

Linking gender, climate change, adaptive capacity, and forest-based communities in Canada

Maureen G. Reed, Alyssa Scott, David Natcher, and Mark Johnston

Abstract: Analyses of climate change and the forest sector have identified the importance of individual actors, institutions, and organizations within communities for effective adaption and climate mitigation. Yet, there remains little recognition of how the internal dynamics of these institutions and organizations are influenced by gender and other social considerations such as age and culture. Research from developing countries and cognate resource sectors suggests that these considerations are critical for enhancing local adaptive capacity. Despite extensive review of forestry research across North America and western Europe, we found almost no research that addresses how differential social capabilities within forest-based communities affect adaptation to climate change. In this paper, we document the potential that gender sensitivity might provide to conceptions and practical applications of adaptive capacity and identify four types of research opportunities to address this gap: (i) developing disaggregated capitals frameworks; (ii) creating inclusive models; (iii) informing social planning; and (iv) understanding gender mainstreaming. Research focused on these opportunities, among others, will provide more robust theoretical understanding of adaptive capacity and strategic interventions necessary for effective adaptation.

Key words: adaptive capacity, gender, forest-based communities, climate change, Canada.

Résumé : Les analyses portant sur le changement climatique et le secteur forestier identifient l'importance des acteurs individuels, des institutions et des organisations au sein des communautés pour une adaptation et une atténuation climatique efficace. Pourtant, on comprend toujours mal comment la dynamique interne de ces institutions et organisations est influencée par le genre et d'autres considérations sociales comme l'âge et la culture. La recherche menée dans les pays en voie de développement et celle qui porte sur les secteurs des ressources semblables indiquent que ces facteurs sont importants pour accroître les capacités locales d'adaptation. En dépit d'une revue exhaustive de la recherche forestière menée en Amérique du Nord et en Europe de l'ouest, nous n'avons pratiquement pas trouvé de travaux qui s'intéressent à la façon dont la différenciation des capacités sociales dans les communautés forestières influence l'adaptation au changement climatique. Dans cet article, nous documentons la contribution potentielle que la sensibilité aux spécificités des genres pourrait apporter aux aspects conceptuels et pratiques de la capacité d'adaptation. Nous identifions quatre avenues de recherche afin de considérer cette lacune : (i) développement de cadres d'analyse désagrégés sur les différentes notions de capital; (ii) création de modèles inclusifs; (iii) appui à la planification sociale; et (iv) compréhension de la problématique hommes-femmes. La recherche axée entre autres sur ces aspects fournira une compréhension théorique plus robuste de la capacité d'adaptation et des interventions stratégiques qui sont nécessaires pour une adaptation efficace. [Traduit par la Rédaction]

Mots-clés : capacité d'adaptation, genre, communautés forestières, changement climatique, Canada.

Introduction: social dynamics and climate change

The degree to which people are affected by climate change impacts is partly a function of their social status, gender, poverty, power and access to and control over resources. Despite the international community's increasing acknowledgement of the differential experiences and skills women and men bring to development and sustainability efforts, ... the impacts of gender inequalities and women's recurrent socio-economic disadvantages continue to be ignored and remain a critical challenge to adaptation efforts ... it is crucial that mitigation and adaptation efforts integrate gender issues at all levels. (Habtezion 2013, p. 1)

The excerpt above is taken from a United Nations (UN) policy brief directed primarily, although not exclusively, to connections between gender relations in developing countries and the chal-

lenges of, and opportunities for, inclusion of women in policies, programs, and strategies addressing climate change adaptation. Its concerns are reinforced by a growing literature on gender and climate change adaptation in developing countries (Carr 2008; Masika 2002; Sweetman 2009; Terry 2009; Dankelman 2010; MacGregor 2010; Mai et al. 2011). For example, Carr (2008) argues that existing gender relations limit adaptive capacity in Ghana by limiting adaptation practices to those that reinforce existing gender roles and male authority, though these practices are deleterious for the community and have disproportionately negative outcomes for women.

It is tempting to think that these gender-based differences have been largely erased in the Canadian context and that people in resource sectors such as forestry can plan for adaptation without concern for gender. Yet, there is sufficient evidence from Canadian rural studies and forestry research, as well as other postin-

Received 1 April 2014. Accepted 5 June 2014.

M.G. Reed. School of Environment and Sustainability, 117 Science Place, Saskatoon, SK S7N 5C8, Canada.

A. Scott. Department of Geography and Planning, 117 Science Place, Saskatoon, SK S7N 5C8, Canada.

D. Natcher. Department of Bioresource Policy, Business and Economics, 51 Campus Drive, Saskatoon, SK S7N 5C8, Canada.

M. Johnston. Saskatchewan Research Council, 15 Innovation Boulevard, Saskatoon SK S7N 2X8, Canada.

Corresponding author: Maureen G. Reed (e-mail: m.reed@usask.ca).

dustrial countries, to call into question such an assumption. Furthermore, while gender mainstreaming is a policy-based approach promoted by the UN and the European Union (Daly 2005), its uptake in the Canadian forest sector remains weak (see Fullerton 2006).

The purpose of this paper is to document how attention to gender in forestry may revise conceptions and practical applications of adaptive capacity in Canada's forest sector and forest-based communities. We consider how sensitivity to gender can help local communities and practitioners identify needs, assess resources, and strengthen adaptive capacity. We argue that conceptualizing and taking action on climate change adaptation in forest-based communities requires the inclusion of gender-based analyses, supported by gender-disaggregated data sets. This will also include using research methods that give voice to a broader range of local residents and practitioners. We start by describing the context for research on adaptive capacity in Canada's forest sector, providing definitions of adaptive capacity, and describing Canadian efforts to assess adaptive capacity in forestry. We turn to feminist scholarship in climate change research to demonstrate its relevance and to explain two challenges with respect to its application to Canadian forestry — linking feminist scholarship to forestry and providing usable knowledge for climate change adaptation at the local level. Next, we address questions about forest-based communities that demonstrate that gender-based differences found in developing countries are also experienced in Canada. We then introduce four types of research that could be pursued to advance a more critical and practical understanding of the relationships between gender, climate change, and adaptive capacity of Canada's forest-based communities. Our presentation of these types of research is selective; we are guided by a desire to offer suggestions that can inform academics and practitioners who may be seeking practical strategies for adaptation to climate change.

Context for research in adaptive capacity in Canada's forest sector

Forest-based communities and adaptive capacity

There is a consensus within the Government of Canada and among academic researchers that climate change is affecting Canada's forest sector. Ecological effects include increased frequency and severity of drought, fires, pests, and diseases (Hogg and Bernier 2005) and changes to growing seasons and the availability of harvestable wood (Johnston and Williamson 2007). Socioeconomic effects include reduced harvest revenues to companies and governments, fluctuations in local timber supply, and employment restructuring (Davis 2011). Many of these changes are already taking place; market conditions, technology, demographic characteristics, social values, and workforce composition are shifting at the same time as alterations are demanded by the changing climate regime (Williamson et al. 2008; Johnston et al. 2011; Bullock 2013). Together, these effects require that new approaches to forestry be considered (Henderson et al. 2010).

Forest-based communities are particularly challenged because their workforce is highly specialized (Davidson et al. 2003), local leaders often underestimate the level of risk, and communities may lack the tools to make the necessary transitions (Clapp 1998; Williamson et al. 2005). Indeed, Patriquin et al. (2007) revealed that communities in Canada's boreal region already face multiple challenges as they confront significantly higher poverty rates, unemployment rates, and lower educational attainment levels than other resource-based towns. Hence, it is easy to draw the conclusion that “the combined effects of higher potential impacts and lower adaptive capacity mean that forest-based communities tend to be more vulnerable to climate change than other types of communities.” (Johnston et al. 2010, p. 19).

Theoretical and applied research has focused on adaptive capacity as a means to address the immediate and long-term effects of climate change (Smit and Pilifisova 2003; Folke et al. 2003, 2005; Armitage 2005; Adger et al. 2009; Williamson et al. 2009; Keskkitalo 2010). Adaptive capacity refers to the ability of individuals and groups to access, mobilize, and deploy assets and endowments in ways that facilitate adaptation to change without degrading those resources (Willbanks and Kates 1999; Adger 2003). This includes the ability to both (a) deal with, accommodate, learn from change, and reorganize (Smit and Wandel 2006) and (b) seize the opportunities that arise with change to transform livelihoods and community well-being (Armitage 2007; Norris et al. 2008; Moser and Ekstrom 2010). This definition places emphasis on building resilience — a process that involves proactive and “intentional action to enhance the personal and collective capacity of its citizens and institutions to respond to and influence the course of change” (Community Resilience Project Team 1999, p. 111; see also Edwards and Wiseman 2010). This emphasis implies using research methods that engage local people in identifying, assessing, and implementing options that are tailored to their local contexts.

