived view of the WUI (Summerfelt, 2003). Observations made after the 2003 OM fire confirm that in most areas the large majority of destruction and damage was confined to this 200 m buffer. A much wider interface zone of 2-2.4 km is too wide to have permitted an analysis of changes from 2004 to 2015 because both study areas (Figure 1) fall entirely within this zone. The number of structures in the 200 m interface zone in 2004 and 2015 was then counted. Structures within intermix WUI zones (see above), consisting of isolated structures and small groups of residences, were included in these counts. Almost all structures counted within the 200 m interface and intermix zones are single-family residences, but for the few multi-family complexes, individual units were counted as separate structures. A small number of other structures such as large detached garages and workshops, schools, churches, electricity sub-stations, water pumping stations, and large farm buildings were included in the counts.

Progress on adopting selected key recommendations of the Filmon Commission report (Office of the Auditor General, 2004) was evaluated through semi-structured expert interviews. The purposive sample was drawn from an inventory of WUI fire risk reduction experts who were selected on the basis of having responsibility for administering hazard and risk reduction programs within the City of Kelowna, local and regional fire departments, Emergency Management BC, the Wildfire Management Branch of the Ministry of Forests, and BC Parks. This permitted a wide range of agency perspectives to be gathered. Expert interviews were chosen to uncover the construct of policy making in political environments (Dexter, 1970) and to understand decision-making processes and policy impacts (Marshall and Rossman, 2010). Semi-structured and open-ended interviews were chosen over questionnaires in order to explore intensive, specific processes with a small sample (Cloke et al., 2004) and better allow interviewees to construct accounts of their experiences in their own words (Valentine, 2005). The interviews were audio recorded and then transcribed. Emic coding was applied to the transcriptions to evaluate progress on the key recommendations of the Filmon Commission (Office of the Auditor General, 2004). Etic coding was also assigned to identify key themes and quotes related to this progress (Crang, 2005). Finally, a categorical analysis was performed rating progress on the Filmon Commission recommendations as very minor, less than half, more than half, or complete.

The current vulnerability of residential areas (*V* in the risk equation in section 2) in the Upper Mission and Glenmore Highlands was evaluated using field photography. The intent was to evaluate measures by the development industry and homeowners to reduce WUI fire risk, with a focus on the use of appropriate building materials and creation of defensible spaces. Residences to be photographed were chosen on the basis of how well or poorly they illustrate these modifications, and the ease with which they could be photographed from the street.

Results and Discussion

Elements at Risk

Figure 2 illustrates the overlap between WUI hazard zones and areas of existing and future residential development designated by the City of Kelowna. Much of the older residential development in the Upper Mission is located adjacent to WUI fire hazard zones (Figure 2a). For example, the

development near Okanagan Lake in the vicinity of Lakeshore and Okaview Roads pre-dates the 2003 OM fire and was impacted to a variable extent by that fire. Most of the development further south and east in Figure 2a has occurred after 2003. Figure 2a also shows that future development will occur almost entirely in WUI fire hazard zones. In addition, significant portions of this zone have been set aside by the city as a future urban reserve (Figure 2a): "...land that has some development potential but is not projected for development within the Official Community Plan 20-year time horizon" (City of Kelowna, 2011b). Figures 3a-b show the change in the wildland-vegetation edge between 2004 and 2015. Table 1 shows the numerical change in the length of this edge and number of structures in the 200 m wide interface and intermix zones. The length of the wildland-vegetation edge, where residential structures abut wildland vegetation, has increased by only 12% over the past 11 years. Yet the number of structures within the 200 m interface zone has increased by 100% (Table 1). Perhaps more significantly, the number of structures within the intermix zone, although relatively small in absolute terms, has increased by 330% (Table 1). These changes indicate that *E* in the risk equation has increased significantly in the Upper Mission. The increase in the number of intermix structures also increases vulnerability (*V* in the risk equation) because these isolated pockets of development frequently have limited access and egress. As discussed further in section 5.4, efficient evacuation from these areas during a rapid-onset WUI fire may therefore be problematic until these pockets of development are eventually swallowed up by further urban growth.

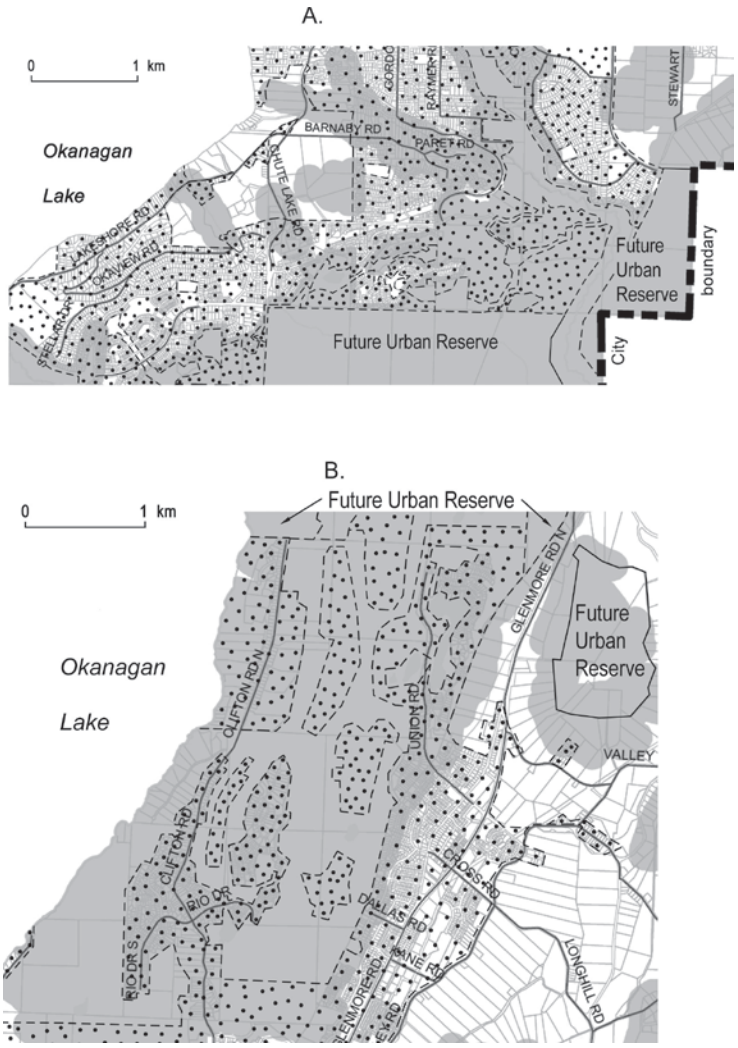

Figure 2. WUI fire hazard zones and existing and future residential development. Residential development is shown by dotted areas enclosed by thin dashed lines: Existing development is indicated by streets and individual lots (light grey lines) while areas slated for future development do not contain streets and lots. "Future urban reserve" areas are described in the text. Areas shaded in grey are WUI fire hazard zones (a) Upper Mission, (b) Glenmore Highlands. Modified from City of Kelowna (2011b).

Table 1: Changes in the length of the wildland-vegetation edge and number of structures in the WUI, 2004-2015: Upper Mission and Glenmore Highlands

	Upper Mission			Glenmore Highlands		
	2004-12-30	2015-04-04	% change	2004-05-31	2015-04-04	% change
Study area size (km^2)	23.3	–	–	23.8	–	–
Wildland-vegetation edge length (km)	30.0	33.6	+12	24.8	37.2	+50

Structures within 200 m interface	1346	2697	+100	1467	2173	+48
Structures within intermix zone[a]	90	387	+330	612	822	+34

[a]Includes structures also counted within the 200 m interface zone if these structures are situated in small pockets of development and surrounded by wildland vegetation.

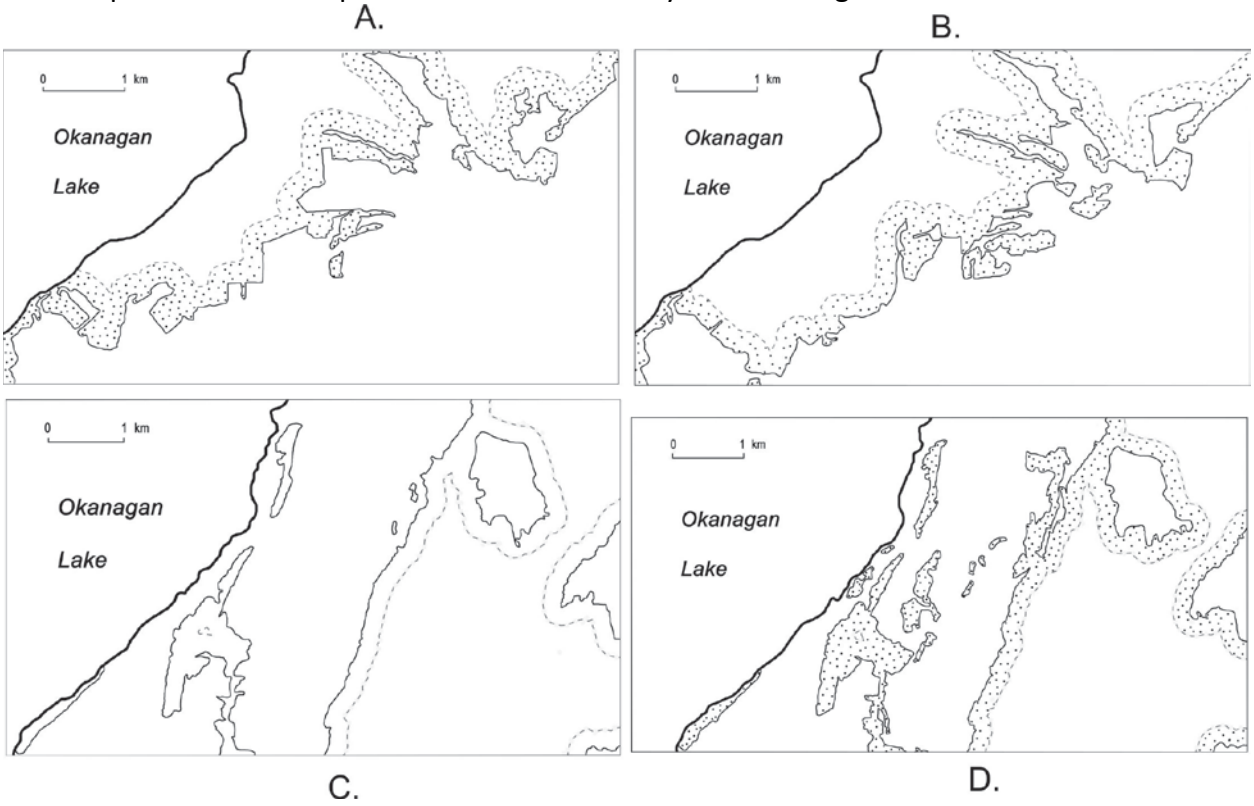

Figure 3. Evolution of the wildland-vegetation edge (solid black line) and 200 m WUI zone (dashed gray line). (a) Upper Mission, 2004 (b) Upper Mission, 2015 (c) Glenmore Highlands, 2004 (d) Glenmore Highlands, 2015.

It appears, therefore, that rather than deter development, the 2003 OM fire has been followed by rapid development in the Upper Mission since 2003 (Figure 4). Because large areas of forest within the city boundaries were burned completely in 2003 and replaced with grassland (Figure 1), land is now more easily cleared for construction by the development industry. Anecdotal evidence suggests that the removal of the forest may also have created a perception amongst residents that the area is now much less likely to be affected by WUI fires (Figure 4).

Figure 4. Rapid expansion of residential construction in the Upper Mission into areas burned by the 2003 OM fire. Burned trees in the foreground are a legacy of this fire.

In the Glenmore Highlands (Figure 2b), large areas of existing residential development and all future development are in designated WUI fire hazard zones. The Glenmore Highlands contain older neighbourhoods with a high level of exposure to WUI fire (especially in the Clifton Road area in Figure 2b), while extensive new development is currently underway in the middle of the WUI fire hazard zone (Figure 5). However, unlike the Upper Mission, the future urban reserves in the Glenmore Highlands (Figure 2b) are not sandwiched between the city and heavily forested provincial parks. Figures 3c-d show the change in the wildland-vegetation edge between 2004 and 2015. Table 1 shows the numerical change in the length of this edge and number of structures in the 200 m wide interface zone and intermix zone. The length of the wildland-vegetation edge and number of structures within the 200 m interface have increased by the same amount, 50% and 48% respectively (Table 1). While the percentage increase in structures within the intermix zone (34%) is small compared to the Upper Mission, the absolute number of intermix structures is much greater (Figures 3c-d and Table 1). Furthermore, the small clusters of residential development that constitute the intermix zone in the Glenmore Highlands (Figures 3c-d) are situated amongst steep hills and, unlike the Upper Mission, may remain surrounded by stands of coniferous forest for many years to come. These changes indicate that, as in the Upper Mission, *E* in the risk equation has increased significantly in the Glenmore Highlands. The limited access and egress in intermix zones in the Glenmore Highlands (for example in the Clifton Road and Rio Drive neighbourhoods in Figure 2b) is a more

serious issue than in the Upper Mission. The threat this poses to human life during evacuation in a sudden-onset WUI fire, with a concomitant increase in *V* in the risk equation, is discussed further below. Also, *P* in the risk equation is higher in the Glenmore Highlands compared to the Upper Mission because there have been no recent fires to remove any of the forest. Mitigating *P* somewhat in the Glenmore Highlands is the much smaller extent of forest lands to the north compared to the large high-elevation provincial parks south of the Upper Mission (Figure 1).

The results above indicate that, despite the catastrophic 2003 OM fire and almost yearly threats from WUI fires in the Okanagan Valley (Wildfire Management Branch, 2014), residential development of WUI areas in Kelowna continues at a rapid pace. This development is most rapid in the two areas selected for this study (Figures 1-2), which have previously been identified as possessing the highest level of WUI fire hazard in the city (Diamond Head Consulting Ltd., 2011). Other WUI areas of Kelowna are experiencing similar suburban development on a smaller scale.

Figure 5. New residential development in the WUI fire hazard zone, Glenmore Highlands.

Progress in Reducing Risk

Six extensive interviews were conducted with senior managers in municipal, regional and provincial governments to gauge progress made since 2004 on reducing *P* and *V* in the risk equation. Although the interviews were limited to only six individuals, the interviewees were carefully selected and represent a wide range of perspectives on management of WUI fire risk. Analysis of the interview transcripts to gauge the progress made on key recommendations relating to proactive measures to reduce *P* and *V* (Office of the Auditor General, 2004) produced the result shown in Table 2. With the exception of one recommendation relating to emergency evacuations (Table 2), included because it has an important bearing on preventing loss of life, other Filmon Commission recommendations pertaining to emergency measures such as fire suppression and post-emergency recovery were not included in the analysis because they are not the subject of this study.

Table 2: Degree of progress on key recommendations of the Filmon Commission (Office of the Auditor General 2004)

Filmon Commission recommendations	Degree of completion			
	Very minor	Less than half	More than half	Complete
Province to lead development of strategic plan for fire prevention.			→	
Undertake fuel treatment pilot projects in areas of high WUI fire risk.		→		
Adopt 'Firesmart' standards for both private and public property.			→	
Use insurance rates to encourage and reward construction to acceptable fire standards.				
Review and amend land use plans to incorporate fire management considerations.	→			
Establish standards for use of prescribed burning as a fuel reduction tool.	→			
Require municipal and regional governments to adopt province wide building regulations and land use plans to limit the impact of WUI fires.	→			
Educate WUI area residents about WUI fire risk and their roles and responsibilities.		→		
Allow more local decision making on evacuations.				→
Engage federal government on cost sharing of fire prevention initiatives.		→		

Only the recommendation pertaining to evacuations has been completed to date, while two other recommendations are judged to have been mostly completed (Table 2). Some insights into this progress to date may be obtained from the interview quotes in Table 3. Three recommendations have seen minor progress, while very little progress has been made on three others (Table 2). No progress has been made to date with the recommendation relating to insurance rates (Table 2). Quotes from the interviews in Table 4 highlight some of the thinking and obstacles behind this lack of progress.

