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A Survey-Based Assessment of Cattle Producers' Adaptation to Climate Change in British Columbia, Canada☆

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ABSTRACT

A quantitative analysis of the British Columbia, Canada cattle ranching community in light of global climate change provides insight as to how stakeholder needs and observations can be included in future planning. More than 63% of the 239 survey respondents believe that human activities are increasing the rate at which global climate changes occur, and 60% of 231 respondents adapted their management because of climate change. Cattle ranchers operating for less than 20 years were more likely to agree that human activities are increasing the rate of global climate change compared with those operating more than 40 years. This may reflect the fact that the concept of climate change has gained more public acceptance in the past 2 decades and would likely be perceived as a legitimate risk to an operation by those in this category in comparison with those who have been operating for a long period of time and tend to rely on experiential or embedded knowledge. Regional analysis showed that the most northerly region is more likely to have noticed change in climate compared with one of the most southern regions. With respect to operation of scale in terms of head of cattle, those ranches with more than 50 head of cattle identified water availability as a significant challenge to operations. Family succession planning was identified as a greater challenge for those operating their ranch for more than 40 years, compared with those operating less than 20 years. Adaptation to climate change included accessing available forage and providing a water source for cattle. Experiential and scientific knowledge will be crucial to future planning to reduce the vulnerability of the ranching industry and building adaptive capacity.

Introduction

Land classified as agricultural, which includes cropland, managed grassland, and permanent crops, occupies 40–50% of the Earth's land surface (Parry et al., 2007; Smith et al., 2007), with managed grazing systems occupying more than 33 million square kilometers or 25% of the global land surface. Rising global temperatures are expected to create an increase in drought, which will affect forage and crop production, intensifying the process of desertification in these systems and reducing the carrying capacity of rangelands and other livestock systems. This could also increase the prevalence of other risk factors due to the availability and cost of grain (Nardone et al., 2010), making agricultural systems more vulnerable and impairing their relative ability to adapt to changing conditions.

Considering that climate influences forage productivity (Antle, 1996) and that global climate change will likely have a significant effect on plant growth, it is important to predict the effects of global climate change on forage productivity and forage quality and the impact global climate change will have on livestock management (Joyce et al., 2013; Polley et al., 2013). Fluctuation in climate conditions usually results in variation in total yield of available forage and thus cattle production. This variability poses challenges to those depending on grazing land to support livelihoods (Conner, 1994; Joyce et al., 2013; Nardone et al., 2010). Crop and pasture growth in grazing-based livestock systems will be negatively affected by lower rainfall and increased drought conditions and by the effect of higher temperatures and solar radiation on animals (Nardone et al., 2010).

Agriculture is a major economic, social, and cultural activity and remains highly sensitive to climate variations in all its different forms and locations (Howden et al., 2007; Kurukulasuriya and Rosenthal, 2013). Soil, water, terrain, and climate conditions provide both constraints and opportunities for agricultural production (Wall and Smit, 2005), and, as such, environmental conditions are often a dominant source of the annual variability of regional production. Continued fluctuations in climate and weather patterns induced by global climate change will undoubtedly impact the future management of farming operations.

According to Mote and Salathé (2010), the general climate prediction for northwestern North America is for warmer and wetter winters and warmer and drier summers. One recent consequence of warmer winters was a mountain pine beetle outbreak in the Pacific Northwest (Carroll et al. 2003), which has indirect positive and negative effects on the ranching industry. A positive effect is the potential for increased forage availability where there are no longer pine forests. A negative

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effect is the potential loss of income those ranchers may face because they rely on tree-harvest licenses to supplement their income. Drier summers would occur from the combined effect of reduced precipitation and increased evaporation in some areas, resulting in an increased water deficit. The expected impact of climate change varies regionally because of the distinct nature of the climate and characteristics of each area. An increase is expected in annual variation in temperature and precipitation and the probability of extreme weather events (IPCC, 2013), contributing to increased agricultural risk (Weber and Hauer, 2003) and vulnerability (Kurukulasuriya and Rosenthal, 2013; Polley et al., 2013).

Farmers, including ranchers in British Columbia, respond to weather events, which, right or wrong, simultaneously constitutes their adaptation to climate change. Further, weather is but one of a myriad of sources of risk (or opportunity) to which farmers are exposed and respond. Events such as commodity market downturns, changes to government support programs, fluctuations in currency and interest rates, and the loss of export markets due to consumer health concerns may present significant risks to producers at certain times. It is in this rather complex context that adaptations to perceived or real climate change will (or will not) be undertaken. This point has been long recognized in the literature on climate change impacts and adaptation in agriculture (see, e.g., Bradshaw et al., 2004; Brklacich et al., 2000; Bryant et al., 2000; Chiotti and Johnston, 1995; Eakin, 2000; Easterling, 1996; Kandlikar and Risbey, 2000; O'Brien and Leichenko 2000; Timmerman, 1989; Smit et al., 1996; Smit et al., 1999; Smithers and Smit, 1997; Wheaton and McIver, 1999). It is only by understanding the nature of agricultural production decisions and situating climate change in a wider risk management context (i.e., climate as one of many sources of risk) that we can make sense of farmers' adaptation to climate change. There is no academic support for empirical research that assumes a direct relationship between climate and adaptation decisions.