Adaptation to climate change has not been a high priority for Canadian forest managers (Johnston et al. 2011) or forest-based communities (Davidson et al. 2003). Nevertheless, over the past decade, government scientists and practitioners have conducted applied research on adaptive capacity to support understanding and action by forest-based communities (e.g., Johnston et al. 2006; Johnston and Williamson 2007; Johnston and Edwards 2013; Williamson et al. 2007; Steenberg et al. 2011). For example, the Canadian Council of Forest Ministers commissioned a study to examine how the criteria and indicators used to gauge Canada's performance in achieving sustainable forest management might be affected by climate change (Steenberg et al. 2011). New guidebooks have been developed to assess the vulnerability of forest-based communities to help them determine their adaptive capacity (e.g., Williamson et al. 2007; Pearce and Callihoo 2011). These guides encourage communities to assess their natural and built assets to determine measures to strengthen their adaptive capacity.

Model forests, created by the Government of Canada in 1992 to advance the policy agenda of sustainable forest management and local decision making, are part of this growing strategic priority. Built on diverse interests and values associated with forests and committed to equitable distribution of economic and social benefits and consensus-based decision-making among participants, the Canadian Model Forest Network (CMFN) has initiated several projects relating to climate change (e.g., Godwin et al. 2007; Williamson et al. 2008). In 2011, the CMFN sponsored the development of a guidebook and a resource book to help model forest communities assess their vulnerability and identify strategies for adjustment (Pearce and Callihoo 2011). This has been followed by publications supported by the Canadian Council of Forest Ministers (e.g., Edwards and Hirsch 2012; Gray 2012; Williamson et al. 2012a, 2012b). Practitioner approaches have typically placed emphasis on preparing for changes in physical infrastructure and local environments (e.g., Furness and Nelson 2012; Pearce and Callihoo 2011; West Coast Environmental Law 2012). There is surprisingly little theoretical or applied research that addresses differential social capabilities within communities.

Potential and challenges of feminist scholarship in climate change research

Despite a small, but growing, literature on gender and climate change in developing countries (e.g., see Reed and Christie 2009; Mai et al. 2011; Masika 2002; Sweetman 2009; Terry 2009; Dankelman 2010), our review reveals no body of research that links gender, climate change, and forest-based communities in postindustrial settings (cf. Davidson et al. 2003; Klenk et al. 2012). MacLellan's (2008) analysis of the SCOPUS database found that nine of 1168 (0.8%) articles about “climate change adaptation” also

used the word “gender”, while MacGregor's (2009) CSA Illumina citation search of 20 feminist journals from 1990 to November 2008 found that 0.06% of articles used the keywords “climate change” and “global warming” in the “words anywhere” box. In short, neither environmental nor feminist scholars have studied gender and climate change in North American forestry. We found only two articles that make these connections with reference to Canadian forestry (Davidson et al. 2003; Klenk et al. 2012). Yet, using evidence from developing and postindustrial countries, the Report of the United Nations Economic Commission for Europe – Food and Agriculture Organization of the United Nations (UNECE/FAO) Team of Specialists on Gender and Forestry (UNECE/FAO 2006, p. 1) reported that “forestry ... has been generally regarded as an arena mainly for men's work, business and governance. Within organizations, from households to companies to authorities, a gendered organizational logic is at work which not only reproduces a structure of gender division but also, paradoxically, at the same time, makes gender invisible.”

An emerging literature examines adaptation to climate change in western rural and agricultural communities (e.g., Alston 2006, 2011; Alston and Whittenbury 2013), as well as in responses to long-term and acute “socioecological” disasters (e.g., drought, flooding, fire) (e.g., Enarson et al. 2006; Kapucu et al. 2013) in countries such as the United States (e.g., Seager 2006; David and Enarson 2012), Canada (Enarson 2001; Cox and Perry 2011; Fletcher 2013; Lemyre and O'Sullivan 2013), and Australia (e.g., Alston 2006, 2011). This literature suggests that capabilities for immediate response and long-term adaptation are highly differentiated by gender, including perception of risk and security (e.g., Davidson et al. 2003; Satterfield et al. 2004), planning for an event (e.g., Enarson 2001, 2013), and responsibilities and impacts during and following a disaster (see Enarson 2001; Seager 2006; David and Enarson 2012; Alston 2011). Factors such as gender (Dankelman 2010; Davidson et al. 2003; Eriksen 2014), age (Wolf et al. 2009), and cultural context (Colombi and Smith 2012; Ensor and Berger 2009; Eriksen 2014) have been identified as influencing residents' interpretations of risk and access to assets. Furthermore, these factors are typically not discreet, but rather intersect with one another and other elements of social difference. Yet these factors have not, to date, been accounted for in analyses of adaptive capacity and climate change in forestry.

Slow-moving effects of climate change such as drought and pest infestations have been particularly difficult to address by “higher order” policy makers and community practitioners alike (Davis 2011), but this does not mean that these effects are not differentiated by gender. In Australia, Margaret Alston (2011), who has studied the effects of long-term drought, reported that “gendered impacts (in health ... and overall welfare) as well as gendered adaptations to climate change ... act to restrict and constrain the lives of women and men” (Alston 2011, p. 55) and concluded “there is no doubt that a lack of gender awareness is a factor in Australia's lack of preparedness for significant social outcomes from ongoing climate change events” (Alston 2011, p. 68). Her conclusion gives pause for reflection. For example, does omitting gender relations in assessing adaptation options limit the capacity of Canadian forest-based communities to make changes? Can including gender help local officials and community members identify and access resources and thereby improve their adaptive capacity?

At least two key challenges arise when applying feminist scholarship to climate change and forestry management in postindustrial settings. The first challenge is making a link between contemporary feminist scholarship and specific policy and program needs in forestry. Few feminist researchers have focused on forestry topics in Canada, and there is little emphasis on how gender relations affect practical strategies for environmental management. Yet feminist scholars have long argued that gender is one relation through which access to and distribution of natural

resources, wealth, work, decision-making, and political power are differentiated and should be viewed (e.g., Rocheleau et al. 1996; Nightengale 2006; Eriksen 2014). Recently, feminist scholars have considered whether the emphasis on gender theory has resulted in a lack of “practical strategies in dealing with daily issues” (discussion edited by Hawkins and Ojeda 2011: 247; see also MacGregor 2009). Identifying almost no uptake of gender analysis in climate change issues, Seager (2011) asked provocatively, “are we doing *useful* gender analysis?” (see discussion edited by Hawkins and Ojeda 2011, emphasis added). Some scholars have expressed frustration that a lack of reliable evidence has given rise to tired stereotypes about men and women (e.g., Arora-Jonsson 2011). Indeed, it seems that to be useful, there is a need to generate research that is accessible to public decision makers and practitioners with results that can be translated into concrete actions.

A second, and related, challenge is making this subject relevant to people who are responsible for the formulation and implementation of policies, programs, and planning in forest-based communities. Neither climate change nor gender issues figure prominently in the priority list for action by local practitioners. Research by Hooper (2012) and Johnston and Hesselin (2012) suggest that forest managers either are not aware of how climate change might affect them or do not see it as a priority amidst their other responsibilities. Similarly, a recent study of rural community planning processes in Saskatchewan suggested that local politicians and even administrators of rural communities do not consider climate change to be of high priority or they lack the tools to address the effects (Zamchevska 2014). Hence, observations made years ago continue to apply as practitioners reproduce “business-as-usual” in the face of uncertainty (Clapp 1998; Davidson et al. 2003). These observations suggest a need to generate usable knowledge that is more accessible to practitioners who can then apply it to planning and program design.

The UN policy brief quoted at the beginning of this paper identifies four key factors that account for the discrepancy between women's and men's differential exposure and vulnerability to climate change risks and their inclusion in planning and decision making processes:

1. a global gender gap in earnings and productivity;
2. differential access in all levels of policy and decision-making processes, making women less able to influence policies programs and decisions;
3. sociocultural norms that limit women's acquisition of information and skills to escape or avoid hazards; and
4. lack of sex-disaggregated data in all sectors that gives rise to an underestimation of women's roles and contributions.

In the following section, we consider the relevance of these factors in the context of Canadian forestry by rephrasing the factors as a series of questions and using published literature to address them.

Interrogating factors affecting our understanding of gender and climate change adaptation

Do Canadian forest-based communities exemplify a gender gap in earnings and productivity?