From the results in Tables 2 and 3, it is clear that risk reduction efforts to date have focussed on emergency response, the responsibility of individual homeowners for fire proofing their properties, and the creation of plans. The 'Firesmart' program, with an emphasis on action by homeowners to reduce home and property ignitability (Firesmart Canada, 2013), has been heavily promoted in Kelowna as a way of reducing WUI fire risk in residential areas (Table 3). While placing fewer demands on community resources, this reliance on individual action is insufficient because evidence shows that homeowners' perception of the WUI fire risk and planning and preparation for fire events is modest at best, even with agency initiatives to educate them about the risk (McKee et al., 2004; McLennan et al., 2015).

Engagement of homeowners in risk reduction measures can be extremely challenging without significant involvement and support from government agencies (McGee, 2011). Financial cost is one of the greatest impediments to individual action to reduce risk (Tierney, 1993): Homeowners are more likely to invest in low-cost but relatively ineffective measures than costlier but more effective strategies (McLennan et al., 2015). A further disincentive to individual action may be that measures such as those promoted by the 'Firesmart' program cannot completely guarantee a defensible space around residences (McCaffrey, 2004). One effective risk reduction measure at the household and community levels is linking the availability and cost of fire insurance to a certain level of expenditure on other measures to protect homes and the community (McKee et al., 2004; Feltmate and Thistlethwaite, 2012; Smith, 2013). However, to date this has not been explored in Kelowna (Tables 2 and 4). Complicating this measure is evidence showing that loss compensating mechanisms such as insurance and government disaster assistance may create a significant disincentive for homeowner expenditures on lowering WUI fire risk (McKee et al., 2004), and may even encourage construction in high-risk areas (Gill et al. 2013). Little progress has been made toward long-term planning and other municipal, regional or provincial government measures to reduce WUI fire risk in Kelowna (Tables 2 and 4). There has also been significant resistance to mandatory measures for reducing the vulnerability of older residential neighbourhoods in Kelowna (Table 4).

Table 3: Quotes by interview respondents on progress made in WUI fire risk reduction

In 2003, when we wanted to evacuate a neighbourhood it actually had to be approved by someone in the provincial government. We could say that we're doing [evacuating] these streets but before we could enforce it, it needed to be signed off by the province. Now the

province allows us to do that. So we still have a process—the mayor has to declare a state of emergency, so on and so forth, but we can do that without any provincial—not interference—but without [them] having to be a part of it.
'Firesmart': if we did nothing on public lands or anything, [but] if the homeowners took care of their piece, their risk would drop significantly by following the 'Firesmart' manual.
You live in a wildfire interface so I think it should be up to the homeowners to pick building materials. We can encourage it but maybe use your head, right? Maybe don't have the pine needles all over the roof.
Well it's 'Firesmart', right? That is central and it's well known, it's easy to publicize, and it's easy for people to follow.
The idea of the Community Protection Plan was developed by the province. These are updated every five years and the province helps out with some of the cost to get these completed and they're done by [a] consultant and this gives some direction to what needs to be done, identifies moderate or high risk areas that we need to do some work on.
What we have is these guide books so it's a program and application guide. This is funding available for local government (...)We call this the Strategic Wildfire Prevention Initiative and it's administered by UBCM[a].

[a] Union of British Columbia Municipalities

Table 4: Quotes by interview respondents on challenges facing WUI-fire-risk reduction

They're doing this in the [US] where insurance companies are getting more involved and won't cover insurance for some homes that are in a wildfire location or disastrous or hazardous place (...) When I spoke to some people in Canada, some insurance people, we're not there because most of their losses are from floods and people's basements flooding (…). So even though in 2013[a] and in Slave Lake[b] those were big losses, really in the scheme of insurance it's not huge. But it is becoming bigger – I know Slave Lake they looked at the losses there and I think [they were] CAD 800 million.
The most effective way to [encourage WUI fire risk reduction by individuals] would be [that] if you didn't do it, maybe your insurance wouldn't cover you. Maybe it's like smoking: maybe if you smoke you pay more health insurance. If you're a high risk you pay more car insurance so maybe if your property is a risk, insurance companies should come and say this is pretty high risk. But it's really hard to regulate that kind of behaviour.
So, really taking a look at where building is happening is an important step. I can understand the challenges; there are constraints here in terms of accommodating growth in the Okanagan. There are only so many places you can [build] so it's understandable that there's going to be some interface development but I think it at least bears consideration when looking at municipal planning.
A lot of municipalities have community wildfire protection plans, things like that, so the efforts seem to have gone that way rather than placement of development in the first place.
They're enacting [legislation in Alberta] like (...) banning any sort of building in floodplains. We need to be looking at that same type of thing.

There's just too much risk, too much development, and then there's also challenges with prescribed burning and trying to meet the existing legislation components for open burning, smoke, and things like that.
But going into homes that have been here 50, 60 years or going to properties that have been around for a long time and legislating [WUI fire risk reduction], we don't have that yet. That might be somewhere where we are going but we're going to try and take a bit of a softer approach.
Regulating them so you have to go inspect them [risk reduction measures] (...) it may be what we end up having to do but until somebody sees another fire it would be hard to convince them that would be important. It's human nature.

[a] June 2013 flood disaster in the city of Calgary and southern Alberta
[b] May 2011 WUI fire disaster in the town of Slave Lake AB

Current Vulnerability

Field photography in the Upper Mission and Glenmore Highlands indicates that new construction following the 2003 OM fire has created housing with lower vulnerability compared to older housing (Figure 6). This has been achieved with measures such as use of non-combustible concrete, stone or tile building materials and fire-resistant roofs (Figures 6a-d), less use of vegetation for landscaping (Figures 6b,d) and use of less flammable deciduous vegetation (Figures 6a,c), and the creation of defensible spaces around homes (Figures 6b,d). It appears therefore that one of the measures in the city's new wildfire protection plan, the creation of WUI fire hazard development permit areas (City of Kelowna, 2011a,b), has been somewhat successful in reducing the vulnerability of new housing. Developers intending to build in these permit areas must retain a professional forester with wildfire management experience to conduct fuel hazard assessments and develop recommendations for mitigating the fire risk (City of Kelowna, 2011a). 'Firesmart' guidelines provide the minimum standards for new development in these areas, and although these guidelines focus mainly on reducing fuel loads through vegetation management and landscaping, they also contain general guidelines for use of non-combustible or fire-resistant building materials (City of Kelowna, 2011a).

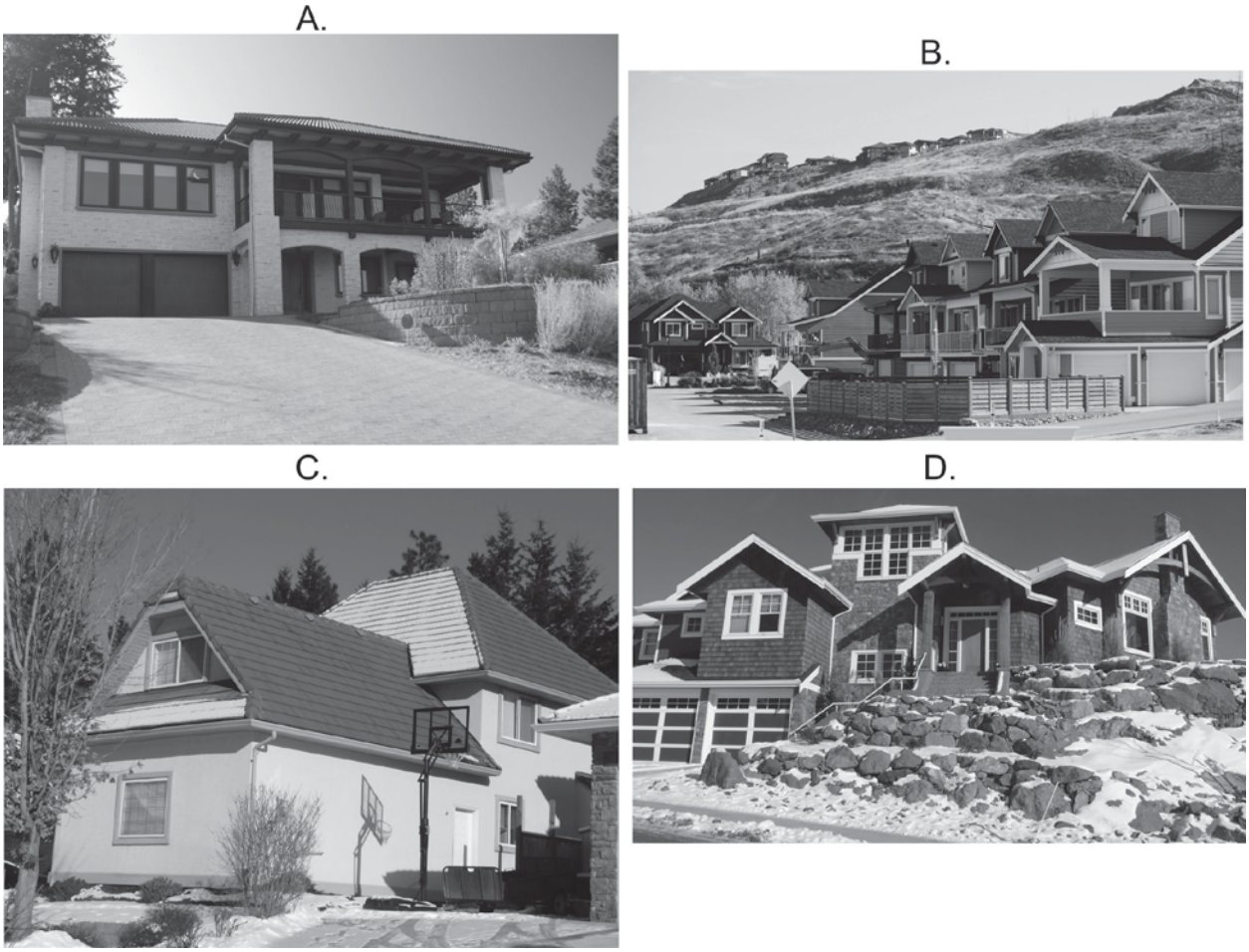

Figure 6. Measures to reduce the vulnerability of new residential construction, Upper Mission and Glenmore Highlands. These include use of non-combustible or fire-resistant roofing and siding materials (a-c), fire-resistant landscaping materials (a-d), defensible zone around the home (b,d) and easy access for emergency vehicles (b). Visible in (b) are grasslands created by forest removal in the 2003 OM fire.

The field photography also indicates that in other parts of the Upper Mission and Glenmore Highlands, the vulnerability of older homes and some newer homes remains high. Several factors contribute to this: continued use of wood shake roofs (Figure 7a), the presence of flammable vegetation next to homes (Figure 7a), limited egress and access in hilly intermix neighbourhoods (Figure 7b), narrow roads with parked vehicles hindering both evacuation and access for firefighters (Figure 7c), and dense coniferous forest surrounding neighbourhoods (Figure 7d). The problem of limited access and egress (Figures 7b-d) is especially significant given the presence of extensive intermix development in the Glenmore Highlands as noted earlier (Figure 5). One factor contributing to the vulnerability of new residential construction may be that the development permitting process to address WUI fire hazard, described above, contains few provisions to ensure that the development permit guidelines have ultimately been met. The city also has no jurisdiction over the

vulnerability of older homes (Table 4), and as a result there is no requirement for those to meet any sort of standards in regards to WUI fire protection. The adoption of 'Firesmart' risk reduction measures (Firesmart Canada, 2013) by homeowners in these older neighbourhoods has been limited because, unlike in some other high-risk jurisdictions (e.g. Squaw Valley Fire Department, 2013 unpublished defensible space self-inspection checklist), enforcement of these measures is impossible.

Figure 7. Existing or newly created vulnerabilities, Upper Mission and Glenmore Highlands. These include wooden roofing and siding materials (a), development in hilly intermix areas with limited egress and access (b), lack of defensible space around homes (a,d),difficulties of access for firefighting apparatus because of narrow lane with parked vehicles (c), and dense coniferous forest surrounding neighbourhoods with only one means of egress and access (d).

Total Risk

The components of the risk equation can be evaluated together to produce a generalized analysis of the trajectory of WUI fire risk in Kelowna. A review of the literature indicates that *P* is currently high in Kelowna and is likely to increase as a result of climate change. The rate of increase in *P* is being held somewhat in check by modest progress in fuel reduction initiatives. However, without significant additional resources for fuel reduction, it is difficult to see how *P* can begin to be reduced. The elements at risk, *E*, have increased significantly in recent decades as a result of an increasing number of residential structures in Kelowna's WUI areas. The results of the expert interviews and field photography indicate that some progress has been made in reducing *V*, largely through voluntary measures. The net result is that the total risk *R* from WUI fires in Kelowna has increased since the OM fire,

and is almost certainly on an upward trajectory into the future.

The loss of residential infrastructure is the major component of *R* in Kelowna because past WUI fire events in the province have shown timely evacuations to be very effective at preventing fatalities. Nevertheless, the risk to human life needs to be considered especially in intermix WUI areas with limited access and egress (Cova, 2005). Past WUI fire disasters in the US and Australia illustrate the significant risk to life that is created by limited and congested egress routes (Smith, 2013) and delayed evacuations (Gill et al., 2013; McLennan et al., 2015). In this respect, *V* and therefore *R* are higher in the western portion of the Glenmore Highlands (Figures 3c-d) compared to the Upper Mission (Figures 3a-b). A night-time fire start during strong winds adjacent to such residential development in steep, forested terrain could make rapid evacuation much more challenging than the evacuation of 33,000 residents during the 2003 OM fire when days of warning time were available.

Sandink's (2009) contention that "British Columbia['s] acts and regulations associated with emergency preparedness are largely focused on response and recovery" (p. 23) is reflected in the results of the risk analysis in this study. The focus on emergency action is evident from the statistics on actual versus budgeted annual costs of fighting wildfires in BC. Over the period 2003/04 to 2014/15, actual annual expenditures have been on average CAD 90 million over budget, with the largest over-expenditures occurring in 2003/04 (CAD 316 million) and 2014/15 (CAD 235 million) (CBC News, 2015). Six of the 13 years saw an over-expenditure of over CAD 100 million, while firefighting costs came in very slightly under budget in only three years. By late August 2015, with the fire season ongoing, the over-expenditure for 2015/16 was already CAD 170 million (Karstens-Smith, 2015). These expenditures include only what is spent by the provincial Ministry of Forests on wildland firefighting, and do not include the cost of structural protection by municipal fire departments in WUI fires. In contrast, only a tiny fraction of the sums spent fighting wildfires is spent provincially on reducing the risk of WUI fire disasters. For example, only CAD one million was spent in 2015/16 in BC on measures such as fuel reduction (CBC News, 2015). Proactive measures to reduce WUI fire risk in Kelowna have been limited to some fuel reduction initiatives in the most high-risk areas, development guidelines rather than enforced regulations, and voluntary action by homeowners. This is despite evidence showing that public expenditures on disaster risk reduction almost always generate a significant positive benefit-to-cost ratio and are more effective than individual action (Dotto et al., 2010; Smith, 2013; Shreve and Kelman, 2014; United Nations, 2015) and can potentially generate significant positive externalities (McKee et al., 2004).