A U.S. and Canadian survey done by Borick et al. (2011) found that climate change believers are divided on the root causes of climate change, citing both human activity and natural causes. Understanding opinions and perceptions about climate change will be a vital

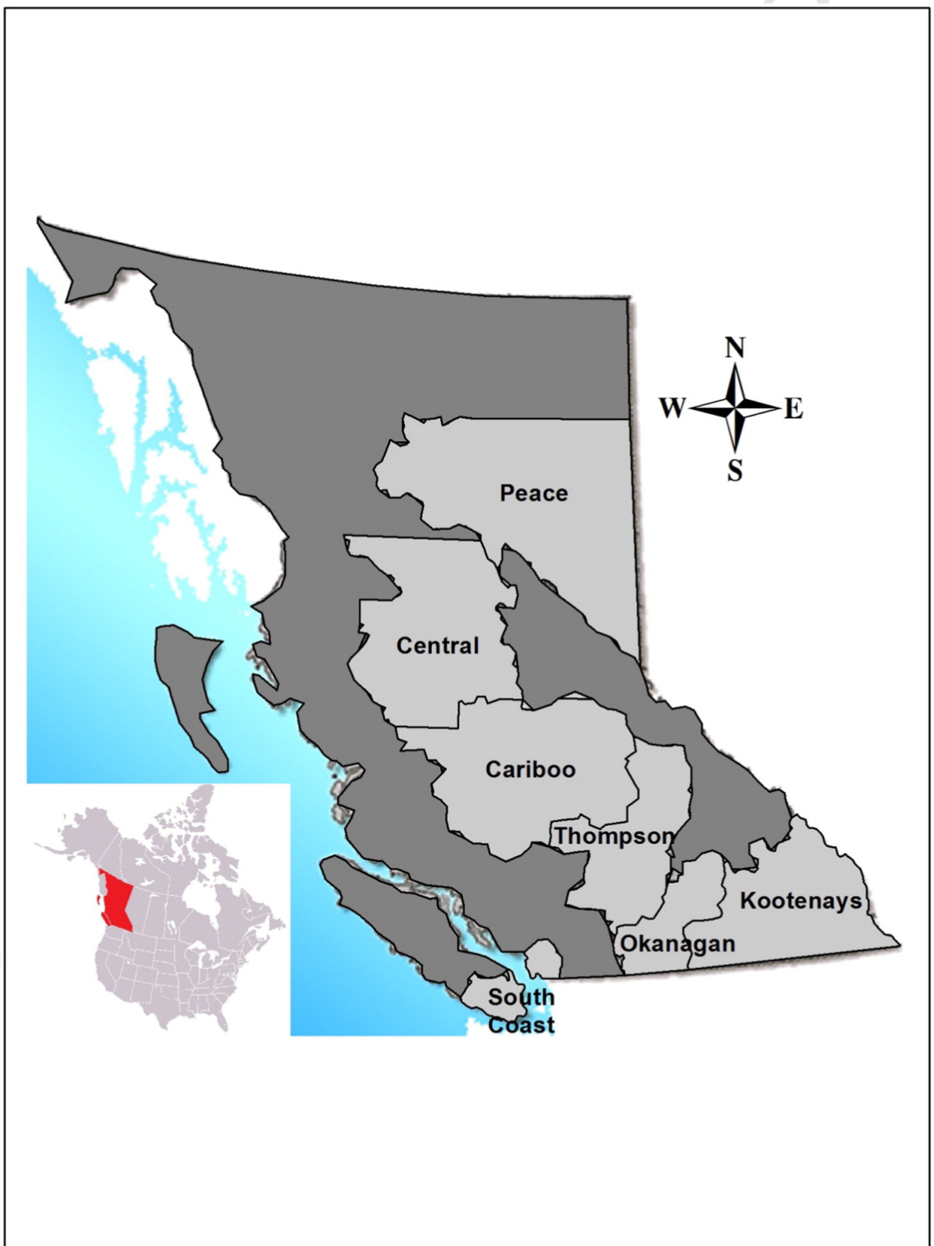

Fig. 1. Map of British Columbia, Canada, identifying the six major cattle regions in the province. Thompson and Okanagan are referred to as one region.