While it is difficult to measure productivity, it is well documented that there is a highly gendered division of labour in forest-based communities (Egan and Klausen 1998; Teske and Beedle 2001; Reed 2003a; Martz et al. 2006; Mills 2006). Canadian forest-based communities have a bimodal income distribution with high-income earners, typically men, in the professional, scientific, and extractive positions and low-income earners, typically women, in the service and support positions (Marchak 1983; Fullerton 2006; Martz et al. 2006; Reed 2008) (Table 1). Review of a special data run for the Canadian 2001 census revealed that women in forestry were also over-represented in part-time jobs and

Table 1. Percentage of female representation by occupational category for all forest industries in Canada, the Canadian Forest Service, all federal public service employees, and Weyerhaeuser Saskatchewan (a private company).

Occupational category	Canada (2001)	Canadian Forest Service (no date)*	Federal public service employees (2006)	Weyerhaeuser, Saskatchewan (2003)
Executive	10	16	39	8
Science professionals	14	20	44	No comparable data
Administration and foreign service	No comparable data	52	58	No comparable data
Technical	15	34	32	No comparable data
Administrative and clerical support	98	94	82	94
Operational	9	6	19	17
Total	14 [†]	34	54	16

Note: Sources: Statistics Canada 2001 census data; Fullerton 2006 (assumed to be based on data from 2001); Martz et al. 2006; Mills 2006; Reed 2008.

*Fullerton (2006) did not provide a date for these figures. It is based on data provided by Statistics Canada either from the 2001 census or from departmental figures between 2001 and 2006.

[†]There is a slight discrepancy between Fullerton (2006), who reports this total as 16%, and Martz et al. 2006, who reports this total as 14%; the proportion "14%" was selected based on a calculation of all forestry jobs from the Statistics Canada data set and reported in Martz et al. 2006.

under-represented in full-time, full-year employment; consequently, women were found to be concentrated in lower income brackets relative to men (Martz et al. 2006).

These findings have been confirmed by using more recent census data to examine incomes in model forest regions in Canada where women's income lagged well behind men's in all five regions studied (Table 2). Incomes in these five forest regions in Canada all decreased between 1996 and 2006 for both men and women. In spite of the fact that, for the most part, the incomes of men had decreased to a greater degree, men still had substantially higher incomes than women. Furthermore, the data show that men had a consistently higher rate of employment and participation in the labour force, although in some regions, female employment and participation rates were rising, while those of men were declining.

From these kinds of analyses, researchers have concluded that women in forestry face differential access to jobs, workplace discrimination, and fewer opportunities for leadership (Teske and Beedle 2001; Reed 2003a, 2003b; Martz et al. 2006; Mills 2006). Additionally, researchers have found that Aboriginal people have less access than non-Aboriginal people to high-income forestry employment (Parkins et al. 2006; Mills 2006; Natcher 2008), particularly as Aboriginal people were found to be even more likely to be hired at the margins in part-time and temporary positions (Mills 2006).

Do men and women in Canada have equal influence in policy and decision-making processes in forestry?

Evidence from Canada suggests that women and men have different interests in forest management and different fundamental values about nature (Reed and Varghese 2007), and they assess the social risks associated with management decisions differently (Davidson et al. 2003). Yet these differences do not appear to be accounted for in decision-making. Two types of studies reveal the limited role that women have played in forestry-based decision-making and planning. First, as previously documented, women continue to be severely under-represented in executive, scientific, or professional categories in which decisions are made about how the industry will operate (Table 1) (see also Teske and Beedle 2001; Fullerton 2006; Martz et al. 2006).

Another avenue for influence may be through the proliferation of community advisory committees that have become a key avenue of public participation in forestry. Community or citizen advisory committees have been introduced across the country to "give voice" to local concerns and help public agencies and private forest operators identify and include public interests and values in the management of Crown lands (Parkins et al. 2006). Given that these committees do not rely on employment as a criterion for representation, they are potential avenues for gaining a wider set of viewpoints into decision-making. Research related to these

committees consistently points to very limited representation of women and of groups that do not subscribe to the overriding goals of industrial forestry (e.g., Reed and Varghese 2007; Richardson et al. 2011; Varghese and Reed 2012). Avenues for influence were often restricted by the nominal representation of women (which exceeded 25% only in British Columbia and Newfoundland) and by the effectiveness of women to be heard. In combination, these studies confirm that in Canada, women do not share the same level of influence as men in Canadian forestry policy and decision-making processes.

How do sociocultural norms affect climate change vulnerability by gender?

Barriers identified in the UN policy brief relate to how sociocultural norms constrain women's use of public space and limit their skill set. Details of such norms in Canada are not really known. Reed (2003a, 2003b) discovered that local norms in communities of Canada's west coast reinforce the marginality of women's contributions in household, workplace, community, and policy forums. Through a comparison of government and academic definitions of forestry work with descriptions provided in interviews by women in forestry communities, Reed (2003a) found that women simultaneously protested their marginal positions within forestry and reinforced dominant stereotypes that excluded them from participating more fully in forestry occupations. Hence, while specific details of marginality between women in developing and postindustrial countries may differ, we do not know if there are sociocultural norms within forestry communities that may differentially affect men's and women's vulnerability to climate (and other) changes. There is simply no research that links these norms to exposure to climate change challenges. However, given other gender-related factors described previously, we cannot assume that such norms do not exist.

How does data aggregation affect our understanding of women's roles and contributions in the forestry sector?

Given the size and importance of the forest industry in Canada, it may seem surprising that relatively little gender-based analysis has been undertaken. A study by Reed (2008) concluded that reliance on inaccurate and outdated data is a reflection of, and continues to shape, inaccurate and outdated images of women in forestry. Research was conducted in the 1980s and 1990s; however, it is partial, regionally focused, and (or) outdated (e.g., Marchak 1983; Grass and Hayter 1989; Egan and Klausen 1998). The consequence of these patchy data is that relatively little is known about women's employment experiences, particularly in the emerging professions. Any outstanding issues faced by women have not reached bargaining units and management tables.

More broadly, lack of accurate data continues to affect our understanding of forestry in North American and European countries,

Table 2. Median income, rate of participation in the labour force, and employment rate for men and women in five Canadian model forest regions.

Model forest region	Year	Income		Participation rate (%)		Employment rate (%)	
		Women	Men	Women	Men	Women	Men
Resources North Association, British Columbia	1996	\$21 324	\$44 163	67.2	84.1	61.1	75.0
	2001	\$23 363	\$46 648	65.7	80.9	58.7	70.8
	2006	\$18 327 (-14%)	\$38 851 (-12%)	65.5	80.5	61.2	73.7
Forest Research Institute, Alberta	1996	\$20 975	\$46 474	67.7	84.7	62.9	78.8
	2001	\$23 426	\$48 049	68.4	82.8	64.5	77.9
	2006	\$18 404 (-12%)	\$39 479 (-15%)	70.1	85.0	66.9	81.3
Prince Albert Model Forest, Saskatchewan	1996	\$17 545	\$29 161	52.5	67.1	45.4	54.6
	2001	\$21 192	\$29 419	57.1	65.9	49.6	53.8
	2006	\$16 242 (-7%)	\$20 346 (-30%)	55.3	64.4	46.3	53.1
Manitoba Model Forest, Manitoba	1996	\$14 698	\$34 302	48.8	60.0	41.4	47.7
	2001	\$18 917	\$26 555	50.5	61.7	43.6	48.0
	2006	\$13 760 (-6%)	\$16 125 (-53%)	48.3	58.3	42.5	48.1
North East Superior Model Forest, Ontario	1996	\$20 244	\$42 716	50.8	69.9	42.5	60.2
	2001	\$23 326	\$51 580	58.6	73.6	51.0	67.5
	2006	\$16 802 (-17%)	\$34 858 (-18%)	58.0	67.9	50.9	59.3

Note: The percentage in parentheses is the percent change in income from 1996 to 2006. Source: Modified from [Klenk et al. 2012](#).

where employment data by gender remain sketchy at best ([UNECE/FAO 2006](#); [Fullerton 2006](#)). Limitations in data availability cause us to underestimate women's roles and contributions and reduce the prospect of generating any understanding of the impacts of climate change or the opportunities for adapting to a changing climate and industry and how women and men might contribute to these dynamics. Reconsideration of how to count women's contributions to the forest industry and to forestry communities will help to establish improved workplace conditions, more equitable delivery of government programs, and more inclusive participatory planning process.

In summary, then, factors revealing differential vulnerability to, influence in, and adaptive capacity associated with climate change risks in developing countries may also be at play in Canadian forestry communities. Several research avenues might provide for improved conceptualization of and practical actions supporting adaptive capacity. In the next section, we briefly describe four such avenues.