Conclusion

This study shows that the normally short window of opportunity for undertaking more extensive risk reduction measures following a major calamity (Sims and Baumann, 1983; Twigg, 2004; Gill et al., 2013), such as created by the 2003 OM fire in Kelowna, has now closed. The WUI fire risk in Kelowna continues to rise, although this is difficult to quantify. The risk is increasing mainly because of rapid encroachment of residential neighbourhoods into WUI areas. It is increasing also partly because the probability of future WUI fires is increasing

despite some efforts in recent years to reduce the fuel load. To counter this increasing risk, there have been modest reductions in the vulnerability of housing and other infrastructure in WUI areas through measures by the development industry and, to a lesser extent, by individual homeowners. More effective long-term reduction of the WUI fire risk in Kelowna needs to move from a strategy based on voluntary action by the development industry and homeowners to a more community-based approach, as has been advocated in other high-risk jurisdictions (McLennan et al., 2015). This approach should include mandatory use of non-combustible or fire-resistant building materials, land-use zoning and roadway planning in WUI areas to reduce fire risk, and mandatory 'Firesmart' type programs in older at-risk neighbourhoods (Gill et al., 2013). Such initiatives take account of the fact that the best way to reduce WUI fire risk is to reduce the potential for structure ignition, especially in newer residential areas with higher housing densities where structure-to-structure fire spread can play a key role in creating a WUI fire disaster (Mell et al., 2010). The City of Kelowna has an opportunity to take a leadership role in this endeavour because being the largest city in one of the most wildfire-prone regions of Canada, it is viewed as a test case by other cities and municipalities (e.g. City of Coquitlam, 2012 unpublished report on proposed interface fire mitigation strategies).

Acknowledgements

The assistance of the WUI fire risk reduction experts who agreed to be interviewed for this study is gratefully acknowledged. Funding from the Department of Community, Culture, and Global Studies at UBC, and a student travel grant from the Canadian Association of Geographers (CAG), enabled DGdS to present the results of this study at the 2014 meeting of the Western Division of the Canadian Association of Geographers and 2015 meeting of the CAG, respectively.

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Analytical framework for community resilience: A case study of Devon, Alberta

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Abstract: *Resource-based communities (RBCs) are a common feature of Canada's economic landscape. Community resilience is critical for RBCs, where economic cycles associated with the fluctuations in prices of natural resources in international markets occur regularly. This paper presents an analytical framework of community resilience of RBCs in the Canadian context. Using the Town of Devon, Alberta as a case study and publicly accessible sources of data, indicators of community resilience for an RBC are identified. The results highlight that the case study community has typical demographic and economic characteristics of a boom and bust cycle in an RBC for majority of the indicators of resilience. Additionally, results also show that existing regional and municipal policies focus on a diversified economic base, improved municipal facilities, and environmental management. This case study suggests the need for further research to examine a RBC's long-term growth trajectory, sensitivity to distance from centres of business and trade, and the impact of policy directives for diversification and environmental protection.*

Keywords: Resource-based community, resource-based economy, community, resilience

Introduction

Resource-based communities (RBCs) are an important part of the economic landscape of Canada (Deacon and Lamanes, 2015). For example, more than half (53%) of Canada's total export value in 2014 was associated with the natural resource sector (Natural Resources Canada, 2016). Canada's vast oil reserves were a significant contributor to this, the majority share of which is found in the Province of Alberta (Alberta Energy, 2016).

Economic cycles of boom/bust have been a familiar pattern of the Albertan economy since the 1970s (Emery and Kneebone 2013). For instance, the economic boom of the 1970s was followed by nearly a 10-year long economic bust. This pattern was again repeated when the province experienced a tremendous boom from 1997 to 2009 to be followed by a period of ongoing economic contraction (Emery and Kneebone 2013). Alberta's economy is dominated by the energy sector with oil, gas, and mining contributing 18.3% of Alberta's GDP in 2015 (Alberta Economic

Development and Trade, 2016). The lack of economic diversification is cited as a contributing factor for economic boom/bust cycles experienced in Alberta (Emery and Kneebone, 2013). The initiatives, or in many cases lack of initiatives, to increase the capacity of RBCs to diversify their social, economic, environmental, and infrastructural sectors has received little academic attention.

The objective of this paper is to develop a conceptual analytical framework to assess the resilience of an RBC to economic shocks associated with resource dependency. Using the Town of Devon, Alberta as a case study, this paper examines federal census data, municipal records, public policies on regional and municipal development plans, and environmental management to explore resilience of this community.

Background

Resource-based communities, referred to as "single industry towns", "boom towns", or "company towns", are a common characteristic of the Canadian economic landscape (Halseth and Sullivan, 2004; Lamanes and Deacon, 2018; Marais et al. 2018). RBCs are typically supported by extractive activities based on resource exploitation (Halseth and Sullivan, 2004; Hayter and Barnes, 2015; Keough, 2015; Lawrie, Tonts, and Plummer, 2011; Watkins, 1963).

RBCs are often identified by their economic boom and bust cycles; periods of exponential growth as a response to high demand for an extracted commodity (Keough, 2015) followed by drastic contraction (i.e. bust) typically resulting in significant and rapid loss of population. Many RBCs experience several boom and bust cycles with associated fluctuations in income, workforce, and resident population over the period of extraction (Martinez-Fernandez et al., 2012).

Staples Theory (Innis, 1936) is a useful framework to explore resource based development in Canada (Watkins, 1963; Innis, 1995). Staples theory is based on a non-existent domestic market for staples and comparative advantage in resource export that results in resource extraction as a primary economic sector (Watkins, 1963). The comparative advantage of staples export limits the chance to diversify economic activity (Hayter and Barnes, 2015; Watkins, 1963). Related to Staples theory, the Staples Trap Model asserts resource rent is not reinvested into fast-growing service or manufacturing sector of the economy (Auty, 2001).

The implications of economic boom and bust cycles on RBCs have been analyzed by various studies (Deacon, et al. 2018; Deacon, et al., 2017; Mckenzie, 2013; Hayter and Barnes, 2015; Lawrie et al., 2011; Martinez-Fernandez et al., 2012; Petrova and Marinova, 2013; Manson, Halseth, and Markey, 2012; Van Assche et al. 2017). However, the primary focus of these studies relate resource extraction with a general decline in socioeconomic well-being such as a shortage of housing (Keough, 2015; McKenzie and Rowley, 2013), insufficient municipal services (Deacon, et al. 2017), economic decline and aging population of RBCs during recession and post mining phase (Skinner

and Hanlon, 2016; Manson et al., 2012) , low education attainment (Lawrie et al., 2011; Martinez-Fernandez et al., 2012), governance of mining activities and achieving public welfare (Cheshire et al., 2014), and income inequality (Lawrie et al., 2011; Petrova and Marinova, 2013).

While resource extraction has largely been linked to negative impacts on the local community and population, there are positive implications. For example, resource extraction can promote sustainable development if the net economic benefit of the extraction activity to the community continues in operation and post-closure phase of mining (Zarsky and Stanley, 2013). Rational exploitation of non-renewable resources can ensure the balancing between the consumption of resources and the investment in produced capital for future consumption (Hartwick, 1977; Zarsky and Stanley, 2013). In many cases, gains in economic sectors from resource extraction do not translate into gains in social and human development or long-term economic development and the economic benefits do not continue indefinitely (Martinez-Fernandez et al., 2012). Additionally, RBCs experience social change related to rapid economic growth and, often, a highly transient population. Achieving socio-economic sustainability for RBCs requires attention to accommodate the social changes (Petrova and Marinova, 2013).

The concept of resilience provides a useful framework to study sustainability issues related to RBCs amidst socioeconomic transition. Resilience studies address the phenomenon of change and transition from one state of equilibrium to another state of equilibrium within a particular system.

Interest in the resilience of local, regional, and national economies has gained interest from across academia in recent years (Christopherson et al., 2010; Deacon and Lamanes, 2015; Deacon et al. 2018; Eraydin, 2016; Martin, 2012; Martin and Sunley, 2015; Modica and Reggiani, 2014) highlighting a diverse range of opinions about what resilience is, what factors are important to consider when examining resilience, and how to analyze and measure resilience (Martin and Sunley, 2015). Despite its infancy and ambiguity in definition, studies of regional economic resilience search for the answer to an age-old question: Why can some regions overcome short or long-term financial crises better than others (Christopherson et al., 2010). Martin and Sunley (2015) conceptualize resilience as the capacity of a regional economy to withstand or recover from shocks (market and environment) to its growth path and argue that a resilient economy will experience adaptive changes in its structure (*i.e.*, economic, social, and institutional) to restore the original growth path or transferring to a new one (pp. 13).

Path dependency is a complementary concept to resilience and can be useful to link the Staples model with the resilience of RBCs. Path dependency typically describes the development process of a technology in a certain pathway because of steady and or increasing returns (Tonts et al., 2014). In economic geography, path dependence is also referred to as place

dependence, where system outcomes are determined by past events and results (Tonts et al., 2014; Wolfe, 2010). Linking the concept of path dependency to the Staples model, it may highlight that RBCs are locked into a unique growth path, and any shock to the system will diminish or hamper the growth of the staples economy. From a resilience point of view, this is aligned with engineering-related concept of resilience where a system has a unique equilibrium point. If the system is unable to return to that equilibrium after an external shock, the system is not resilient Evolutionary resilience describes a system's capacity to restore to its original growth path or transfer to a new one post-shock (Martin and Sunley, 2015). Building on this discussion, the resilience of a Staples economy can be described as its capacities to escape the Staples trap. Resilient communities employ changes to move to a growth path when the system faces external shocks based on its constraints on resources placed by the existing growth path (Wolfe, 2010).

Several researchers (Berkes and Ross, 2013; Christopherson et al., 2010; Cutter et al., 2008; Eraydin, 2016; Foster, 2007; Graziano and Rizzi, 2016; Magis, 2010; Martin, 2012; Martin and Sunley, 2015; Osth et al., 2015; Sherrieb et al., 2010; Simmie and Martin, 2010) have developed methodologies, using a range of factors, to explore resilience of communities (Table 1).

Table 1: Different factors of regional economic resilience

Authors	Factors of resilience
Foster (2007)	Economic structure, government structure, political mode, state policy, civilian structure
Cutter et al. (2008)	Infrastructure, institutional plans and policies, environmentally critical area, employment, demographics, housing stock
Christopherson et al. (2010)	A regional system of innovation, factors that create a learning region, productive infrastructure, skilled workforce, supportive financial system and a diversified economic base
Magis (2010)	Variety of employment opportunities, participation in voting, civic organizations, effective governance, collaboration and participation
Martin (2012)	Level of employment in economic sectors
Berkes and Ross (2013)	Knowledge, skills, social networks, governance, diverse economy, infrastructure, leadership
Martin and Sunley (2015)	Economic structure, labor market, financial system and governance
Osth et al. (2015)	Income inequality, household spending on housing, educational attainment, population

	over the poverty line, density of civic organization employees in a region, home ownership, voter participation
Graziano and Rizzi (2016)	Population growth rate, innovation, economic infrastructure, business density, social/ health / recreational infrastructure per inhabitants, urban green areas, waste management, ISO certified industries, pedestrian areas, restricted access areas, eco-management, cycle paths, renewable energy
Eraydin (2016)	The diversity of economic sectors, employment distribution in economic sectors, the number of patents per capita, the level of entrepreneurship, educational attainment, the share of employment in science and technology, bank deposit per capita, import, export, public investment per capita, land provided in industrial estates, priority development areas
Sherrieb et al. (2010)	Employment, median income, educational attainment, economic diversity, community organisatuons, voter turn out, migration, urban proximity
Deacon et al. (2018)	Governance, economic structure, labor market, long term urban planning, economic shocks

Factors of resilience can be organized into categories such as financial, socio-economic, natural or environmental, infrastructure, and governance/legislative.

Financial resilience: Financial factors of resilience may include employment distribution across sectors, diversified economic sectors, share of science and technology-oriented jobs in the economy, business density, innovation, entrepreneurship, economic infrastructure, urban proximity, and availability of financial services (Berkes and Ross, 2013; Christopherson et al., 2010; Eraydın, 2013; Foster, 2007; Graziano and Rizzi, 2016; Magis, 2010; Martin, 2012; Sherrieb et al., 2010).

Socioeconomic resilience: Socioeconomic factors of resilience include population growth rate, personal income, Gross Domestic Product (GDP), educational attainment, knowledge, skills, and expenditure on housing, civic organizations, social network, migration (Berkes and Ross, 2013; Christopherson et al., 2010; Eraydın, 2013; Foster, 2007; Magis, 2010; Martin, 2012; Martin and Sunley, 2015; Osth et al., 2015).

Environmental resilience: Factors associated with the environmental dimension of regional economic resilience include the existence of environmentally

critical areas, waste management, urban green areas, environment-friendly modes of transportation, renewable energy usage, and eco-management (Cutter et al., 2008; Graziano and Rizzi, 2016).

Infrastructural resilience: The level of infrastructure supply is another factor that has been considered as crucial for regional development and resilience. Public investment per capita, rates of hospital services usage, community and civic organizations per inhabitant, and lot availability in industrial parks have been included as factors to explore the role of infrastructure in regional economic resilience (Berkes and Ross, 2013; Christopherson et al., 2010; Cutter et al., 2008; Graziano and Rizzi, 2016; Osth et al., 2015; Sherrieb et al., 2010).

Governance/Legislative resilience: Factors used to explore the role of governance include analysis of policies and economic planning programs, the density of civic organization employees, voter turnout, collaboration and participation in resource management (Berkes and Ross, 2013; Eraydin, 2016; Magis, 2010; Osth et al., 2015; Sherrieb et al., 2010).

Analytical framework for community resilience and the case study

For this project, a conceptual analytical framework of resilience was developed using existing literature, consultation with Alberta Municipalities (Devon, St. Albert, Olds), and municipal, provincial, and federal level data as sources of information.

Analytical framework of community resilience

In this framework, resilience is conceptualized as the ability of a community to change from a stable state and evolve into a new state of stability. The analytical framework illustrates the areas of resilience that are significant for an RBC to withstand and grow through cycles of economic shocks (Figure 1). The framework includes five dimensions of resilience, several sub-dimensions, and specific indicators under each of the sub-dimension. The five dimensions and their respective sub-dimensions of this analytical framework of resilience are as follows:

Dimension one – *Economic resilience*: Sub-dimensions of economic resilience are: trends in employment across different sectors, the external relationship of the community and the capacity and stability of a community's economic base

Dimension two – *Social resilience*: Sub-dimensions of social resilience are: population stability and economic capacity of inhabitants, human capital development

Dimension three – *Environmental resilience*: Sub-dimensions of environmental resilience are: sustainable management and environmental conservation efforts

Dimension four – *Infrastructural resilience*: Sub-dimensions of infrastructural resilience are: levels of public investment and assessment of existing built and social infrastructures, community amenities

Dimension five – *Governance/institutional resilience*: included are three areas of

discussion, roles of policies on resilience, institutional decision-making, and the process of coordination and public participation in policy decision making

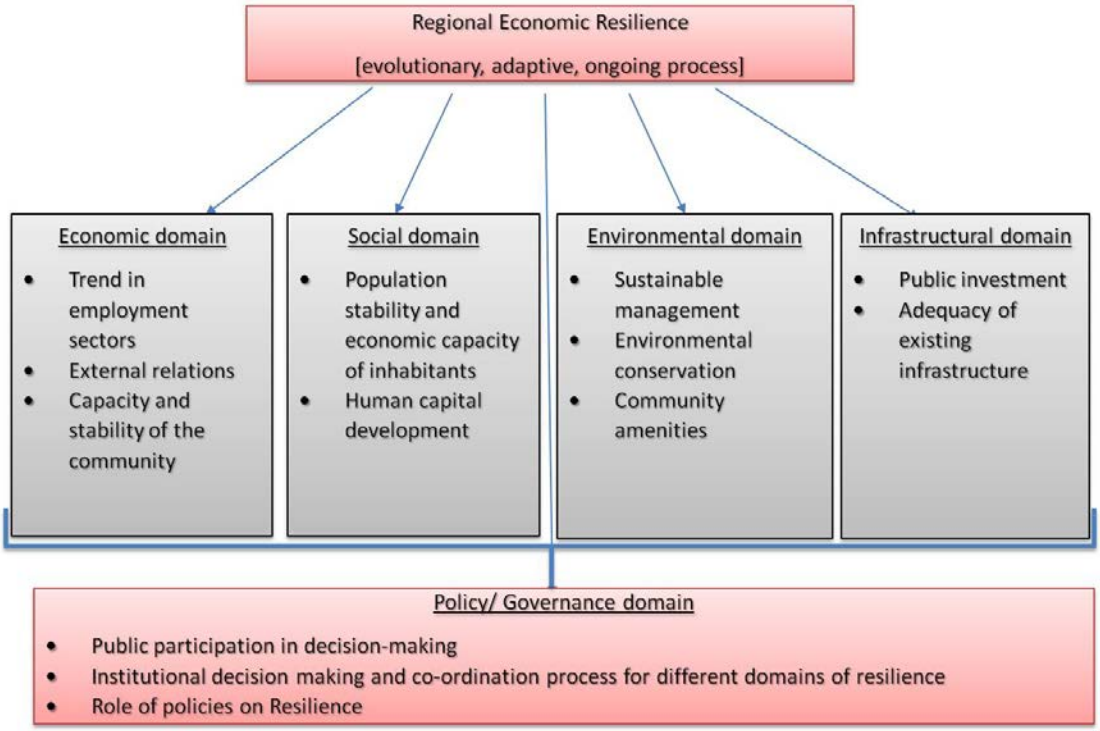

Figure 1: Schematic diagram of analytical framework of community resilience

Methods

A mixed-method case study design was used for data collection and analysis. Methods implemented include a historical trend analysis of secondary quantitative data and primary *and* secondary qualitative data. This approach was suitable as it enabled different sources of data to be examined to help develop a pragmatic and holistic comprehension of the research problem (Creswell, 2014). This pluralistic approach considers quantitative and qualitative data on economic growth, social development, environmental protection, provision of infrastructure and services, and governance arrangements for the RBC in question. Justification for mixing methods include complementary, expansion, context setting, and enhancement of quantitative and qualitative findings (Creswell and Clark, 2011). Quantitative and qualitative data were collected from the following sources: federal census database, federal and provincial open data portals, municipal plans and records, government reports, and informal discussions with the municipality. This project was reviewed and approved by the University of Alberta Research Ethics Office. Prior conducting

any interviews, written or oral informed consent was provided.

The informal discussion with municipal officials (2016) was conducted as group and virtual meetings. The discussion was focused on two themes: i) which indicators are the best fit to explore the resilience of RBCs at a municipal level and ii) the availability of data for those indicators. The discussion with municipal officials from Devon also examined the town's plans and past performances on economic, social, infrastructural, environmental, and governance factors of resilience according to the proposed framework of resilience.

This study relies on demographic data collected by Statistics Canada [1991-2006], and municipal records from 1991 to 2016. This is an appropriate time frame as the province of Alberta had experienced a resource boom and bust cycle. More locally, the town experienced the closure of its local Imperial Oil gas plant. The federal census data from 2011 was not considered because of the inconsistencies associated with the National Household Survey (NHS), which replaced the survey in 2011. The NHS was voluntary, and its method and data variables were different from previous censuses. One limitation of using census data was that it provided a view of the discrete points of the timeline in the town's response to economic cycles across indicators. However, the effect of economic cycles typically impacts economic, social, infrastructural indicators over several years after the event has taken place (Soucy and Wrobel 2000, Emery and Kneebone 2013). Census data from 1991-2006 was adequate to explore the effect of the town's economic cycle over the one and a half decades in question. Census data unavailability for some of the chosen indicators in the framework is addressed with data collected from municipal records during the informal discussions with the municipal officials, open data portals, and policy documents.

Case Study: The Town of Devon

The town of Devon is located approximately 27 km (17 miles) southwest of the provincial capital of Alberta, Edmonton, (Town of Devon, 2012b) (Figure 2) and is located along the North Saskatchewan River. Devon is situated in the heart of the oil and gas boom in Alberta. The boom and bust cycle took place in Alberta during the 1970s, 1980s, and late 1990s and 2000s (Emery and Kneebone, 2013). Highway 60 and Highway 19, running west and south of the town respectively, service Devon. Devon was founded in 1947 as a company town for Imperial Oil after oil was discovered in the *Leduc 1 Well,* located south of the community (Town of Devon, 2006). After the closure of Imperial plant site in 2006, the town has maintained its local service centre function for employment centres in the region, including the City of Edmonton, the Edmonton International Airport and the Nisku and Acheson Industrial Parks (Town of Devon, 2006). According to Statistics Canada, in 1991 Devon was in the Census metropolitan area (CMA) but not under the municipal influence zone (MIZ) meaning the commuter flow to the CMA urban core was less than 40% or no

people out of the labour force (Rambeau and Todd, 2000).

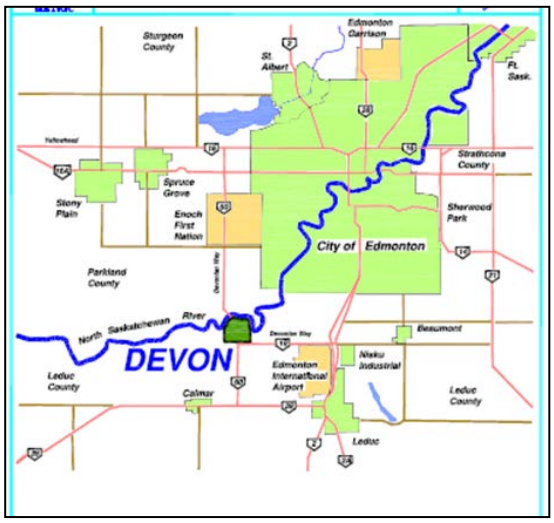

Figure 2: Regional setting of Town of Devon (Source: Town of Devon, 2012b)

Results

There were two objectives of the study: 1) Develop a conceptual framework to analyze the resilience of RBCs and analyze its applicability in the context of RBCs and; 2) Apply the framework to a case study community in the Canadian context. The results from the case study analysis on the Town of Devon, Alberta are presented and discussed here.

Economic factors of resilience

During the federal census period (1991-2006) Devon experienced an increase in total employment from 2,110 to 3,620, coinciding with the economic boom during that time. The largest sector in 1991 was the mining, quarrying, and oil industries; however, by 2006, the retail sector accounted for the largest increase in number of employees. The employment distribution illustrates that employment share across different economic sectors was diversified in 2006. Retail trade accounted for 12.85% of total employment followed by mining and oil

and gas extraction (10.91%), construction (10.08%) and manufacturing (8.98%) sectors.

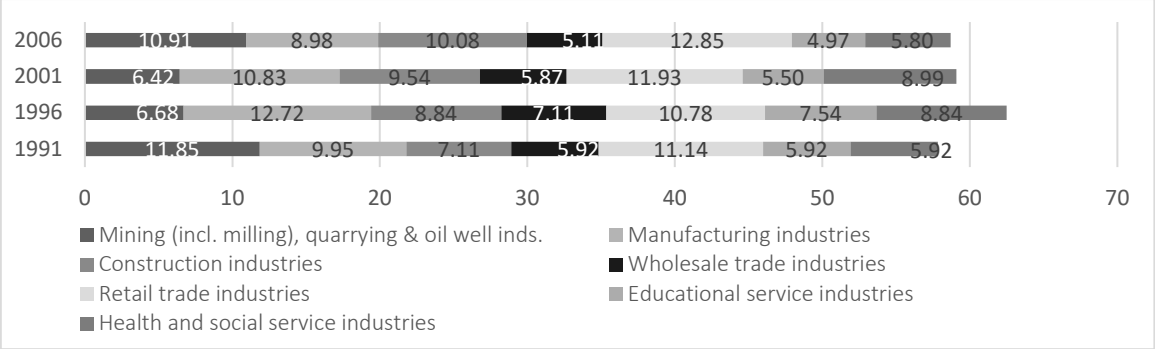

Figure 3: Trend of employment share by selected industries from Federal Census 1991-2006 (percentage value) (Source: Statistics Canada)

Retail trade and construction industries experienced steady growth in employment from 1996 to 2006 (Figure 3). The retail sector's contribution to total employment of Devon increased from 11.84% to 12.85% in the stated period. During the same time, employment share in construction industries increased from 7.11% to 10.08%. Data on employment in manufacturing, wholesale, health and social services, and education industries illustrate that employment in those sectors steadily declined from 1996 to 2006. Within the economic sectors, mining, quarrying and oil well industries played a significant role until 2006, resembling characteristics of RBCs stated as being dependent on the mining sector (Auty, 2001; Robertson and Blackwell, 2014). According to Devon municipal records, most of the 265 active business licenses issued from 2009 to 2014 were for resident commercial and home occupation businesses. The records also show that the taxable assessment of properties from 2015 to 2016 increased by 5.97%, and the largest share was represented by residential and farmland properties.

Social factors of resilience

From 1991-2006 Devon's net population increased by approximately 50 percent (Figure 4). During this time the percentage of the population aged 0-14 years decreased gradually. Additionally, population mobility numbers from the same period were examined to highlight the percentage of residents who have lived in the town for more than one year or more and people who had lived for more than five years. There was not any significant change in population mobility (inter-community) during the period of examination (Figure 5). The percentage of residents who lived in Devon for five years or more declined slightly in 2006, which is

consistent with the sharp rise in the town's population in the 2001-2006 census period. From 1991 to 2006 the number of people in the labour force who worked in the same municipality of their place of residence declined by 2.8% in Devon. During the same period the number of people working in places outside of their place of residence increased by 72.0%.

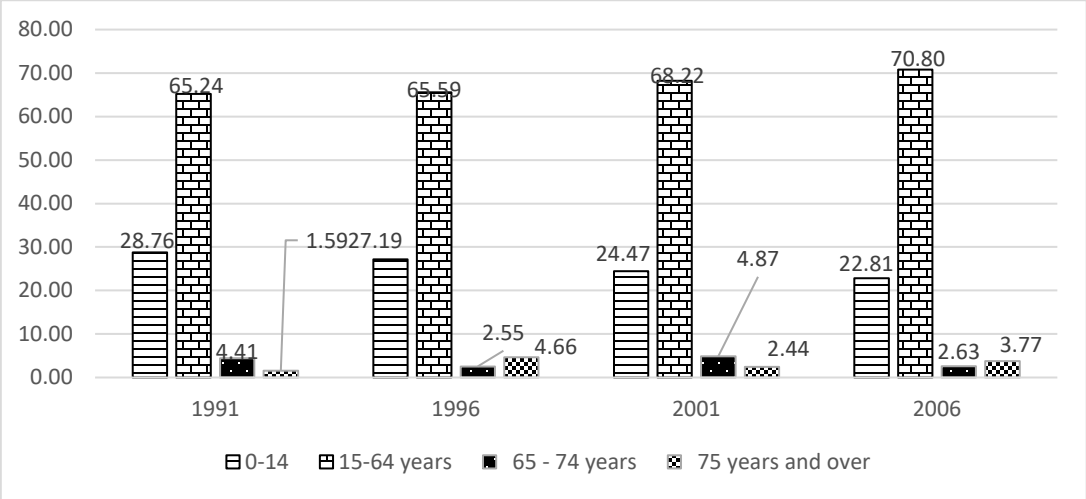

Figure 4: Distribution of population in different age groups from Federal Census 1991- 2006 (percentage value) (Source: Statistics Canada)

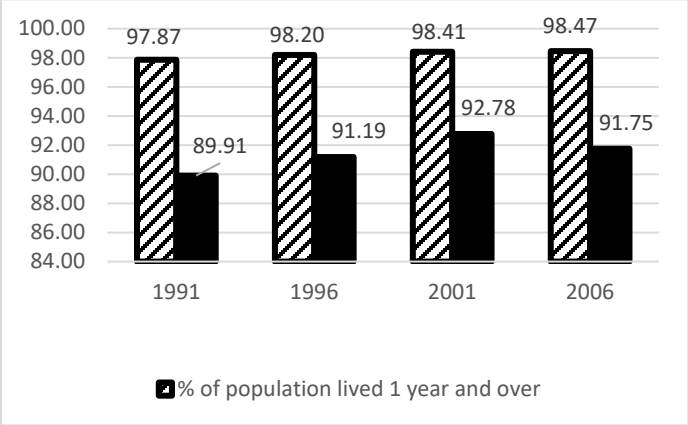

Figure 5: Mobility of population from Federal Census 1991- 2006 (percentage value) (Source: Statistics Canada)

During the census period 1996 to 2006, the average personal income per capita increased from $24,686 to $40,418, while average private household income also increased from $48,816 to $83,569. The growth of income was consistent with the

regional economic boom during the (1997-2009) period as was the increase in the ownership of private dwellings. Data from the federal census (1991-2006) indicates that the rate of ownership of private dwellings increased by 74.41%, an increase from a total of 1,055 to 1,840.

High school completion rate in Devon (76.9%) was greater than the provincial average (74.1%) in 2014 (Black Gold Regional Division no. 18, 2015). From 1991-2006, the percentage of people aged 15 and over with a trades certificate, diploma, or university degree increased from 10.35% to 23.04%. However, Devon's post-secondary attainment rate of 23.04% in 2006 continued to be lower than the Canadian national average of 60% (Statistics Canada, 2009).

Environmental factors of resilience

Per the municipal authority of Devon, the municipal waste generation rate was 517.1 kg/capita/year in 2012. This resulted in reaching the municipal target of 500 kg/capita/year set by the Municipal Development Plan (MDP) (Municipal records, 2014).

Environmental conservation initiatives in Devon are focused on the conservation of the North Saskatchewan River valley and improvement of recreational amenities while preserving the natural environment. Two significant projects are The Devon River Valley Master Plan for Recreational Purposes and Erosion Control and Multi-use Pedestrian Trail Management (Town of Devon, 2011, 2013).

The largest brownfield site in the municipality is the Imperial Oil Plant site. However, there are no reclamation efforts sponsored by the municipality occurring on any brownfield sites.

In 2015, the ecological footprint of Devon was calculated to be 21.49 Hectare/capita (Informal discussion with Town of Devon, 2016). Compared to the 2015 footprint calculated for the City of Edmonton (7.6 global hectare/capita) Devon has a larger ecological footprint. This result is similar to findings in previous studies showing that RBCs have environmental degradation issues (Martinez-Fernandez et al., 2012).

Infrastructural factors of Resilience

Data on public investments in planned, under construction, and completed projects is collected from open-data portals of the Alberta Government and Government of Canada, and municipal plans (Table 2). The projects are focused on transportation, recreation, and municipal services (Alberta Government, 2015; Government of Canada, 2016; Town of Devon, 2012). The largest project currently under construction is the Capital Region River Valley Park. The planned realignment of highway 60 and highway 19 is another large infrastructural project for Devon. Together, these two projects account for an investment of 118 million CAD in the region.

Table 2: Public investment in large capital projects

Project Name	Sector	Stage	Eligible cost (CAD)	Brief description
Road Improvements - Devon	Infrastructure	Completed	3,782,616.00	Upgrade of local roads and sidewalks was completed in November 2011
Highway 19 Twinning	Infrastructure	Announced	80,000,000.00	Highway 19 and Highway 60 will be realigned to facilitate through movement via interchanges
Capital Region River Valley Park - Connectivity Phase	Recreation	Under construction	90,000,000.00	The ultimate recipient of this project would be River Valley Alliance formed by seven municipalities including Devon.
Wastewater treatment plant	Infrastructure (municipal services)	Under construction	28,000,000.00	The project is expected to be complete by June 2018. Devon's previous wastewater treatment plant operating agreement with AB Environment expired in 2015.