Research opportunities

Developing disaggregated capitals frameworks

Researchers of adaptive capacity have used a capitals framework to characterize the capacity of communities to adapt to climate change. For example, [Armitage \(2007\)](#) conceptualized adaptive capacity as built on a set of assets (or capitals) and formal and informal governance institutions. Assets include financial, ecological, built, human, social, cultural, and political capitals.¹ Institutions include formal rules and procedures such as policies, programs, and property rights, as well as informal relations including power relations, systems of knowledge, cultural norms, values, and worldviews. Establishing indicators to determine access to and mobilization of capitals is tricky because of the uneven availability of data, as well as cultural and gender dynamics. For example, common definitions of human capital include individuals' knowledge, education, and skills that can be used for economic and other advantages such as prestige, influence, leadership, and survival ([Becker 1964/1993](#)). It is important that these attributes are disaggregated by gender (and likely other characteristics such as age and cultural background) to better understand contributions that women and men can make to local capacity. Social capital refers to resources

embedded within networks of social relations that are accessed and (or) mobilized in purposive action ([Lin 1999](#); [Putnam 2000](#)). Cultural capital refers to myths, beliefs, concepts, skills and technologies, narratives, customs, traditions, knowledge systems, and levels of cognition that are shared and distributed among cultural groups ([Force and Machlis 1997](#); [Turner et al. 2003](#); [Colombi and Smith 2012](#)). Inclusion of cultural capital affirms the importance of indigenous culture in enhancing adaptive capacity while simultaneously recognizing that nonindigenous communities also have myths, beliefs, customs, and traditions that can contribute to (or possibly hinder) adaptive capacity.

Determining indicators and then acquiring appropriate data are challenging. As these capitals are interrelated and vary within and across household units, their individual and collective contributions to adaptive capacity are not well understood. Gender, family structure, and traditions, including systems of inheritance, appear to be key to understanding these variations ([Iyer et al. 2005](#); [Wolf et al. 2009](#)). Additionally, selecting defining characteristics of each capital will require a judicious determination of efficiency, accuracy, and cultural sensitivity ([Larsen et al. 2010](#)), particularly as Canadian forest regions are co-inhabited by Aboriginal and non-Aboriginal populations ([Sherry et al. 2005](#)). Research methods that include Aboriginal and non-Aboriginal peoples in selecting and interpreting indicators may be required to ensure that the findings are valid for these communities.

[Emery and Flora \(2006\)](#) also demonstrated the importance of the interaction among capitals and the ways in which capitals "flow" or circulate within communities. They found that social capital was a key driver of other capitals and that cultural capital was significant "in driving the ongoing flow of capital assets toward an upward spiral that allowed synergetic capitals to grow and continually build on themselves" ([Emery and Flora 2006](#), p. 33). These observations are important because they suggest that a primary focus on economic wealth or human capital may overlook other elements that are important in a community's ability to adapt to external influences such as climate change. Their findings also suggest the need for research that is sensitive to cultural differences such as how Aboriginal and non-Aboriginal communities understand gender, what constitutes appropriate adaptation, and interpretations of how culture and nature are connected.

¹Built capital refers to any human-constructed formation or infrastructure used to support community economic development. It may include buildings, machinery, roads, telecommunications towers, and water and sewage systems. In this definition, it also includes technology, although some definitions separate technological from built capital.

Wall and Marzall (2006) offered a framework that includes a profiling tool to describe the resources underlying community capacity to adapt to changing environmental, social, or economic conditions. They provided a set of indicators reflecting social, human, institutional, natural, and economic assets and related them to climate change adaptation at the community level. They then identified data sources that can be used and applied the framework to the analysis of an anonymous Canadian rural community. Using primary and secondary data, they scored indicators for each asset. This score then informed a visual depiction (amoeba diagram) of the strengths and limitations of community capacity. They noted that such analysis could be used to compare change over time or to make comparisons with other communities in the region or with similar economic bases, thus informing higher order governments about regional variation in adaptive capacity. They did not, however, attempt to disaggregate the results by gender or any other social category. A gender-based analysis, however, might reveal differential access to those assets “within” a community.

A study by Klenk et al. (2012) attempted to do just that by exploring how adaptive capacity varies by gender within forest-based communities by using census data to conduct a “rapid assessment” of adaptive capacity in five Canadian model forest regions. Model forests are delineated forest regions in which volunteer boards of stakeholder representatives work together to generate learning and practice for forest and forest community sustainability (Klenk et al. 2012). The five model forests assessed are rural regions in the boreal forests of British Columbia, Alberta, Saskatchewan, Manitoba, and Ontario, each comprising a large number of census subdivisions. Their assessments were based on four types of capital assets as determinants of adaptive capacity: economic, human, social, and cultural capital assets. To describe economic assets, they adopted indicators of labour force participation, employment, and income; to describe human capital, they examined three levels of education attainment and age; and social capital was represented by indicators of family structure and duration of time in the community. They found that despite having higher levels of educational achievement in these regions, women had substantially lower economic capital assets (Table 2). Additionally, they found that women also had less access to social capital assets because of higher rates of lone-mother families and higher rates of divorce among women.

Although this research was conducted as a rapid assessment using solely census data, Klenk et al. (2012) disaggregated the data by gender and ethnicity, revealing that Aboriginal populations exhibited different trends between genders. Hence, they recommended that employment and (or) training and social service programs might be targeted to serve different situations of men and women across regions. Their disaggregation also demonstrated that the choice of indicators of adaptive capacity is not culturally neutral and further research will be required to gain a better understanding of how cultural capital relates to economic and human assets. For example, they noted that one cannot assume that great cultural capital can be measured by language diversity or that this measure will mean that the community has greater access to local or traditional knowledge and skills. They concluded: “without knowing how Aboriginal people are utilizing capital assets to adapt to changes in the forest sector, we cannot assume that declines in regional access to economic and human capitals will impact their adaptive capacity in the same way that the literature suggests it will impact non-Aboriginal communities” (Klenk et al. 2012, p. 96). Following up preliminary or rapid assessment with in-depth community studies involving local people might better reveal these relationships and outcomes.

Creating inclusive models

Modeling exercises attempt to articulate relationships among driving factors of capacity. Many of these factors are identified as

the “capitals” or “assets” described above. For example, Moser and Ekstrom (2010) offer a systematic diagnostic framework by which to identify barriers to undertaking intentional, planned adaptation. Their focus on detecting barriers is “to design strategies to circumvent, remove, or lower the barriers” (Moser and Ekstrom 2010, p. 22030). Their decision-making model is both actor-centric and context-aware as it draws attention to the interconnections among actors, governance, and environmental context and the system of concern. Their contribution includes a series of questions to be asked throughout the broad stages of understanding (e.g., problem detection and framing), planning and decision-making (development and assessment of options), and problem management (involving implementation, monitoring, and evaluation). Their questions focus on “actors” in the broadest sense. Fully aware that their framework “requires testing and refinement if it is to aid in decision-making” (Moser and Ekstrom 2010, p. 22030), they suggest that it serves as “a starting point for answering critical questions that can ultimately inform and benefit climate change adaptation at all levels of decision-making” (Moser and Ekstrom 2010, p. 22031). To this end, we suggest that gender sensitivity might encourage users of the framework to reflect on specific actor groups within a given context and consider how gender relations affect who the actors are, how different actor groups access resources and decision-making venues, and what groups benefit from and (or) bear the burdens of adaptation measures.

Similarly, Cutter et al.'s (2008) model for understanding resilience at the community level identifies six categories of community resilience indicators that are remarkably similar to the capitals described earlier: ecological, social, economic, institutional, infrastructure, and community competence. Social (e.g., demographics, social networks, and embeddedness), economic (e.g., employment), institutional (e.g., participation in hazard reduction programs), and community competence (e.g., local understanding of risk, health, and wellness) indicators will all vary by gender. Their nod to this possibility is found in the comment that “Social resilience can be enhanced through the development and implementation of disaster plans, the purchase of insurance, and the sharing of information to aid in the recovery process. Some of these are a function of the demographic characteristics of the community and its access to resources.” (Cutter et al. 2008, p. 603). They also describe community competence as a measure of how well a community functions before and after a disaster event. Community competence includes attributes associated with population wellness, quality of life, and emotional health (after Norris et al. 2008). Research by Enarson (2001), Enarson et al. (2006), and David and Enarson (2012) in relation to flood response illustrates differences by gender across all of these dimensions through the “life course” of a disaster event (from community preparedness to recovery). Despite these efforts to conceptualize and assess resilience, these metaphorical and theoretical models have not progressed to the operational stages where they effectively measure or monitor resilience or planned adaptation at the local level. Hence, next steps could include using more participatory approaches to refine indicators suggested by the capitals frameworks, disaggregate the data by gender and other social categories, and work with communities to test the results in a real-world application.

Informing social planning

Studies that we have just described can potentially be undertaken without direct input from community members, although as we have suggested, they may be improved through more inclusive methodologies. However, planning for social change will require that communities — including local leaders — be engaged in planning processes. This is challenging because climate change competes with other, often more immediate challenges. Hence, climate change may not be a high priority, and gender concerns

are not typically raised within local government structures. Hence, the challenge is to integrate tools generated to help local leaders and administrators plan for climate change at the local level (e.g., Pearce and Callihoo 2011; West Coast Environmental Law 2012) with those that might help them to learn about and take actions that account for gender and other social differences.

Pathways to Climate Change Resilience (Pearce and Callihoo 2011) is a document that provides Canadian rural forest communities with a guide to adapting to climate change. While there is a strong focus on community in this guidebook, there is little explicit attention paid to issues of inclusion or difference within the community such as gender issues. There are several opportunities to incorporate gender analysis into the instruction and advice for assessing climate change impacts and planning adaptation actions.

The guidebook identifies six steps along the path, beginning with “getting prepared”. Key to the first step is perhaps a broader consideration of who should be involved in adaptation planning to include women and people from other groups who are not typically represented. This may include social service, community health, indigenous, educational, and even religious representatives because these groups are typically part of the social networks within a community that are part of or serve people at great risk from climate change or who have typically been excluded. The guidebook suggests that existing community planning structures should be used in adaptation planning, but given our previous discussion, there is reason to analyze whether and how women and other groups are represented in these structures. Having broad representation is important for all remaining parts of the adaptation planning process, including identifying community impacts of climate change, assessing opportunities from climate change, prioritizing impacts for action planning, identifying potential actions, and monitoring and assessing the action.

The guidebook encourages communities to identify potential community impacts of climate change, but it is assumed that these impacts will be uniform throughout the community. As we have seen, this is likely not the case. Thus communities should be supported in identifying ways in which women or other minority groups may be impacted by climate change and may contribute to adaptive capacity. Potential impacts of climate change are identified: property loss and (or) damage, crop loss and (or) damage, job disruption, travel and (or) supply disruption, health impacts (e.g., from heat, flooding), and (or) evacuation. At the very least, census (and other) data should be disaggregated to aid in making informed choices about these impacts and to determine if some groups are more likely than others to experience potential harm because of their geographic proximity to risk or their capacity to mitigate or adapt to it.

The guidebook assists communities in assessing adaptive capacity at the aggregate community level. It describes assets and limitations for adaptive capacity in forest-based communities. For example, the guide identifies people, technology, economic resources, and institutions as being four main factors determining community adaptive capacity. Where these factors are raised, attention should be given to their gendered dimensions. The “people” factor includes assets such as education, skills, experience, networks, and knowledge (human and social capital). As we have already seen, economic resources and human and social capital are not distributed equally among people in forestry communities, and these differences must be taken into account. Such an accounting can help communities capitalize on previously hidden strengths while supporting those social groups that may be disadvantaged.

Furthermore, the factors given in the guidebook to assess community institutions could include the inclusiveness of these institutions and their effectiveness in managing impacts for all community members. Consideration to gender differences could help communities generate more authentic and inclusive impact ratings, adaptive capacity ratings, and risk and vulnerability

ratings, which provide guidance in deciding what actions are necessary. Lastly, gender difference should be incorporated into assessments of adaptation actions. For example, the guidebook's suggested criteria for assessing adaptation actions could include criteria such as assessing how the benefits and costs of an action are distributed among community members and for determining who is most ready to assist.

The processes by which communities might use the guidebook are as important as the content of the work. The guidebook anticipates variations in how it will be used, and its creator has already engaged in modified planning exercises suited to individual communities. Appreciative inquiry is a participatory action research method in which researchers and study communities work together to design questions, learn, and search for practical knowledge that can support collective and transformative action (Nyaupane and Poudel 2012). Importantly, such inquiry focuses on working from the strengths of a community rather than its deficits or gaps, as the latter is more likely to lead to defensiveness and even conflict rather than shared understanding. Such a suggestion is antithetical to some modeling exercises that focus on identifying adaptive capacity deficits (e.g., Williamson et al. 2012b). However, in the context of community-focused adaptation, working from a positive framing may remove the stigma associated with specifying individual limitations and, instead, encourage collective action dedicated to positive social change.

Understanding gender mainstreaming

The issues documented above raise a broader point — that Canadian forestry policy might be improved through gender mainstreaming. Gender mainstreaming “seeks to institutionalize equality by embedding gender sensitive practices and norms in the structures, processes, and environment of public policy” (Daly 2005, p. 435). It can entail having gender equality objectives in many different areas of policy and using gender analysis tools in the design and implementation of policies (Daly 2005). Gender-disaggregated statistics, gender impact assessment, and gender budgeting are some tools that can be developed to aid in improving public policy. Our previous discussion suggests that research that helps to build such tools might better inform climate change adaptation efforts at the local level.

We can also learn from other jurisdictions that have adopted gender mainstreaming. For example, Sweden has a particularly broad and robust practice of gender mainstreaming where “responsibility for gender equality is extended to most, if not all, actors involved in public policy” (Daly 2005, p. 438) and it has been integrated into all policy areas, including forestry (Toresson, 2006). This directive has affected Sweden's forestry policy in a number of ways. All decisions must be analyzed from a gender perspective; all statistics that are gathered about forestry are disaggregated by gender to enable gender analysis. In 2011, Sweden launched a national strategy for gender equality in the forest sector that included several actions aimed at increasing women's participation in forestry (Lidestav and Berg Lejon 2013). While still subject to criticism, the policy provides a benchmark against which action (or inaction) can be judged. As noted earlier, structural conditions in Canadian forestry have restricted women's participation; these conditions have been remarkably resistant to change (Teske and Beedle 2001; Reed 2008). Hence, learning how gender mainstreaming has been accomplished elsewhere, along with its challenges and limitations, may provide lessons for making change in Canada. Such learning would require additional systematic study that would account for contextual differences between the countries while advancing an ambitious agenda for change.

Research to build, test, and assess such tools — particularly with communities planning for change — could offer many practical benefits. We are aware that it would be easy to classify such efforts as “women's work” or, at the very least, the work of social scien-

tists. Yet, with respect to climate change and forestry, the subject matter is highly interdisciplinary with expertise required of natural and social scientists, as well as humanities scholars. It also requires that academics work with community and policy practitioners to ensure that “theory” and “practice” inform each other. We are acutely aware of the difficulties documented by [Harrison and Watson \(2012\)](#) when natural and social scientists attempt to collectively understand and respond to gender issues in environmental management. These difficulties include a gendered division of research labour, the elevation of natural science methods and ways of knowing over social science, the perception that gender analysis is a “woman’s” issue, communication and challenges across different ways of knowing, and intellectual competition between disciplines. Yet our own experience of collaboration across these challenges (having been raised in environmental geography, biology, and social anthropology in academic and government settings) suggests that we can gain richer insights and more effective results than can be achieved by working alone. Given the global and local challenges of climate change adaptation, such collaborations are more vital (and more fun).

Conclusion

Our conceptual and empirical review remains superficial. Nevertheless, it suggests that the gaps in our understanding of gender, adaptive capacity, and forestry are large. To date, most literature on adaptive capacity is highly conceptual, with relatively little place-based application and concrete lessons learned, particularly for forest-based communities. Feminist scholarship in recent years has also tended to favour theory over practice. Consequently, there has been virtually no research in Canada or other postindustrial countries that explicitly links gender and related social characteristics of communities to adaptive capacity for climate change in the context of forest-based communities. Forest-based communities are frequently characterized as “vulnerable” to the impacts of climate change and associated environmental risks without sufficient attention to how local knowledge may influence capacity positively, what is the continuum of impacts that affect individuals across a spectrum of socioeconomic differentiation, or how local institutions can provide appropriate responses. Significant challenges lie ahead. One is the misguided belief that factors affecting differential exposure and vulnerability of women and men to climate change as expressed in developing countries are not at play in Canada. What little research has been done reveals that key factors are shared in Aboriginal, non-Aboriginal, and “mixed” communities alike, although specific details may vary. A second challenge lies in getting local managers and decision-makers aware and interested in conducting such planning, particularly when faced with multiple competing and seemingly more immediate concerns ([Johnston and Hessel 2012](#); [Hooper 2012](#); [Johnston and Edwards 2013](#)). Integration of adaptive capacity planning into the pre-existing planning process may be one place to start ([Pearce and Callihoo 2011](#)). Moving from theory to usable knowledge is also needed, as adaptive capacity models are still highly conceptual.