The Devonian Industrial Park is an area within the region that continues to receive development funding. There are currently 11 lots in the park, and the municipality is working to secure 40 additional acres of un-serviced industrial land to ensure that the town has physical space for future industrial growth (Informal discussion with the Town of Devon, 2016).

Devon's 2012 Facility Development Plan identifies municipal facilities that require infrastructural development in the near- and mid-term. These include improved Royal Canadian Military Police (RCMP) facilities, an updated and improved fire hall, modernized municipal workshop and yard, the outdoor rink, arena, high school classrooms, youth drop-in centres, and public library (Town of Devon, 2012). Devon's new wastewater treatment plant is currently under construction (Informal discussion with the Town of Devon, 2016).

Governance factors of resilience

Public participation in municipal governance is measured through voter turnout rates as a higher voter turnout rate is associated with higher socioeconomic resilience (Osth et al., 2015). Voter turnout in municipal elections in 2010 and 2013 was 31.87% and 43.38% respectively. Given that the eligible voter base was similar in both the elections, it can be concluded that

Devon's voter turnout rate increased in the 2013 election. For comparison, the voter turnout rate in Devon was higher than that in the 2013 Edmonton Municipal election (34.5%) (Ramsay et al., 2013).

The ability of a municipality to deliver services and maintain capital development is an important indicator of resilience (Cheshire et al., 2014; Cutter et al., 2008; Martin and Sunley, 2015). Given the educational governance structures across Alberta, Devon has a limited ability to influence decisions for investment in secondary and post-secondary educational institutions in addition to other capital-intensive transportation infrastructure and community facility decisions (Informal discussion with the Town of Devon, 2016). Devon is responsible for the maintenance of the transportation infrastructure within its jurisdiction. Needs assessment and investment in municipal development projects are largely promoted and lobbied by the municipality at the provincial and national level (Informal discussion with the Town of Devon, 2016).

Devon's MDP and the Capital Region Growth Plan are two important policy documents related to future growth and development. In neither of the policies was any consideration given to the possibility of an economic bust or crisis in Devon. Municipal policies discouraged new heavy industries that carried potentially negative environmental or societal impacts. The municipality is responsible for the preservation and maintenance of critical environmental areas like river valley and urban green area conservation following the guidelines of Alberta Environment. The Inter-Municipal Development Plan for Devon and Leduc County states to plan for long-term integrated policies between Leduc County and Devon and share the cost of development initiatives where possible.

Discussion

The results from the case study analysis based on the framework of community resilience provides insight into resilience of the economic, social, environmental, infrastructural, and governance systems for Devon.

Economic factors

Results from the analysis of employment distribution and growth for various economic sectors illustrate typical characteristics of an RBC in Canada. Devon has achieved some degree of diversification in its economic sectors. However, data illustrates there is an ongoing dependency on the oil and gas sector. This can be attributed to Devon's position in the larger provincial economy and the resource dependence of the latter. Additionally, many of the new municipal business licenses [2009 to 2014] were issued for resident commercial and home occupation businesses, which are less able to adapt to economic shocks (Erayd in, 2016). Economically, Devon shows weakness in its resilience of economic sectors. However, Devon's proximity to the City of Edmonton and Calgary and good access to the regional transportation network is a requisite for resilience for communities identified by the resilience literature.

Social factors

Devon has experienced rapid population and income growth and low post-secondary educational attainment, which are common characteristics of an RBC. Devon's growth of ownership of private households is unlike the housing crisis typically observed in RBCs. The taxable assessment of properties has increased from 2015 to 2016 during the ongoing economic crisis of Alberta, and the largest share came from residential and farmland properties. The increasing percentage of residents who work outside of Devon, a high proportion of residents who have lived in the town for more than five years, and recent growth in residential tax assessment shows Devon's resilience to attract and retain resident population. Devon's low level of post-secondary educational attainment makes it less resilient in the human capital component of social resilience, and this is a common characteristic for post-extraction RBCs.

Environmental factors

Findings from environmental resilience indicators show that effective environmental management practices did not accompany high levels of growth in employment, income, homeownership rate, and the population. Devon had a large environmental footprint in 2015 and does not have any plans for brown field reclamation. There are policy guidelines for critical environmental area protection, although recreational development plans in the river valley area will negatively impact the environment. This result is similar to the findings of studies on the resilience of industrial and recreational centres and RBCs, which tend to include critical environmental concerns (Graziano and Rizzi, 2016; Zarsky and Stanley, 2013). Devon's promotion of landfill waste reduction goals and plans for no heavy industrial development in the future is a sign that community leadership is aiming for an environmentally-friendly development path.

Infrastructural factors

Ensuring access to adequate infrastructure and facilities is crucial for the resilience of RBCs (Lamanes and Deacon 2018; McKenzie and Rowley, 2013). In addition to Devon's access to the region's transportation network, civic organisations, regional hospital and recreational facilities, the municipality has plans for the expansion of community facilities to be completed over the next two decades. Devon has good access to built and social infrastructure, and it shows strong infrastructural resilience (Berkes and Ross, 2013; Christopherson et al., 2010; Cutter et al., 2008; Graziano and Rizzi, 2016; Osth et al., 2015; Sherrieb et al., 2010).

Governance factors

The increased voter turnout rate is an indicator of increased public participation in the decision-making process. It is important because research has found that voter participation rates are higher in socioeconomically resilient communities (Magis, 2010; Osth et al., 2015; Sherrieb et al., 2010). Municipal policies in Devon are focused on promoting environmentally sustainable economic development, future municipal facilities,

and environmental conservation efforts, especially for the river valley, demonstrating proactive municipal policies, which are atypical of RBCs (Martinez-Fernandez et al., 2012; Van Assche et al., 2018). Devon has limited or no power to make decisions on important factors of resilience such as investing in secondary and post-secondary educational institutions, transportation infrastructure, and capital-intensive community facilities. Whereas the municipality is accountable to its residents to ensure the resilience of Devon, it is unable to make decisions and investments in critical areas that promote resilience. Similar findings have also been found in RBCs across Australia, New Zealand, and other Canadian jurisdictions (Marais et al., 2018; Cheshire et al., 2014). Devon has co-operated with neighbouring communities, which is a sign of moving towards a resilient path of local governance.

Conclusion

Using Devon, AB as a case study, this study developed an analytic framework of community resilience to explore the resilience of an RBC. The results illustrate the characteristics of a resource-based economy which has moved through the boom and bust cycle to a post-extraction phase with municipal attempts to transition to a more resilient path. This study analysed various indicators of resilience for Devon and compared the findings with results from past studies of community resilience.

There have been several studies of community resilience. But few specifically examine resource-based communities. The framework of resilience developed for this study attempts to contribute to the ongoing conceptualization of resilience and link the resilience concept with the literature of resource-based economies. The framework can be used to develop a unified resilience index for resource-based communities in the Canadian context by applying the framework to RBCs like Tumbler Ridge, Kitimat, Fort McMurray etc. One of the difficulties faced while developing the framework was finding and developing a dataset for all the indicators representing the same point in time. Despite that, the framework provides a basis for combining the quantitative and qualitative strands of data and analysing the resilience of Devon to economic cycles based on that.

Referring to the Staples Theory discussed at the beginning of this paper, Devon is a quintessential staples economy, originally developed to house workers of the resource extraction sector. Results of economic and population indicators from the 1991 to 2006 census data show many of the common traits of a RBCs' boom and bust cycle. Example traits are economic dependence on the resource sector, and rapid population and income growth, which mimicks the economic bust during the early 1990s and boom in post-2000s in the resource extraction sector in Alberta. However, several indicators show that Devon has moved to a different growth path from that of a typical staples economy during and after the 2006 oil plant closures. The town is developing policies to function as a residential service centre for the wider metropolitan zone, and indicators such as population mobility, residential tax assessment, and

waste reduction are characteristic of residential service centres. Hence, Devon appears to be moving toward the growth path of residential development than that of a typical RBC. However, the town's major source of employment is still the oil, gas, and mining sector, and it still provides services to the wider region, which is dependent on a resource-based economy. The volatility of economic resilience of the Alberta capital region may continue to impact Devon's community resilience. The results of this paper provide scope for future studies on the impact of economic cycles on larger RBCs, and policy goals for sustainable development based on the resilience of such communities. The results also call for further exploration of resilience indicators to analyse development pathways of RBCs in a cyclical economy.

Acknowledgement

We thank the municipal officials and council of the Town of Devon for providing us access to the relevant data and resources for conducting this research. We also express our gratitude to Mitacs, Tessellate Inc., and Killam Trusts for providing the necessary funds for this study. Portion of this study have been presented in abstract form at the 58th WDCAG Annual Meeting at UNBC, Prince George on March 12, 2016. Lastly, we want to thank the two anonymous reviewers, whose thoughtful comments have improved the overall quality of this article.

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RESEARCH NOTE

A classroom contemplation: who is empowered to lead discourse and define paradigms? – Casting a glance at knowledge production and decision-making

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Abstract: *According to Foucault discourse can be defined as the articulation of power. Further, political ecologists point out that questions of power, influence, and the environment are anchored in context. Drawing upon these key concepts, originally as a student in Meletis' third year undergraduate Political Ecology class, and then as I prepared for and later delivered a student presentation at the WDCAG 2017, I aimed to answer the question of who is empowered to lead discourse and define paradigms. In order of doing so, I conducted a literature study review to identify influential ideas and actors. I chose to compare works by Arturo Escobar (1996) and Paul Robbins (2012). Based upon their conclusions 'Western' influence remains prevalent and powerful, support for the recognition and integration of local environmental knowledge is lacking and Foucault's theories are key in order to understand underlying power relations. Reflecting upon Foucault's understandings of power, I also wanted to get 'us' - the audience, reflecting on how we understand, explain, interact with, and influence our environment. I wish to highlight the importance of reflecting upon the origins of discourses' by tracing their evolution and searching for associated agendas, in order to better understand them and their implications. This research note concludes with personal reflections while bearing in mind that 'we' are part of the system ourselves.*
Keywords: political ecology; discourse; power; environment

Introduction

Words and texts are critical in our society. Discourses allow us to communicate complex ideas. Communication between human beings would be complicated if only non-verbal ways of communication were used. Language is a central component and reflection of culture and society; it is a medium that helps to convey knowledge, describe objects and couch intentions.

Foucault defines discourse as the articulation of knowledge and power with truth being an effect of power, one that is formed through language (cf. Foucault 1980). The great political potential of language as a medium of influence becomes apparent when critically examining the idea of language as bearer of messages. Language describes and conveys but also produces and legitimizes meanings (cf. Gregory et al 2000). Every year, the Oxford Dictionary names a word that has had great presence. Chosen in 2016, "Post-truth" is a familiar example that shows changes in discourse and power associations over time. The word "seems to have been first used [...] in a 1992 essay by [...] Steve Tesich" (Oxford University Press 2017), then its frequency peaked in 2016 in the context of the EU referendum and the presidential election in the United States (ibid.). The correlation of change in the word's meaning along with the increase of

its use impressively reflects the dynamic nature of discourse. Power must have been exerted as discourse was significantly altered (cf. Foucault 1980).

Background

This piece draws from a critical review paper written for a Political Ecology class. Political ecology can be defined as "approach to, but far from a coherent theory of, the complex metabolism between nature and society" (cf. Blaikie 1985, in Gregory et al 2000:590). To get a sense of key words in political ecology a Wordcloud was created by using the introduction chapters of Zimmerer & Bassett (2003) and Robbins (2012). According to those scholars, 'society', 'nature', 'power' and 'diversity' are suggested as key topics. Political ecology compels us to critically analyze actors' abilities to create discourse by investigating underlying power relations, and observing contextual considerations, in trying to better understand human-environment relations and the politics that inform them (Robbins 2012:25-49).

Methods

Starting as a class-related literature-based study, I analyzed Escobar (1996) and Robbins (2012:122-143). I then compared their conclusions and investigated relationships between those and other branches of theory in order to consider underlying philosophical concepts. I used examples of world events to help illustrate abstract ideas. The piece concludes with personal reflections.

Discussion

Whereas Escobar names "the Western scientist that speaks for the earth" (Escobar 1996:329), Robbins highlights the power of "daily conversations as well as media, music and arts, [that] can be held responsible for transmitting and thereby reproducing constructions" (Robbins 2012:74). Especially Robbins' conclusion underlines the fact that it is not only 'others' that implement change. Therefore it is important to reflect upon the idea that generally speaking every person holds the power of making people heard when empowering their discourse. A contemporary example is Twitter, where individual actions can become a powerful discussion thread if a Tweet gets picked up by others on a large scale.

However, power is more likely to be shared between actors that enjoy similar levels of power (cf. Escobar 1996:329). Therefore, some actors' ability to influence discourse is greater than others. Further, the demographics of the powerful may not adequately represent the group of people that they are meant to take decisions for. Most often, gendered imbalances of power exist, with the IPCC fifth assessment report being a current example (Ivanova 2015).

In addition to analyzing power relations and how they influence discourse light needs to be shed on the gap that exists between language and meaning. The diversity of perceptions that exist at personal scale challenge the paradigm's reliability as there is no certitude that the audience perceives the paradigm the same way, best exemplified by Rénée Magritte's painting 'Ceci n'est pas un pipe' where some might see a pipe while others might not (cf. Foucault 1976).

Furthermore, it is necessary to reflect upon the fact that power also exists in those forwarding challenges to discourse, and power can also be created or expanded upon when doing so. This power being generated might be resulting from processes very similar to the ones that created the dominant discourse and its associated power. Those proposing new ideas may also be pursuing their own interests. As Reuber

puts it "every initial position is based on subjective constructions resulting in perceptions distorting reality to achieve subjective objectives (Reuber 1999*), meaning that everyone's own background influences their perception from the beginning, and that these components are hard to disentangle from position and power.

Conclusion

Everyone is responsible for contributing to constructions of environment, and for helping to determine and question "whose knowledge counts". 'We' are all part of a system and thus able to influence discourse when supporting or spreading ideas. In doing so, 'we' are co-creating landscapes of discourse and power. For this reason, the positions of actors who appear to be leading discourse at present should not be seen as permanent. Their predominance was chosen by the power of the currently privileged and therefore most influential audience. Hence the starting question about who will be defining paradigms in the future can be answered with 'those that are empowered by the ones in power at present'.

While it is important to challenge discourse, it is also key to reflect upon and challenge 'our' own perceptions. Moreover, 'we' should consider personal abilities that make waves within larger structures and dialogues and think about their impact, especially in regards to shifting boundaries of discourse, and where those shifts might take us in the future.

Acknowledgements

From the bottom of my heart I want to thank the University of Northern British Columbia. I, especially but not exclusively, want to offer thanks to the members of the Geography Program for their support. Here, discourse is failing me when trying to put in words how much this means to me. Thank you very much. Danke vielmals.

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Faith-Based Environmental Work in Canada: A Profile

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Abstract: *In response to growing interest in faith-based environmental engagement, this study explores faith-based organizations in Canada participating in a wide range of environmental work. The research investigated sixteen organizations through interviews, participant observation, and focus groups, detailing their history, context, and activities. Study organizations represented a variety of Christian denominations, and interfaith, Muslim, and Jewish communities. Older organizations began as social justice agencies, later integrating environmental concerns, while newer organizations tended to focus more specifically on environmental issues. Most organizations were small, and relied heavily on collaboration and partnerships. Study findings indicate a wide variety of program areas, including education, theological reflection, advocacy, congregational resourcing, agriculture and food, and conservation. The discussion highlights the strong integration of social and environmental justice within the organizations, and analyses their approaches to advocacy and activism. As a preliminary study, suggestions for future research are also offered.*

Faith and the Environmental Crisis

In his famous 1967 article, Lynn White, Jr., argued: "What people do about their ecology depends on what they think about themselves in relation to things around them. Human ecology is deeply conditioned by beliefs about our nature and destiny – that is, by religion" (White, 1967: 1205). This essay has been widely read as an indictment of Christianity and its role in causing the current ecological crisis (Hitzhusen, 2007; Taylor, Van Wieren and Zaleha, 2016). While this is an accurate reading in part, more fundamentally, White's essay was a call to action and reform (Taylor, Van Wieren, and Zaleha, 2016). White (1967) exhorted Christians to reconsider the theological premises that shape human relationships with nature, and suggested St. Francis as a model. In the discourse that followed the publication of White's essay, many Christians and people from other faith traditions echoed this appeal for religious environmental reform (Berry, 1988; Bouma-Prediger, 2001; Clements, Xiao, and McCright, 2014; Scharper, 1997). And as the environmental crisis has deepened, environmental concern and action have grown within many faith communities (Gardner, 2002; Gottlieb, 2006), while scientists and environmental practitioners have begun considering the potential within these communities and their traditions to contribute to the environmental movement (Johnston, 2013; Van Dyke, 2010). Scientists have also issued appeals for environmental engagement to the religious community (e.g., Sagan *et al.*, 1990; Wilson, 2006).