There is good reason to believe that improving our understanding and action on adaptive capacity in Canada’s forest sector and forest-based communities will also benefit from improved gender awareness. The greatest need is to move concepts into practice and to demand that data supporting our understanding be disaggregated by gender and other social categories. Improvements in social planning can be achieved by offering tools that raise awareness, provide concrete practical advice, and create incentives for their use.

In making the case for gender, we are not suggesting that gender is the only marker of social difference. Research has demonstrated that Aboriginal peoples have experienced fewer benefits from forestry than non-Aboriginal peoples. Additionally, interpre-

tations of adaptation, capacity, risk, and even gender are cultural, meaning that singular (often western) ideas about how best to adapt to climate change cannot be simply transferred from one community to another. Methods by which such assessments are made must be inclusive and account for differences of interpretation to identify locally appropriate strategies for adaptation.

Notwithstanding these sensitivities, how our policies and daily practices construct gender and how gender positioning affects the formation and implementation of policy and practice still influence the differential capacity of women and men living and working in forestry communities to adapt to climate change. Hence, a gender focus can help sensitize researchers and practitioners to multiple social dimensions and create opportunities for more inclusive analyses and policies and practices. Feminist scholarship also more broadly encourages understanding of broad systemic forms of marginalization with a view to changing inequalities in social relations. The expertise of social and natural scientists, practitioners, and residents in the research process can be used to generate usable research that builds awareness within forest-based communities; identifies requirements for equitable and effective adaptation; provides options for planning processes in government agencies at local, provincial, and federal levels; and contributes to interdisciplinary academic discourse on climate change adaptation.

Acknowledgements

Funding for this work was provided by the Social Sciences and Humanities Research Council of Canada. We are grateful to Cindy Pearce, whose work with model forest communities on climate change adaptation and whose frank discussions stimulated this work. We would also like to thank the Editors of the Journal for encouraging this submission and the reviewers who helped us to sharpen our arguments and examples.

References

- Adger, W.N. 2003. Social capital, collective action and adaptation to climate change. *Econ. Geogr.* 79: 387–404. doi:10.1111/j.1944-8287.2003.tb00220.x.
- Adger, W.N., Dessai, S., Gouden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J., and Wreford, A. 2009. Are there social limits to adaptation to climate change? *Clim. Change* 93(3–4): 335–354. doi:10.1007/s10584-008-9520-z.
- Alston, M. 2006. The gendered impact of drought. In *Rural gender relations: issues and cases*. Edited by B.B. Bock and S. Shortall. CABI, Cambridge. pp. 165–180.
- Alston, M. 2011. Gender and climate change in Australia. *J. Sociol.* 47(1): 53–70. doi:10.1177/1440783310376848.
- Alston, M., and Whittenbury, K. (Editors). 2013. *Research, action and policy: Addressing the gendered impacts of climate change*. Springer, Dordrecht.
- Armitage, D. 2005. Adaptive capacity and community-based natural resource management. *Environ. Manage.* 35(6): 703–715. doi:10.1007/s00267-004-0076-z.
- Armitage, D. 2007. Building resilient livelihoods through adaptive co-management: the role of adaptive capacity. In *Adaptive co-management: collaboration, learning and multi-level governance*. Edited by D. Armitage, F. Berkes, and N. Doubleday. UBC Press, Vancouver, B.C. pp. 62–82.
- Arora-Jonsson, S. 2011. Virtue and vulnerability: discourses on women, gender and climate change. *Global Environ. Change*, 21(2): 744–751. doi:10.1016/j.gloenvcha.2011.01.005.
- Becker, G.S. 1964/1993. *Human capital*. University of Chicago Press, Chicago, Illinois.
- Bullock, R. 2013. Mill town identity crisis: reframing the culture of forest resource dependence in single-industry towns. In *The social transformation of rural Canada: new insights into community, culture, and citizenship*. Edited by J.R. Parkins and M.G. Reed. UBC Press, Vancouver, B.C. pp. 269–290.
- Carr, E.R. 2008. Between structure and agency: livelihoods and adaptation in Ghana’s Central Region. *Global Environ. Change*, 18(4): 689–699. doi:10.1016/j.gloenvcha.2008.06.004.
- Clapp, A. 1998. The resource cycle in forestry and fishing. *Can. Geogr.* 42: 129–144. doi:10.1111/j.1541-0064.1998.tb01560.x.
- Colombi, B.J., and Smith, C.L. 2012. Adaptive capacity as cultural practice. *Ecol. Soc.* 17: 13. doi:10.5751/ES-05242-170413.
- Community Resilience Project Team. 1999. *The Community Resilience Manual: a new resource will link rural revitalization to CED best practice*. Making Waves, 10: 10–14.
- Cox, R.S., and Perry, K.-M.E. 2011. Like a fish out of water: reconsidering disaster recovery and the role of place and social capital in community disaster resil-