Some scholars are now suggesting that a green shift is occurring within the world's

religions (e.g., Gottlieb, 2006; McDuff, 2012), citing as evidence the works exploring ecological imperatives that religious scholars from within faith traditions have produced over several decades (e.g., Bouma-Prediger, 2001; Francis, 2015; Lysack & Munn-Venn, 2013; Schaeffer, 1970; Wilkinson *et al.*, 1991), and the practical work of sustainability[1] in which faith communities are increasingly engaging. Numerous studies have documented this phenomenon, but the evidence is insufficient to determine how deep this apparent shift reaches (Taylor, 2011). Despite some claims that a widespread greening of religion is occurring, the empirical evidence is largely anecdotal and not supported in broader survey data (Clements, Xiao, and McCright, 2014; Gottlieb, 2006; Taylor, 2011; Taylor, Van Wieren, and Zaleha, 2016). At the same time, the anecdotal evidence indicates that there is at least an active minority within faith communities that is heeding White's call to embrace environmental concerns (e.g., Johnston, 2013; McDuff, 2012; Sluka *et al.*, 2011).

The dearth of conclusive evidence for a green shift within faith communities is compounded by the limited scope of existing studies. The majority of these studies have been undertaken in the United States and among Christians (Veldman, Szasz, and Haluza-DeLay, 2014). International studies are also beginning to proliferate, particularly within the African context (Bhagwat, Ormsby, and Rutte, 2011; Sluka *et al.*, 2011; Moyer, Sinclair, and Spaling, 2012). However, only a few newer works are beginning to address multi-faith, and multi-national initiatives (Johnston, 2013; Veldman, Szasz, and Haluza-DeLay, 2014), and beyond the work of Haluza-DeLay (e.g., 2008) and Lysack (e.g., 2014), research on faith-based environmental engagement in Canada is currently limited.

As White (1967) noted, religion affects how society responds to its environment, and there is growing interest in the potential for faith communities to help society address the moral and spiritual elements of the environmental crisis and thereby assist in effecting deep-seated societal transformation toward sustainability (Ellingson, 2016; Gardner, 2002; Gottlieb, 2008). Responding to this potential, and the gaps in the research detailed above, this study investigates faith-based organizations (FBOs) – non-governmental organizations (NGOs) affiliated with or directed toward faith communities – doing environmental work in Canada. The aim of this paper is to provide a basic profile of these FBOs, considering their historical origins, their contexts, and the programs and activities they provide.

The time period covered in this research is confined to the period in which the organizations studied existed (starting in the 1960s) and were engaging environmental issues, from the 1970s until the present. Their story, however, fits into a larger history of faith-based environmentalism that is both too long and too understudied, especially in

[1] I define sustainability as promoting the flourishing of social-ecological systems and the individuals within them (Moore, 2005; Sterling, 2001). In the scope of this research, I focus on activities with a broad range of environmental foci and include social sustainability components where they intersect with environmental sustainability components.

Canada, to relate here.[2] It is important to note, however, that faith-based environmentalism and related environmental FBOs have evolved in a parallel but separate stream to the secular environmental movement (Ellingson, 2016), developing unique motivations, worldviews, sub-streams, and approaches (e.g., Grizzle and Barrett, 1998; Jenkins, 2008; Kearns, 1996; Moyer and Scharper, [Accepted]).

Methods

The research was conducted through a qualitative, multi-case study approach. First, I developed an extensive list of potential FBOs based on: my personal network of contacts built through a decade volunteering with the Mennonite Creation Care Network and previous related research; and various lists (Canadian Interfaith Call for Leadership and Action on Climate Change, 2011; FORE, 2013; RCEN, 2013; Social Network for Sustainability, 2013; The King's University, 2013).[3] Organizations qualified for the extensive list only if they were NGOs (i.e., churches, church committees, and religious orders were not included), and if they described a faith affiliation[4] of some kind on their websites, were involved in environmental work, and provided programming in Canada directed to a Canadian audience. Organizations whose primary activity in Canada was raising money for work abroad were not included. Faith affiliation was determined by considering the organization's self-description, supporting community, target audience, and mission.

Having identified the list of FBOs, I selected organizations for in-depth study that exhibited the following criteria: well-established programming; a diversity of faith affiliations; and diversity in regional representation and programming across the selected FBOs. Sixteen organizations met the criteria, and I conducted interviews with one or more staff or volunteers from each organization to document its history, objectives, context, and activities. When

[2] To explore this history, see, for example, Fowler (1995), Gottlieb (2006), Johnston (2013), and Van Dyke (2010).

[3] The Social Network for Sustainability and the Christian Environmental NGO list at The King's University are no longer active online.

[4] I define faith as a profound commitment, "an alignment of the will, a resting of the heart, in accordance with a vision of transcendent value and power, one's ultimate concern" (Fowler, 1981: 14). When people of a shared faith come together, they form faith communities, that constitute cumulative, living traditions (Smith, 1963) encompassing beliefs, myths, sacred texts, symbols, values, norms, rituals, and other practices that function to explore and communicate understandings of the meaning of existence and the presence of the divine in human experience, among other functions (Geertz, 1973; Choquette, 2004). Faith communities have the potential to be organic, creative, dynamic, and continually responding to and making meaning of the lived experience of their members (Taylor, 2007). For the most part, I focused on "traditional" faith communities, and did not include newer expressions of non-institutional spirituality because their characteristics are sufficiently distinct to merit a separate or intentionally comparative study.

possible, I attended events or programs. I also conducted four focus groups with a total of 27 volunteers, interns, and participants in the FBOs' programming to gather responses to the organization's activities. Despite attempts at wide recruitment, focus group participants were mostly Toronto-based and involved with only five FBOs (see Table 1 below). Finally, I conducted interviews with 15 "experts," mostly academics, religious leaders, and politicians with experience in faith-based environmentalism, who could provide background to this work in the Canadian context. Interviews were conducted between October 2013 and August 2014, at the offices of the organizations or by telephone. The geographic range of the organizations exhibits a strong concentration in southern Ontario, which may reflect the geographic location of my research bases (Toronto and Winnipeg), but is also a function of the concentration of population in that area, and the consequent impetus for collective action. At the same time, there are likely smaller, local organizations operating regionally that were missed.

Most interviews were audio-recorded, and all were transcribed in full. Data were then organized and coded with NVivo software[5] for themes and patterns. Initial codes were developed deductively based on the literature (e.g., Berger, 2003), the interview questions, and the research objectives, and subsequent inductive codes were grounded in the data. I took two passes through the data, first coding the sources (e.g., interviews, field notes, etc.), then checking the nodes (or categories), to ensure consistency in analysis. Rigour was established through trustworthiness and authenticity by: providing transcripts to interviewees for review of accurate content (member checking); member checking of the findings and the preliminary analysis through a focus group with some of the FBOs and a newsletter sent to all interviewees that summarized the results; triangulation of various data sources; and audit trails documenting research decisions and activities throughout the process (Creswell, 2009; Merriam, 2002).

Environmental FBOs in Canada: A Profile

Table 1 provides a list of the 16 organizations studied, and a summary of their general profiles. Acronyms are sometimes used to identify the organizations, and are defined in Table 1.The sections that follow elaborate on the summary in Table 1, structured loosely on Berger's (2003) analysis framework, considering their history and aspects within their religious, organizational, strategic, and service dimensions.

[5] QSR International 2014, Version 10.

Table 1: Profile of Faith-Based Organizations

FBO	Date of Origin (Beginning of environmental activities)	Focus	Size	Faith Affiliation	Scope	Primary Location(s)/ Main Office
Citizens for Public Justice (CPJ)	1963 (1970s)	Promoting public justice – human flourishing and the integrity of creation – by shaping public policy debates	Medium	Christian ecumenical, Christian Reformed roots	National	Ottawa, ON
Mennonite Central Committee Canada (MCC)	1963* (1970s)	Relief, development, and peace for right relationships with God, each other, and creation around the world	Large	Mennonite and Brethren in Christ	National/International	Winnipeg, MB
Ignatius Jesuit Centre (IJC)	1964 (1999)	Through spiritual development, cultivate community and care for the land	Medium	Catholic: Jesuit Order of Canada	Local/Regional	Guelph, ON
Canadian Catholic Organization for Development and Peace	1967 (late 1970s)	Supporting and empowering people in the Global South, and educating Canadians about the North-South imbalance	Large	Catholic	National/International	Toronto, ON; Montréal, QC
Christian Peacemaker Teams (CPT)[F]	1988 (early 2000s)	Transforming violence and oppression toward people and creation	Medium	Christian ecumenical, Mennonite Brethren	National/International	Toronto, ON

				in Christ, and Quaker roots		
Kairos Spirituality-for- Social Justice Centre (KSSJC)	1998	Spiritual development toward justice and peace	Small	Catholic: Grey Sisters of the Immaculate Conception	Local/Regional	Ottawa, ON
A Rocha Canada (ARC) [F]	2000*	Conservation and education as expressions of God's love for all creation	Medium	Christian, mostly Evangelical	National	Surrey, BC; Houston, BC; Winnipeg & Morden, MB; Toronto & Hamilton, ON
Faith and the Common Good/ Greening Sacred Spaces (GSS) [F] **/Fossil Free Faith**	2000 (2003)	Supporting communities and individuals of faith to be role models for sustainability	Medium	Interfaith, United Church origins	Regional (mostly Ontario, some national presence)	Toronto, ON
KAIROS+ [F]	2001*	Facilitating Canadian churches and religious organizations in working for peace, human rights, and ecological justice	Medium	Ecumenical Christian	National/International	Toronto, ON
Turtle Lodge	2002	Sharing knowledge and reconnecting with the Earth and people	Small	Anishinaabe	Local/Regional	Sagkeeng First Nation, MB

Elderberry Connection	2004	Christian spirituality to foster ecological and social justice	Small	Ecumenical, mostly Catholic	Local/Regional	Southern Ontario
Église Verte	2006	Empowering faith communities through awareness, spirituality, and action toward environmentally sound practices	Small	Ecumenical/Catholic, United Church origins	National (mostly Québec, expanding nationally)	Montréal, QC
Green Awakening Network (GAN) [F]	2008	Networking United Churches and others to respond to climate change to through changes in lifestyle and building operations	Small	United Church of Canada	Local/Regional	Greater Toronto Area
Shoresh	2009	Responding to current food and ecological issues rooted in Jewish wisdom and practice	Small	Jewish	Local/Regional	Toronto, ON; Hillsburg, ON
Green Faith Alliance (GFA)	2011	Networking, capacity building, and shared political advocacy among faith groups in response to climate change	Small	Interfaith	Local/Regional	Winnipeg, MB
Khaleafa	2011	Promoting discourse on Islamic environmentalism in Canada	Small	Muslim	Local/Regional (website has national scope)	Toronto, ON

[F] These organizations' participants, volunteers, and interns contributed to the focus groups.

[+] *Kairos* is a Greek word for time, specifically extraordinary or holy time, encompassing a sense of crisis, opportunity, and a need for action (KAIROS, 2014). Although it is not an acronym, the name of this organization is usually spelled with capital letters. KAIROS is an ecumenical organization whose members in 2014 included: The Anglican Church of Canada, Canadian Catholic Organization for Development and Peace, Canadian Conference of Catholic Bishops, Canadian Religious Conference, Christian Reformed Church in North America, Evangelical Lutheran Church in Canada, Mennonite Central Committee of Canada, The Presbyterian Church in Canada, Presbyterian World Service and Development, The Primate's World Relief and Development Fund, Religious Society of Friends (Quakers), The United Church of Canada

* These organizations had earlier origins in a different form or different locations. The first A Rocha project was initiated in Portugal in 1983. KAIROS was preceded by a conglomeration of ecumenical coalitions that formed during the 1970s. MCC was formed in 1920 based in Pennsylvania with participation from both Americans and Canadians.

Historical Roots

The first Canadian FBOs to become involved in environmental activities (e.g., Development and Peace, Citizens for Public Justice, Mennonite Central Committee) were launched in the 1960s, largely as social justice and international development organizations, operating both in Canada and internationally. They adopted environmental foci in the 1970s and 1980s, instigated by a growing understanding that human development and social justice are intertwined with environmental integrity. For example, Luke Stocking[6] provided the following explanation for how Development and Peace expanded its focus from addressing poverty to including environmental sustainability concerns:

> It was recognized that in order to truly be of service to the poor, some attention had to be given to the environment. But at Development and Peace, our interest in the environment is rooted in our commitment to integral human development, and an understanding that integral human development cannot occur without due regard for the planet where we live.

KAIROS evolved from multiple ecumenical coalitions, such as Project North and the Taskforce on the Churches and Corporate Responsibility, which also formed during the 1970s. These coalitions, along with the Mennonite Central Committee, Citizens for Public Justice, and Christian Peacemaker Teams (though CPT formed somewhat later), began working closely with Indigenous peoples, creating relationships that helped to catalyze their environmental engagement. For example, CPJ and Project North became involved in advocating for Indigenous communities affected by large development projects. In particular, they worked with the Dene people during the Mackenzie Valley Pipeline Inquiry, which investigated the impacts of a proposed gas pipeline through the Northwest Territories. These interactions with Indigenous peoples were critical moments in shaping the faith communities' relationship to the environment and their understanding of its place in their faith. Documenting Citizens for Public Justice's history, MacAdam (2003) reflected: "While working with Aboriginal people, CJL met people who understood in their souls what living in harmony with the earth is all about."[7] In a similar reflection on KAIROS's predecessors' work with Indigenous peoples, Hamel (1994: 30) wrote:

> Our work with aboriginal peoples in the struggles for justice has brought incredible dividends to the churches. Our understanding of creation has been greatly enhanced. The aboriginal peoples have taught us that social justice is inextricably linked to environmental justice. Justice in the social order cannot be achieved in isolation from a recovery of the integrity of creation.

[6] This project was approved by Research Ethics Board of the University of Toronto. Staff and volunteers within the case FBOs and expert interviewees were given the choice of selecting a pseudonym or using their real names, which most chose to do. All focus group participants are identified by pseudonyms.

[7] CJL: Committee for Justice and Liberty, now CPJ.

These quotes illustrate how social justice initiatives undertaken with Indigenous peoples reshaped these Christian organizations' approach to the environment, which resulted in a shift in their programming to include a more environmental focus.

The most prominent environmental FBOs, including A Rocha, Greening Sacred Spaces, and KAIROS, were established in the late 1990s and early 2000s, which was a critical period of development for environmental FBOs. The public's interest and participation in the environmental movement has waxed and waned in Canada (Staggenborg and Ramos, 2016). The research indicates that Canadian environmental FBOs have mostly followed behind the secular environmental movement, except during the late 1990s and early 2000s. A decline in public interest for the environment followed the economic recession of the mid-1990s (MacDowell, 2012; Staggenborg and Ramos, 2016), but these were fertile times for FBOs involved in environmental activities, as indicated by the creation of FBOs like ARC, GSS, and KAIROS. According to Ted Reeve, a GSS founder, GSS was ahead of the curve when it started, but he thinks that faith-based initiatives have fallen behind since the 2008 financial crisis. The data indicates, however, that there has been a steady growth in new, environmentally focussed FBOs and environmental initiatives throughout the 2000s and into the 2010s.