- ience. *Am. J. Community Psychol.* **48**(3–4): 395–411. doi:10.1007/s10464-011-9427-0.
- Cutter, S.L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., and Webb, J. 2008. A place-based model for understanding community resilience to natural disasters. *Global Environ. Change*, **18**(4): 598–606. doi:10.1016/j.gloenvcha.2008.07.013.
- Daly, M. 2005. Gender mainstreaming in theory and practice. *Social Politics*, **20**(4): 433–450. doi:10.1093/sp/jxi023.
- Dankelman, I. (Editor). 2010. *Gender and climate change: an introduction*. Earthscan, London.
- David, E., and Enarson, E. (Editors). 2012. *The women of Katrina: how gender, race, and class matter in an American disaster*. Vanderbilt University Press, Nashville, Tennessee.
- Davidson, D.J., Williamson, T.B., and Parkins, J.R. 2003. Understanding climate change risk and vulnerability in northern forest-based communities. *Can. J. For. Res.* **33**(11): 2252–2261. doi:10.1139/x03-138.
- Davis, E.J. 2011. *Resilient forests, resilient communities: facing change, challenge, and disturbance in British Columbia and Oregon*. Unpublished Ph.D. dissertation, The University of British Columbia, Vancouver, B.C.
- Edwards, J.E., and Hirsch, K.G. 2012. *Adapting sustainable forest management to climate change: preparing for the future*. Canadian Council of Forest Ministers, Ottawa, Ontario.
- Edwards, T., and Wiseman, J. 2010. Climate change, resilience and transformation: challenges and opportunities for local communities. In *Climate change and human well-being: global challenges and opportunities*. Edited by I. Weissbecker. Springer, New York. pp. 185–200.
- Egan, B., and Klausen, S. 1998. Female in a forest town: the marginalization of women in Port Alberni's economy. *BC Studies*, **118**: 5–40.
- Emery, M., and Flora, C. 2006. Spiraling-up: mapping community transformation with community capitals framework. *Community Development*, **37**(1): 19–35. doi:10.1080/15575330609490152.
- Enarson, E. 2001. What women do: gendered labor in the Red River Valley flood. *Environmental Hazards*, **3**(1): 1–18. doi:10.3763/ehaz.2001.0301.
- Enarson, E. 2013. Two solitudes, many bridges, big tent: women's leadership in climate and disaster risk reduction. In *Research, action and policy: addressing the gendered impacts of climate change*. Edited by M. Alston and K. Whittenbury. Springer, USA.
- Enarson, E., Fothergill, A., and Peek, L. 2006. Gender and disaster: foundations and directions. In *Handbook of disaster research*. Edited by H. Rodriguez, E.L. Quarantelli, and R. Dynes. Springer, USA.
- Ensor, J., and Berger, R. 2009. Community-based adaptation and culture in theory and practice. In *Adapting to climate change: thresholds, values, governance*. Edited by W.N. Adger, I. Lorenzoni, and K.L. O'Brien. Cambridge University Press, Cambridge. pp. 227–239.
- Eriksen, C. 2014. *Gender and wildfire: landscapes of uncertainty*. Routledge, New York.
- Fletcher, A. 2013. From “free” trade to farm women: gender and the neoliberal environment. In *Research, action and policy: Addressing the gendered impacts of climate change*. Edited by M. Alston and K. Whittenbury. Springer, Dordrecht. pp. 109–122.
- Folke, C., Colding, J., and Berkes, F. 2003. Synthesis: building resilience and adaptive capacity in social–ecological systems. In *Navigating social–ecological systems: building resilience for complexity and change*. Edited by F. Berkes, J. Colding, and C. Folke. Cambridge University Press, Cambridge. pp. 352–387.
- Folke, C., Hahn, T., Olsson, P., and Norberg, J. 2005. Adaptive governance of social–ecological systems. *Annu. Rev. Environ. Resour.* **30**: 441–473. doi:10.1146/annurev.energy.30.050504.144511.
- Force, J.E., and Machlis, G.E. 1997. The human ecosystem. Part II. Social indicators in ecosystem management. *Soc. Nat. Resour.* **10**(4): 369–382. doi:10.1080/08941929709381035.
- Fullerton, M. 2006. Gender structures in forestry organizations: Canada. In *Time for action: changing the gender situation in forestry*. UNECE/FAO Team of Specialists on Gender and Forestry, Report. Food and Agriculture Organization of the United Nations, Rome. pp. 20–26.
- Furness, E., and Nelson, H. 2012. Community forest organizations and adaptation to climate change in British Columbia. *For. Chron.* **88**(5): 519–524. doi:10.5558/tfc2012-099.
- Godwin, R., Thorpe, J., and Johnston, M. 2007. *The impacts of climate change on the island forests: a report prepared for the Prince Albert Model Forest*. Saskatchewan Research Council, Saskatoon, Saskatchewan, Publication No. 12168-1E07.
- Grass, E., and Hayter, R. 1989. Employment change during recession: the experience of forest product manufacturing plants in British Columbia, 1981–1985. *Can. Geogr.* **33**: 240–252. doi:10.1111/j.1541-0064.1989.tb00907.x.
- Gray, P.A. 2012. *Adapting sustainable forest management to climate change: a systematic approach for exploring organizational readiness*. Canadian Council of Forest Ministers, Ottawa, Ontario.
- Habtezion, S. 2013. Overview of linkages between gender and climate change. Policy Brief. United Nations Development Programme, New York.
- Harrison, E.A., and Watson, E.E. 2012. Mind the gap: disciplinary dissonance, gender, and the environment. *Soc. Nat. Resour.* **25**: 933–944. doi:10.1080/08941920.2011.633597.
- Hawkins, R., and Ojeda, D. (Editors). 2011. *Gender and environment: critical tradition and new challenges*. Contributors: K. Asher, B. Baptiste, L. Harris, S. Mollett, A. Nightengale, D. Rocheleau, J. Seager, and F. Sultana. Environment and Planning D: Society and Space, **29**: 237–253.
- Henderson, N., Barrow, B., Dolter, B., and Hogg, E. 2010. Climate change impacts and management options for isolated northern Great Plains forests. In *The new normal: the Canadian Prairies in a changing climate*. Edited by D. Sauchyn, H. Diaz, and S. Kushreshtha. CPRC Press, Regina, Saskatchewan. pp. 308–321.
- Hogg, E.H., and Bernier, P.Y. 2005. Climate change impacts on drought-prone forests in western Canada. *For. Chron.* **81**: 675–682. doi:10.5558/tfc81675-5.
- Hooper, R. 2012. *Climate change impacts and forest management adaptation measures in Sweden and British Columbia, Canada: a case study of Swedish forest managers*. M.Sc. thesis, Swedish Agricultural University, Umeå, Sweden.
- Iyer, S., Kitson, M., and Toh, B. 2005. Social capital, economic growth and regional development. *Reg. Stud.* **39**(8): 1015–1040. doi:10.1080/00343400500327943.
- Johnston, M., and Edwards, J. 2013. *Adapting sustainable forest management to climate change: an analysis of Canadian case studies*. A report of the Climate Change Task Force of the Canadian Council of Forest Ministers. Canadian Council of Forest Ministers, Ottawa, Ontario.
- Johnston, M., and Hessel, H. 2012. Climate change adaptive capacity of the Canadian forest sector. *For. Policy Econ.* **24**: 29–34. doi:10.1016/j.forpol.2012.06.001.
- Johnston, M., and Williamson, T. 2007. A framework for assessing the vulnerability of the Canadian forest sector to climate change. *For. Chron.* **83**(3): 358–361. doi:10.5558/tfc83358-3.
- Johnston, M., Williamson, T., Price, D., Spittlehouse, D., Wellstead, A., Gray, P., Scott, D., Askew, S., and Webber, S. 2006. *Adapting forest management to the impacts of climate change in Canada*. A BIOCAP Research Integration Program synthesis paper. BIOCAP Canada, Kingston, Ontario. Available from www.biocap.ca/rif/report/Johnston_M.pdf [accessed 17 December 2008].
- Johnston, M., Williamson, T., Munson, A., Ogden, A., Moroni, M., Parsons, R., Price, D., and Stadt, J. 2010. *Climate change and forest management in Canada: impacts, adaptive capacity and adaptation options*. A State of Knowledge report. Sustainable Forest Management Network, Edmonton, Alberta. Available at <http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/31584.pdf>.
- Johnston, M., Williamson, T., Nelson, H., Van Damme, L., Ogden, A., and Hessel, H. 2011. Adaptive capacity of forest management systems on publicly owned forest landscapes in Canada. In *Climate change adaptation in developed nations*. Edited by J. Ford and L.B. Ford. Springer, Berlin. pp. 267–278.
- Kapucu, N., Hawkins, C.V., and Rivera, F.I. 2013. *Disaster resiliency: interdisciplinary perspectives*. Routledge, New York.
- Keskitalo, E.C.H. 2010. Vulnerability and adaptive capacity in a multi-use forest municipality in Northern Sweden. In *Community adaptation and vulnerability in arctic regions*. Edited by G. Hovelsrud and B. Smit. Springer, Berlin.
- Klenk, N., Reed, M.G., and Mendis-Millard, S. 2012. Adaptive capacity in Canadian model forest communities: the forest industry in a global perspective. Edited by M.S. Beaulieu and R.N. Harpelle. Laurier University Press, Waterloo, Ontario.
- Larsen, J.N., Fondahl, G., and Young, O. 2010. Introduction: Human development in the Arctic and Arctic social indicators. In *Arctic social indicators. A follow up on the Arctic Human Development Report*. Edited by J.N. Larsen, P. Schweitzer, and G. Fondahl. Nordic Council of Ministers, Copenhagen. pp. 11–28.
- Lemyre, L., and O'Sullivan, T. 2013. Enhancing community resilience: a matter of multi-level framework, mixed methods, and multi-sectoral tools. In *Disaster resiliency: interdisciplinary perspectives*. Edited by N. Kapucu, C.V. Hawkins, and F.I. Rivera. Routledge, New York. pp. 271–290.
- Lidestav, G., and Berg Lejon, S. 2013. Harvesting and silvicultural activities in Swedish family forestry — behavior changes from a gender perspective. *Scand. J. For. Res.* **28**(2): 136–142. doi:10.1080/02827581.2012.701324.
- Lin, N. 1999. Building a network theory of social capital. *Connections*, **22**: 28–51.
- MacGregor, S. 2009. Natural allies, perennial foes? On the trajectories of feminist and green political thought. *Contemporary Political Theory*, **8**(3): 317–350. doi:10.1057/cpt.2009.11.
- MacGregor, S. 2010. A stranger silence still: the need for feminist social research on climate change. *Sociological Review*, **58**: 124–140. doi:10.1111/j.1467-954X.2010.01889.x.
- MacLellan, J.I. 2008. *Climate change adaptation literature*. Adaptation and Impacts Research Division, Environment Canada, Downsview, Ontario, Occasional Paper 14.
- Mai, Y.H., Mwangi, E., and Wan, M. 2011. Gender analysis in forestry research: looking back and thinking ahead. *Int. For. Rev.* **13**: 245–258. doi:10.1505/146554811797406589.
- Marchak, P. 1983. *Green gold: the forest industry in British Columbia*. UBC Press, Vancouver, B.C.
- Martz, D., Reed, M.G., Brueckner, I., and Mills, S. 2006. *Hidden actors, muted voices: the employment of rural women in Canadian forestry and agri-food industries*. Policy Research Fund, Ottawa, Ontario.
- Masika, R. (Editor). 2002. *Climate change*. Gender & Development, **10**(2).
- Mills, S.E. 2006. Segregation of women and Aboriginal people within Canada's forest sector by industry and occupation. *Can. J. Native Stud.* **26**: 147–171.
- Moser, S.C., and Ekstrom, J.A. 2010. A framework to diagnose barriers to climate

- change adaptation. *Proc. Natl. Acad. Sci. U.S.A.* **107**: 22026–22031. doi:10.1073/pnas.1007887107.
- Natcher, D.C. 2008. The forest economy of the Little Red River Cree Nation: prioritizing formal and informal modes of forest production. *In* Seeing beyond the trees: the social dimensions of Aboriginal forest management. Edited by D.C. Natcher. Captus Press, Concord, Ontario. pp. 127–140.
- Nightengale, A. 2006. The nature of gender: work, gender and environment. *Environment and Planning D: Society and Space*, **24**: 165–185. doi:10.1068/d01k.
- Norris, F.H., Stevens, S.P., Pfefferbaum, B., Wyche, K.F., and Pfefferbaum, R.L. 2008. Community resilience as a metaphor, theory, set of capacities and strategy for disaster readiness. *Am. J. Community Psychol.* **41**: 127–150. doi:10.1007/s10464-007-9156-6.
- Nyaupane, G.P., and Poudel, S. 2012. Application of appreciative inquiry in tourism research in rural communities. *Tourism Management*, **33**: 978–987. doi:10.1016/j.tourman.2011.10.009.
- Parkins, J., Hunt, L., Nadeau, S., Sinclair, J., Reed, M., and Wallace, S. 2006. Public participation in forest management: results from a national survey of advisory committees. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Northern Forestry Centre Information Report NOR-X-409.
- Patriquin, M.N., Parkins, J.R., and Stedman, R.C. 2007. Socio-economic status of boreal communities in Canada. *Forestry*, **80**(3): 279–291. doi:10.1093/forestry/cpm014.
- Pearce, C., and Callihoo, C. 2011. Pathways to climate change resilience: a guidebook for Canadian forest-based communities. Canadian Model Forest Network, Ottawa, Ontario. Available from http://www.modelforest.net/images/Guidebook_Climate_Change_ENG_2011.pdf.
- Putnam, R. 2000. Bowling alone: the collapse and revival of American community. Simon and Schuster, New York.
- Reed, M.G. 2003a. Marginality and gender at work in forestry communities of British Columbia, Canada. *J. Rural Stud.* **19**(3): 373–389. doi:10.1016/S0743-0167(03)00021-4.
- Reed, M.G. 2003b. Taking stands: gender and the sustainability of rural communities. UBC Press, Vancouver, B.C.
- Reed, M.G. 2008. Reproducing the gender order in Canadian forestry: the role of statistical representation. *Scandinavian J. For. Res.* **23**(1): 78–91.
- Reed, M.G., and Christie, S. 2009. We're not quite home: re-viewing the gender gap in environmental geography. *Prog. Hum. Geogr.* **33**: 246–255. doi:10.1177/0309132508094079.
- Reed, M.G., and Varghese, J. 2007. Gender representation on Canadian forest sector advisory committees. *For. Chron.* **83**: 515–525. doi:10.5558/tfc83515-4.
- Richardson, K., Sinclair, J., Reed, M.G., and Parkins, J. 2011. Constraints to participation in Canadian forestry advisory committees: a gendered perspective. *Can. J. For. Res.* **41**(3): 524–532. doi:10.1139/X10-220.
- Rocheleau, D., Thomas-Slayter, B., and Wangari, E. (Editors). 1996. Feminist political ecology: global issues and local experiences. Routledge, New York.
- Satterfield, T.A., Mertz, C.K., and Slovic, P. 2004. Discrimination, vulnerability and justice in the face of risk. *Risk Analysis*, **24**: 115–120. doi:10.1111/j.0272-4332.2004.00416.x.
- Seager, J. 2006. Noticing gender (or not) in disasters. *Geoforum*, **37**: 2–3. doi:10.1016/j.geoforum.2005.10.004.
- Sherry, E., Halseth, R., Fondahl, G., Karjala, M., and Leon, B. 2005. Local-level criteria and indicators: an Aboriginal perspective on sustainable forest management. *Forestry*, **78**: 513–539. doi:10.1093/forestry/cpi048.
- Smit, B., and Pilifisova, O. 2003. From adaptation to adaptive capacity and vulnerability reduction. *In* Enhancing the capacity of developing countries to adapt to climate change. Edited by S. Huq, J. Smith, and R.T.J. Klein. Imperial College Press, London.
- Smit, B., and Wandel, J. 2006. Adaptation, adaptive capacity and vulnerability. *Glob. Environ. Change*, **16**: 282–292. doi:10.1016/j.gloenvcha.2006.03.008.
- Steenberg, J.W.N., Duinker, P.N., Van Damme, L., and Zielke, K. 2011. Indicators of sustainable forest management in a changing climate. Final report to the Canadian Council of Forest Ministers. Canadian Council of Forest Ministers, Ottawa, Ontario.
- Sweetman, C. (Editor). 2009. Climate changes and climate justice. *Gender & Development*, **17**(1).
- Terry, G. 2009. No climate justice without gender justice: an overview of the issues. *Gender & Development*, **17**(1): 5–18. doi:10.1080/13552070802696839.
- Teske, E., and Beedle, B. 2001. Journey to the top, breaking through the canopy: Canadian experiences. *For. Chron.* **77**: 846–853. doi:10.5558/tfc77846-5.
- Toresson, B. 2006. Short overview of Swedish gender policy and how it affects the Swedish forest policy. *In* Proceedings of the Seminar on Gender and Forestry and IUFRO 6.08.01 Workshop. Edited by G. Lidestav and E. Holmgren, Umeå, Sweden, June 17–21, 2006.
- Turner, N.J., Davidson-Hunt, I.J., and O'Flaherty, M. 2003. Living on the edge: ecological and cultural edges as sources of diversity for socio-ecological resilience. *Hum. Ecol.* **21**: 439–461. doi:10.1023/A:1025023906459.
- UNECE/FAO. 2006. Time for action: changing the gender situation in forestry. Report of the Team of Specialists on Gender and Forestry. Food and Agriculture Organization of the United Nations, Rome.
- Varghese, J., and Reed, M.G. 2012. Theorizing the implications of gender order for sustainable forest management. *Int. J. Forest. Res.* Article ID 257280. doi:10.1155/2012/257280.
- Wall, E., and Marzall, K. 2006. Adaptive capacity for climate change in Canadian rural communities. *Local Env.* **11**: 373–397. doi:10.1080/13549830600785506.
- West Coast Environmental Law. 2012. Preparing for climate change: an implementation guide for local governments in British Columbia. West Coast Environmental Law, Vancouver, B.C.
- Willbanks, T., and Kates, R.W. 1999. Global change in local places: how scale matters. *Clim. Change*, **43**: 601–628. doi:10.1023/A:1005418924748.
- Williamson, T.B., Parkins, J.R., and McFarlane, B.L. 2005. Perceptions of climate change risk to forest management and forest-based communities. *For. Chron.* **81**: 710–716. doi:10.5558/tfc81710-5.
- Williamson, T.B., Price, D.T., Beverly, J.L., Bothwell, P.M., Frenkel, B., Park, J., and Patriquin, M.N. 2008. Assessing potential biophysical and socioeconomic impacts of climate change on forest-based communities: a methodological case study. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta, Inf. Rep. NOR-X-415E.
- Williamson, T.B., Price, D.T., Beverly, J.L., Bothwell, P.M., Parkins, J.R., Patriquin, M.N., Pearce, C.V., Stedman, R.C., and Volney, W.J.A. 2007. A framework for assessing vulnerability of forest-based communities to climate change. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta, Inf. Rep. NOR-X-414.
- Williamson, T.B., Colombo, S., and Duinker, P. 2009. Climate change and Canada's forests: from impacts to adaptation. Sustainable Forest Management Network and Natural Resources Canada. Available from http://www.nofc.cfs.nrcan.gc.ca/bookstore_pdfs/29616.pdf [accessed 23 August 2010].
- Williamson, T.B., Campagna, M.A., and Ogden, A.E. 2012a. Adapting sustainable forest management to climate change: a framework for assessing vulnerability and mainstreaming adaptation into decision making. Canadian Council of Forest Ministers, Ottawa, Ontario.
- Williamson, T.B., Hessel, H., and Johnston, M.H. 2012b. Adaptive capacity deficits and adaptive capacity of economic systems in climate change vulnerability assessment. *Forest Policy and Economics*, **15**(1): 160–166. doi:10.1016/j.forpol.2010.04.003.
- Wolf, J., Lorenzoni, I., Few, R., Abrahamson, V., and Raine, R. 2009. Conceptual and practical barriers to adaptation: vulnerability and responses to heat waves in the UK. *In* Adapting to climate change: thresholds, values, governance. Edited by W.N. Adger, I. Lorenzoni, and K.L. O'Brien. Cambridge University Press, Cambridge. pp. 181–196.
- Zamchevska, V. 2014. Strengthening sustainability assessment in town planning in rural Saskatchewan. Unpublished Master of Environment and Sustainability thesis, University of Saskatchewan, Saskatoon, Saskatchewan.