Size and Geography

In Table 1, the size of the organizations is described according to three categories. These designations were derived from the number of paid staff and volunteers at each organization at the date of the interview. Interviewees could often only provide estimates, resulting in loose categorizations. Large organizations were those with over 50 staff and over 100 volunteers. The largest of these was the Mennonite Central Committee, with over 200 employees, and around 17,000 volunteers. The medium-size organizations had between 10 to 49 paid staff, and 10 to 99 volunteers. This category includes organizations such as A Rocha, KAIROS, Greening Sacred Spaces, and Citizens for Public Justice, which were providing some of the most active faith-based environmental programs across the country. The small organizations had fewer than 10 staff. Within this group, the Green Faith Alliance, Khaleafa, Elderberry Connection, the Kairos Spirituality-for-Social Justice Centre, and the Turtle Lodge had no paid staff and were run entirely by volunteers. These organizations had more focused objectives, both regionally, and in terms of program and audience. Half of the organizations studied fit into the smallest category. Many of the small FBOs were also the most recently established organizations, which may indicate a growing commitment to environmental sustainability amongst faith communities that has potential for further
growth.

Because this research focuses on the Canadian context, I strove to find the most prominent organizations across the country, and to capture the range of organizations both in terms of program focus and location. Given the limitations described above in achieving geographic representation, I am hesitant to make any conclusions about different regions of the country. It does appear, however, that there is a gap in faith-based environmental programming in certain regions, particularly the Prairies and

Atlantic Canada. At the same time, about half of the organizations, wherever their base, have a national scope (Table 1).

Faith Affiliation and Constituency

As explained above, faith affiliations were largely self-described. The majority of organizations were Christian (Table 1), with two interfaith, one Jewish, one Muslim, and one Indigenous. This distribution reflects the historical profile of religion in Canada as a predominantly Christian country, as well as its growing diversification through immigration (Kunz, 2009). To ensure that I was not favouring Christian FBOs because of my personal connections and expertise, I consulted with members of several different faith communities and leaders of the non-Christian organizations about other initiatives across the country. There are small initiatives in individual mosques, synagogues, and temples, but at the level of organization required for the scope of this project, it appears that few non-Christian FBOs have formed in Canada. Several participants explained that in immigrant communities people are struggling with more immediate concerns related to finding work and settling into a new country. There are also some international non-Christian organizations, such as Eco-Sikh, that have connections in Canada, but had no official presence during the research period. More recent research has revealed that Eco-Sikh has had Canadian board members and its activities are promoted by the World Sikh Organization of Canada. It will be interesting to see if similar research conducted in future decades will yield a different spread of faith affiliations.

Some additional exceptions and clarifications regarding faith affiliation should be noted. Lucy Cummings specified that Greening Sacred Spaces was not faith-based but rather a secular organization that worked with faith communities. Additionally, Shoresh worked to encompass a broader segment of the Jewish population than just those who consider themselves practicing Jews. Director, Risa Cooper, specified that "faith is not a necessary component in order to be practising an environmental ethic from a Jewish perspective," and that participants within the Jewish environmental movement connect on a variety of levels, including spirituality, Jewish identity and values, and Jewish culture, history, and culinary practices.

Finally, Dave Courchene, the leader of Turtle Lodge, specified that this organization was not part of a religious faith, but rather was following an Indigenous set of values and way of life. While Indigenous values and spiritual traditions differ in this way from the other faith communities included in the study, I deemed they merited inclusion because of their foundational place within Canadian culture, their significant role in Canadian resource management and development discourses (Klein, 2014; Mitchell, 2015), and the broader societal commitment to reconciliation. At the same time, it was challenging to find organizations that fit the scope of the research criteria and were sufficiently similar to be compared to the other FBOs. While there were numerous Indigenous organizations engaging in environmental issues, such as Idle No More, their spiritual or faith components often were not explicit, and consequently, only one Indigenous organization was selected for the study.

Among Christian organizations, the spectrum of denominations in the study is fairly well-represented, including various Catholic, Mainline Protestant, and

Evangelical groups. Evangelicals are the least visible, mostly being served by A Rocha, while the Orthodox community is absent. Within the Christian community, the United Church has played the most prominent role, having helped to found GSS, GAN, and Église Verte, and providing institutional support for KAIROS and GFA.

The Christian organizations were largely formed to serve a specific Christian population or to express its particular values, beliefs, and mission. In general, a congregational focus was evident amongst several organizations, notably Greening Sacred Spaces, Green Awakening Network, and Église Verte, for whom the church, (or synagogue, mosque, or temple, in GSS's case) served as a physical and institutional connecting point to broader communities. Several of the FBOs described their work as being aimed at Canadian society at large, with the faith community in which they were situated (e.g., Catholic, United Church, Mennonite) serving as a vehicle for reaching that goal because that is the community to which they have access.

Amongst many of the Christian organizations, a notable trend of wider inclusion and diversifying was apparent. Several organizations were founded as ecumenical initiatives, bringing together numerous denominations, such as KAIROS, which is a joint venture of 12 Christian denominations and organizations. Others with more specific denominational roots, such as Citizens for Public Justice (Christian Reform), the Mennonite Central Committee (Mennonite), and Christian Peacemaker Teams (historic peace churches, such as Mennonites and Quakers), remarked that their funding base, program participants, and staff are expanding beyond their traditional communities. CPT in particular has taken steps to open its borders, stating in a membership policy approved in 2011: "We are committed to building a Peacemaker Corps that reflects the rich diversity of the human family in ability, age, class, ethnicity, gender identity, language, national origin, race and sexual orientation" (Elizabeth Rebo, CPT). CPT also offers associate membership to individuals of other faith convictions who share CPT's values and commitments.

Other organizations that were founded by or continue to target a specific faith tradition still exhibited a commitment to openness and inclusion in some way. The Ignatius Jesuit Centre, rooted in the spiritual disciplines of St. Ignatius, hosted a Buddhist retreat and welcomed spiritual pilgrims from any faith interested in its programs. Similarly, Muaz Nasr, founder of Khaleafa, designed that organization's website with a Muslim audience in mind, but worked to make the site accessible to everyone. Finally, as mentioned above, Shoresh wrestled to be relevant to the wide spectrum of the Jewish community, from the most observant to the ethnic and secular.

Partners, Collaboration, and Funding

Partnership and collaboration constituted a key approach for many of the organizations. Discussion of partnerships arose throughout the interviews, and specific questions about partners revealed a wide variety of collaborations. It was striking how much the FBOs selected for this research were working with each other. Figure 1 illustrates this network of connections. Greening Sacred Spaces and KAIROS were both leaders in faith-based environmental work and hubs of connection with other organizations. Citizens for Public Justice, Green Awakening Network, and the Mennonite Central Committee were also leaders and

networking hubs to a lesser degree. There were also several prominent clusters of organizations that connected in various ways. For example, GSS, GAN, Shoresh, and Khaleafa (left side of figure) form a cluster of active groups in the Toronto area. MCC, A Rocha, the Green Faith Alliance, and Christian Peacemaker Teams (right side of figure) have Winnipeg connections, and share various Mennonite affiliations. The Kairos Spirituality-for-Social Justice Centre, the Ignatius Jesuit Centre, and Elderberry Connection (bottom right of figure) are connected less through geography or programming but rather through the fact that they derive inspiration from the work and teachings of Thomas Berry, a Passionist priest and self-described "geologian" who promoted ecological imperatives through the study of cosmology (e.g., Berry, 1988). Notably, Turtle Lodge, as the only Indigenous organization, was not connected with any of the other FBOs, though it is geographically proximate to the organizations with links to Winnipeg.

The FBOs also partner with a wide variety of other organizations and institutions (Table 2). There is not space to list all the various partnerships, but Table 2 provides a sampling of the broad variety of organizations with which the FBOs were working, demonstrating their openness to diverse partnerships. These collaborations consisted of joint program delivery, administrative and program support, sharing of educational resources, use of facilities, and funding.

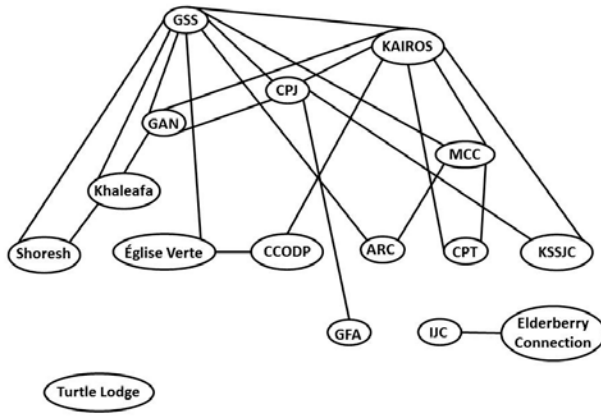

Figure 8. Network of Partnerships among FBOs

Table 2: FBO Partners

Type of Partners		**Examples**
Faith-based	Institutions	Canadian Council of Churches; Noor Cultural Centre; UJA Federation
	NGOs	Canadian Foodgrains Bank; Scarboro Mission
	Universities	Regent College, Trinity Western University, Canadian Mennonite University
Secular	Conservation organizations	Little Campbell Watershed Society; Trout Unlimited; Great Canadian Shoreline Clean-Ups
	Environmental advocacy groups	Citizen's Climate Lobby; Council of Canadians; Idle No More; David Suzuki Foundation; 350.org
	Social justice agencies	Toronto Social Housing; Foodshare Toronto; Winnipeg Harvest
	Businesses	Solar Share; Zoo Share
	Government	Department of Fisheries and Oceans; Environment Canada; Toronto and Region Conservation Authority

The FBOs acquired funding from a variety of sources, including businesses and various levels of government. For example, the most common business funder was the TD Friends of the Environment, and government funding sources included Environment Canada, the Ontario Trillium Foundation, and the Canadian International Development Agency (CIDA), while it existed. Several FBOs have also received funding from private foundations, such as Fondation Béati and the Atkinson Foundation. While some fruitful projects have been accomplished through such funding relationships – e.g., Shoresh's Kavanah Garden and A Rocha's Salish Sucker pond rehabilitation – several organizations noted the challenges and risks associated with applying for grants, particularly from the government. The Ignatius Jesuit Centre and Église Verte reported being ineligible for funding due to their religious affiliations, while others (e.g., Development and Peace, and KAIROS) recognized the delicate balance in receiving funds from governments whose values may not match those of the organization. For instance, throughout Development and Peace's long history of receiving funding from CIDA, it constantly struggled to retain its integrity and its freedom to critique the government from which it received funds (Bouchard, 1992).

This tension, and the uncertain relationships with government and secular institutions that can result, is illustrated by KAIROS's experience. In 2009, after receiving grants from CIDA for over two decades, KAIROS applied for a grant of about $7 million over four years, consistent with previous funding grants. This application was rejected. No reason or explanation was given except that KAIROS's program "did not fit CIDA's priorities" (KAIROS, 2013). This decision affected programs in various Global South countries, as well as educational programming in Canada. As a consequence of such challenges, many of the organizations (e.g., A Rocha, Christian Peacemaker Teams, Ignatius Jesuit Centre) received much or most of their funding from religious organizations, churches, and individual donors.

Activities

The focus and objectives of the organizations mirrored their origins. For the most part, the older, larger organizations (Christian Peacemaker Teams, Citizens for Public Justice, Development and Peace, Mennonite Central Committee, and KAIROS) functioned as social justice organizations, with varying degrees of environmental focus and commitment. The bulk of the organizations, all of which formed in the 21st century, focused more specifically on environmental issues, with additional interest in social justice and spirituality. Three organizations (Ignatius Jesuit Centre, Kairos Spirituality-for-Social Justice Centre, the Turtle Lodge) delivered spirituality programs, with a strong environmental component.

Table 3 shows the activities in which the study FBOs engaged, ranked in order by frequency. The activity types listed in the table were developed to demonstrate how the FBOs devoted their time and energy and are not mutually exclusive categories. ***Education*** work in a variety of forms was the most common activity, in which all the organizations were involved. Greening Sacred Spaces, KAIROS, Église Verte, and Khaleafa had extensive websites that provided a range of educational resources. Others organized regular events, such as the Shoresh Food Conference, and the joint Green Awakening Network/Greening Sacred Spaces forum. A Rocha, Citizens for Public

Justice, and KAIROS, among others, provided educational presentations in churches, and both A Rocha and Shoresh connected with school systems to provide environmental education programs. These educational activities covered a range of topics including other activity types listed in Table 3, from policy discussions, to practical skills, and theological reflection and development.

Table 3: FBO Activities

Activity Type	Examples
Education	*ARC*: place-based learning programs at field centres *Shoresh*: Food Conference *GAN/GSS*: Annual Forum *KAIROS*: Blanket Exercise, Watershed Discipleship *Église Verte, GSS, KAIROS, Khaleafa*: online resources
Theological Reflection & Development	*GSS*: Green Rule Poster *CPJ*: *Living Ecological Justice* (2013) *Elderberry Connection*: Annual Retreats *Khaleafa*: Green Khutbah campaign
Policy and Advocacy	*CPJ, KAIROS*: research, analysis, and publication; meeting with political leaders
Congregational Resourcing	*GSS*: Green Audit, Solar Audit, retrofitting support *GAN*: Sustainable Energy Loans *GSS, GAN, Église Verte* : Green Team support
Agriculture and Food	*Shoresh:* Kavanah Garden, Bela Farm *ARC, IJC*: Community Shared Agriculture programs
Worship and Ritual	*Turtle Lodge*: ceremonies and sacred sites *IJC*: monthly Earth Prayers; Stations of the Cosmos
Networking	*GFA*: Climate in Peril events *GSS*: Fossil Free Faith divestment network *ARC, MCC*: Germinating Conversations
Nature Experience	*ARC*: day camps; Fun on the Farm *IJC*: recreational trails *Shoresh*: Urban Teva Adventures
Activism	*CPT*: Elsipogtog fracking blockade *KAIROS*: letter writing campaigns, bell ringing for climate talks in Copenhagen, *CPJ, Shoresh, GAN, GSS*: People's Climate March
Conservation	*ARC:* species monitoring; habitat restoration *IJC:* Old-Growth Forest
Spiritual Direction	*IJC:* spiritual retreats *KSSJC*: spiritual direction meetings
Internal Greening	*MCC*: office retrofits; environmental assessment; carbon tracking

Nearly all the organizations engaged in ***Theological Reflection and Development*** activities, which largely involved publishing, particularly study resources (e.g., GSS, 2014; Lysack & Munn-Venn, 2013). Organizations also sent representatives to speak at worship services and other events. ***Spiritual Direction*** was a related but less common activity, offered as the primary programs of the Ignatius Jesuit Centre and the Kairos Spirituality-for-Social Justice Centre. These programs linked theological reflection to personal spirituality and individuals' faith journeys, integrating ecological elements within this process.

Policy and Advocacy, ***Congregational Resourcing***, and ***Agriculture and Food*** activities were undertaken by a smaller number of organizations, but were the primary activities for these FBOs. KAIROS, Citizens for Public Justice, and to a lesser degree, the Mennonite Central Committee, were the primary policy and advocacy FBOs, engaging politicians and political processes, and producing research, analysis, and publications on topics ranging across pipelines, divestment from fossil fuels, United Nations climate talks, carbon pricing, green economies, and Indigenous ecological wisdom, as well as a variety of social justice issues.

Greening Sacred Spaces, often in partnership with Green Awakening Network and Église Verte, led the Congregational Resourcing work, focusing on buildings and activities within the life of the faith community. These organizations provided green audits, solar audits, financial and technical support for retrofitting, and a green certification program. These organizations also helped congregations to form Green Teams to provide leadership in undertaking these initiatives.

Agriculture and Food activities at A Rocha, Shoresh, and the Ignatius Jesuit Centre provided another practical approach to engaging sustainability as an expression of faith. At the Brooksdale Environmental Centre in Surrey, BC, A Rocha operated an integrated sustainable agriculture enterprise with a large community shared agriculture program, and a livestock program with chickens, sheep, cattle, and a llama (Field Note, 2014-08-05). In Winnipeg, A Rocha's "Just Growing" project addressed food security by involving people on the social and economic margins in urban gardening. Shoresh's Kavanah Garden at the UJA Federation's Joseph & Wolf Lebovic Jewish Community Campus in Vaughn, ON, and its community shared agriculture programs in Toronto, ON, served local community members, and school children, producing food for households and for charity. Bela Farm produced organic fruits, vegetables, and honey on a one-hundred acre property northwest of Toronto. These projects "[sought] to model and inspire Jewish social and environmental responsibility" and to "[merged] nature-based art with experimental agriculture, and [served] as a laboratory for creative responses to [*sic*] global environmental crisis" (Shoresh, 2013).

Many of the organizations presented or facilitated worship services, ceremonies, and rituals (***Worship and Ritual***). Turtle Lodge held traditional ceremonies and events as one of its main activities, while the Ignatius Jesuit Centre hosted monthly Earth Prayers,

and a "Stations of the Cosmos" reflective walk on its property. Citizens for Public Justice, KAIROS, and Église Verte, produced, collected, and disseminated worship resources, and sent staff to contribute to worship services.

Networking was a secondary activity across numerous organizations that was undertaken through initiatives such as Germinating Conversations, a joint project of A Rocha, the Mennonite Central Committee, Canadian Mennonite University, and Food Matters Manitoba to bring urban and rural populations together in conversation about faith, food, and the land. Fossil Free Faith was an interfaith network that Greening Sacred Spaces was helping to develop to support and engage faith communities in discussion about fossil fuel divestment.

Direct ***Conservation*** and providing ***Nature Experience*** was primarily undertaken by A Rocha and the Ignatius Jesuit Centre. At each of their three field stations, A Rocha staff, interns, and volunteers engaged in regular monitoring of a variety of species. For instance, in 2014, A Rocha conducted a study of cliff swallows around its Surrey, BC, field station, and they have facilitated an annual Raptor Count in Manitoba's Pembina Valley for many years. Habitat restoration projects constituted the other half of A Rocha's conservation work. In Surrey, A Rocha has improved fish habitat along the Little Campbell River and in a pond on their property (Field Note, 2014-08-05). While the Ignatius Jesuit Centre's primary focus was spiritual direction, it was also engaging in direct conservation work on its substantial land holding. IJC has dedicated a 40 hectare section of land as a 200-year, old-growth forest project, involving both protection and restoration (Field Note, 2014-01-21). This forest, along with much of the IJC property, provided space for recreational activities such as hiking and cross-country skiing. A Rocha's centres and programs also provided opportunities for nature experiences, informally and through days camps, and other community events.

Activism was a prominent activity amongst only a few FBOs, though several of them supported or encouraged activism as a secondary activity. Christian Peacemaker Teams were the exception, engaging regularly in peaceful, direct action, such as participation in the 2013 fracking blockades in Elsipogtog, NB, and ongoing support of logging blockades in Grassy Narrows, ON. KAIROS, Citizens for Public Justice, Green Awakening Network, Shoresh, and others planned and encouraged activist activities, such as participation in the 2014 People's Climate March in New York. Finally, a few organizations, most notably the Mennonite Central Committee, explicitly mentioned ***Internal Greening***, such as office retrofits and conducting environmental assessments on projects, while others (e.g., A Rocha, Shoresh) demonstrated internal greening commitments in activities such as food provision.

Deepening the Profile

This paper opened with a quotation from White (1967), highlighting both the critique of and the call to action for Christians and other faith communities to respond to the growing environmental crisis. Anecdotal evidence suggests that at least some pockets within faith communities are actively engaging in sustainability initiatives, but empirical evidence investigating the degree to which environmental reforms have taken hold within faith communities has been largely inconclusive. This paper provides one of the first systematic studies of faith communities engaging in environmental

activities in Canada, and the FBOs in this study add another increment to the evidence of a greening strand within faith communities. They are participating most extensively in education and theological work, addressing the worldviews that White (1967) identified as problematic, and engaging in numerous and more varied forms of practical environmental work, from improving the efficiency of worship buildings, to engaging food and agricultural issues, to direct conservation and activism work. Both the young age and small size of the most environmentally focused FBOs within the study indicate the time it has taken for White's message to germinate and start taking root.

Several features of the FBOs' approaches and activities deserve further consideration. Partnership and collaboration were prominent features among most of the FBOs studied. The strong ties among the various Canadian FBOs, and between the FBOs and other organizations and agencies, both faith-based and secular, demonstrate a willingness to work with diverse partners and a commitment to including any who share similar environmental concerns. These connections also indicate a robustness in the movement network (Krinsky and Crossley, 2014). The partnerships with secular agencies are evidence of integration and cooperation with the broader environmental movement at the local level, though this integration is less apparent at the regional or national level. This parallels network ties among environmental FBOs in the United States (Ellingson, 2016). At the same time, FBOs chose their partners and funding sources carefully, seeking to protect the integrity of their particular approach and their framing of environmental concerns. This tension between building broad networks and appealing to a specific constituency and its worldview is one that FBOs must balance carefully (Ellingson, 2016).

Partnerships can also be understood as a facet of holistic approaches, which are identified in the literature as one of the more unique attributes of FBOs (e.g., Moyer, Sinclair, and Spaling, 2012; Van Dyke, 2010). Another aspect of holism manifested among these FBOs was an integrated vision of justice, including both human and environmental concerns. Amongst nearly all of the FBOs studied, a clear commitment to integrating social and environmental justice was articulated in their theologies or worldviews and in their work (see Tables 1 and 3). Among Christian FBOs, for instance, many derived theological inspiration and justification for their environmental involvement from scriptures calling for love of neighbour and care of the oppressed, recognizing the human suffering that environmental degradation causes (Moyer and Scharper, [Accepted]). Practical examples from their work include: the connections organizations such as A Rocha and Shoresh made between sustainable food production and food security for marginalized populations; commitments by KAIROS and Christian Peacemaker Teams to solidarity and reconciliation with Indigenous peoples and the land through advocacy and activism; and Citizens for Public Justice's climate justice focus (e.g., Lysack and Munn-Venn, 2013). When compared to secular organizations, this approach appears to be unique. Haluza-DeLay and Fernhout (2011) studied the communications of environmental organizations across English-speaking Canada and found only marginal evidence of a commitment to social justice concerns. In conversation, environmental

sociologist Haluza-DeLay noted that further unpublished research confirms that Christians are more committed to social justice than secular environmental organizations (Field Note, 2013-12-12). At the same time, there are some secular organizations, such as the David Suzuki Foundation and the Council for Canadians, which do integrate social and environmental concerns.

The strong integration of social justice and environmental concern within the FBOs studied is in part linked to their historical focus and their path to environmental work. The older and larger organizations nearly all began with a social justice focus, whether within Canada (e.g., Citizens for Public Justice, and KAIROS), or abroad (e.g., Development and Peace, and the Mennonite Central Committee). These organizations arrived at their environmental focus by recognizing the human cost of environmental problems both in the international setting and among Indigenous peoples. Secular environmental organizations of a similar age, such as the Sierra Club, Greenpeace, and the Land Conservancy, have a different history, beginning with a mandate that largely excluded human concerns, aiming to protect land and species (MacDowell, 2012).

A holistic approach is not only evident in the older social justice FBOs, but also in the newer, more environmentally-focused organizations, such as the Kairos Spirituality-for-Social Justice Centre, A Rocha, Faith and the Common Good/Greening Sacred Spaces, and Shoresh. For these organizations, a fundamental recognition of the interdependence and connection between the social and ecological spheres has been woven into their fabric from their inception. When the first A Rocha project was developed in Portugal, for instance, its founders determined that their approach would involve being rooted in a local community, connecting with both the people and the land in that place (Harris, 2008). Accordingly, A Rocha projects around the world have been established by developing field centres where staff, volunteers, visiting researchers, and guests live together in close community that connects intentionally to the local people (Harris, 2008; Moyer, 2015). This model facilitates an integrated understanding of how local environmental problems, and programs designed to solve them, are impacting local people.

While the FBOs' integration of social and ecological elements demonstrates one of their strengths, Lysack (2013; 2014) has lamented the lack of direct activism and strong advocacy, particularly in relation to climate change, within faith communities in Canada. He recognizes the importance of personal or congregational level greening activities, but argues that "The magnitude and speed of climate change and environmental decline are such that personal change alone is a grossly inadequate response and not the right scale for effectively mitigating climate change" (Lysack, 2014: 168). Some organizations, however, defended their intentional choice to focus their energies away from activism and advocacy. Greening Sacred Spaces's choice of focus, for example, was described as follows:

> There are very strong groups doing social advocacy, for example KAIROS, and there were strong intra-denominational, or intra-faith groups doing environmental work, so I think we tried to fill that space that was in between. So, environmental or

> sustainability work that was very applied (Lucy Cummings, GSS).

Thus, Greening Sacred Spaces chose to focus on congregational greening, with the goal of making churches, mosques, and synagogues models of sustainability. Similarly, organizations such as A Rocha and Shoresh have chosen to model sustainability through their agricultural practices, and in A Rocha's case, their community life.

A Rocha and the Mennonite Central Committee have sometimes chosen to defer from strong activism or advocacy to avoid alienating their supporting constituency or target audience. An A Rocha staff member participating in the focus group articulated A Rocha's approach in this way:

> I have friends who think that I'm really compromised because A Rocha's not taking a public stand on issues of pipelines, issues of whatever. On the flip side, I know we would burn half of our bridges as soon as we did that, bridges that have taken a long time to build within faith communities, that for political reasons, just stand where they stand. So, I think that there is an implicit critique in what we're doing, about the way that we are living in the world. And yet, we're trying to figure out how to model an alternative to that, and tell an alternative story that draws you along that path rather than simply standing and pointing out what's wrong (Obadiah Clapton, ARC).

Similarly, the Mennonite Central Committee has received criticism from some of its constituents for various environmental activities in the past, and in 2012, one of its member denominations withdrew from the organization, citing as the grounds for this decision MCC's engagement with environmental issues, along with its position on Israel-Palestine, its involvement with the United Nations, and its participation in conversations about sexuality (Braun, 2013). For organizations that serve diverse populations, environmental advocacy and activism are tricky paths to navigate. At the same time, organizations such as MCC, which represent a broad constituency, can have a powerful impact, as noted by one of its staff:

> When we do get around to saying something, it matters, because you're carrying a huge constituency behind you, so I think we're not viewed as a niche group, and we're not necessarily predictable in what we're going to say. So when we can actually get around to doing something, it reaches every region and it reaches people who are connected to the oil industry, urban Mennonites in Toronto. So it feels like it matters, but getting to doing something is not easy (Dan Leonard, MCC).

Those organizations that were intensely involved in advocacy and activism – e.g., KAIROS, Citizens for Public Justice, and Christian Peacemaker Teams – all have older roots, and have always had an advocacy mandate. CPJ, for example, is grounded in the Christian Reformed tradition of public justice. Likewise, KAIROS grew from the work of ecumenical coalitions working to effect social change through political action beginning in the 1970s (Lind and Mihevc, 1994). CPT originated from a speech at the Mennonite World Conference in which

Ronald J. Sider (1984) challenged Mennonites, Brethren in Christ, and other historic peace churches to be active and prepared for self-sacrifice in their peacemaking.

The FBOs that refrain from direct activism and advocacy tend toward an approach Smith and Pulver (2009: 147) describe as ethics-based environmentalism, which "calls for broad attitudinal and lifestyle changes to be made and seeks to provide individuals with a generalized framework within which to view their responsibility to others and to the natural world." This contrasts with issues-based environmentalism that responds to particular environmental problems, such as climate change, through advocacy shaped by scientific and technological perspectives, and aimed at legal and political channels. Smith and Pulver (2009) conclude that both issues-based and ethics-based strategies have strengths and weaknesses. While issues-based work may be more visibly effective in the short term, ethics-based approaches are likely to yield more permanent and profound transformations (Smith and Pulver, 2009). Given how the environmental movement has struggled to maintain its momentum and position as it competes with other issues for attention and priority (Staggenborg and Ramos, 2016), the permanence and depth of commitment that ethics-based approaches can offer are paramount. Furthermore, some of the ethics-based FBOs in this study are not only working to transform lifestyles and attitudes, but are developing alternatives communities that can serve as experimental models for building a more sustainable society.

At the same time, as Lysack (2014) noted, given the current urgency to address problems such as climate change, we may not have the time to wait for the fruits of ethics-based work to mature. Lysack's (2014) analysis was specifically aimed at climate change advocacy among the institutional leadership within faith communities, rather than para-church (or synagogue, mosque, etc.) FBOs, and therefore his critique did not fully account for the range of work conducted by organizations such as KAIROS, Citizens for Public Justice, and Christian Peacemaker Teams, which are filling the advocacy role. Given the contributions that both approaches can make to addressing environmental concerns in both the short and long term, it seems appropriate to employ a variety of strategies, which together the FBOs in this study are doing. Only time will tell if the balance between the approaches within the FBOs in Canada is optimal.

Building the Profile: Future Directions

This research raises numerous questions for future study. Given the research gap related to faith-based environmental activities in Canada, there is a need for more quantitative and qualitative studies in this context. Building on Lysack's (2014) work on climate change within faith communities, further research could ascertain the commitment to environmental concerns at the leadership level of faith communities in terms of preparing statements of commitment and educational and worship resources. Furthermore, the degree of penetration of these leadership level activities (both by religious institutional and administrative bodies and by FBOs) into local-level faith communities also requires study. To what degree are regular members of these communities aware and supportive of the initiatives of their leaders? In addition, there is potential to explore the role that faith-based educational institutions are

playing, particularly the Christian colleges and universities that offer environmental studies programs. Finally, a more sophisticated network analysis of the partnerships and collaborations outlined here could also be illuminating, while the enduring question of which approaches and strategies are more effective continues to deserve attention.

Conclusion

As a preliminary exploration of faith-based environmental organizations in Canada, this study endeavours to provide a basic profile of these organizations and their activities. In summary, FBOs were largely concentrated in Ontario, with some pockets of activity in Quebec, Manitoba and British Columbia. The older and larger organizations mostly had a broader social justice mandate that integrates environmental concerns, while newer and smaller organizations tended to have a more specific environmental focus. While attempts were made to reflect the diversity of faith communities in Canada, the majority of the environmental FBOs currently active across the country were Christian, representing a broad spectrum of denominations. Other faith traditions were served by interfaith organizations and a few faith-specific organizations within the Jewish, Muslim, and Indigenous communities. The FBOs relied heavily on collaboration, both within and beyond their faith communities. Within these partnerships, there were various indications of commitment to embracing diversity and seeking inclusion. At the same time, FBOs need to be careful in protecting the integrity of their faith-based vision, particularly with respect to seeking funding partnerships with secular bodies, such as government. The most common activities included various approaches to education and theological development. A significant number of FBOs also engaged in policy and advocacy, congregational resourcing, and sustainable agriculture and food issues. Finally, a minority group conducted land-based conservation, providing nature experiences, and direct political activism.

Acknowledgements

I am deeply grateful to the organizations that participated in the research. I also wish to thank Mike Ferber, Laura Rogers, and the anonymous reviewers for providing thoughtful comments on the manuscript, and the Social Sciences and Humanities Research Council for funding the research.

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