



Discussion

Billion dollar boreal woodland caribou and the biodiversity impacts of the global oil and gas industry



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ABSTRACT

Awareness of the impact of the global energy industry and associated landuse change on biodiversity conservation has been steadily growing amongst conservation biologists. Across Canada, 28 of 57 populations of boreal woodland caribou (*Rangifer tarandus caribou*) are declining and 20 of 25 southern mountain populations are in decline with several recent high-profile extirpations. Declines stem from widespread landuse change from energy development and forestry that will take decades to recover, if ever. In Western Canada's Boreal forest, a globally significant oil and gas industry has emerged that is the biggest source of foreign oil to US markets. All woodland caribou populations overlapping oil and gas development in oil-rich Alberta are in rapid decline, shrinking by 50% every 8 years. After a decade of delay, the Federal government released recovery plans under the Canadian Species-at-Risk Act (SARA) in 2012 and 2014 for these two caribou ecotypes, and will audit provincial compliance in 2017. Yet recovery actions have been inadequate, and have relied on wolf control as a short-term solution. Given the stark reality, conservation triage might be expected. Instead, the conservation objective at Federal and Provincial levels remains legally committed to recovery of all populations despite the paradox of continued declines. I suggest the reason for ineffective conservation planning is the staggering cost of effective habitat protection that far exceeds \$150 billion (CDN) in Alberta alone. Declines of woodland caribou also allegedly violate Canadian Aboriginal treaty rights that have been challenged in court. This complex conservation case-study urgently illustrates the need for strategic conservation triage at provincial and national levels. And more generally, caribou conservation demonstrates the challenge of using national endangered species legislation to retroactively counteract the global energy industry without strategic conservation planning coordinated with energy and cultural policies.

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1. Introduction

Home to underappreciated biodiversity (Venier et al., 2014), the boreal forest of Canada is also one of the largest remaining carbon stores of the planet (Bradshaw et al., 2009; Pimm et al., 2009; Schindler and Lee, 2010; Warkentin and Bradshaw, 2012). And yet, Canada's boreal forests are undergoing some of the most rapid landuse change across the globe (Hansen et al., 2013). In Western Canada, this is especially driven by the emergence of an underappreciated, but globally relevant energy industry that is the biggest supplier of foreign oil to the United States (Naugle, 2010). For example, while the debate about Keystone XL focused on US impacts and the global climate battle, the collateral costs to biodiversity of outsourcing America's energy footprint to the boreal forest escaped notice. The challenge of conserving boreal biodiversity while developing the globally-relevant oil and gas energy industry in Western Canada

constitutes a major global conservation issue, and provides a valuable case study of the collision of the global energy industry and biodiversity conservation in the 21st century. This is symbolized by the conservation challenges facing biodiversity's boreal icons - threatened woodland caribou (*Rangifer tarandus caribou*), a flagship and umbrella species for boreal biodiversity, and, indeed, the climate future of the planet through landuse changes to the vast carbon stores in the boreal forest (Hansen, 2012).

Here, I first briefly review evidence of the widespread effects of Western Canada's expanding energy and forestry industry on the boreal forest and biodiversity. Next, I introduce the causes of decline of the Boreal forests' iconic umbrella species, woodland caribou and caribou recovery planning and actions. This highlights the looming policy conflict between unrealistic recovery goals and the staggering costs of habitat protection in Western Canada. As if these challenges weren't enough, I review underappreciated risks from climate change and Aboriginal treaty rights that until now have been largely ignored. This complex nexus of conservation challenges strongly suggests a case for conservation triage (Wiens et al., 2012), but I review policy barriers to

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implementation of triage, and conclude with a stark future for Boreal woodland caribou and indeed, Canada's boreal forest biodiversity. Conservation triage is urgently needed at national scales if scarce conservation dollars are going to have any chance at conserving Canada's boreal forest and its iconic umbrella, woodland caribou.

1.1. Landuse change and energy development in Western Canada's boreal forest

Energy development is one of the leading threats to biodiversity and ecosystem services worldwide (Allred et al., 2015; Butt et al., 2013; Naugle, 2010). In a recent analysis across central North America, Allred et al. (2015) revealed that since 2000 there have been 50,000 oil and gas wells drilled in central North America every year, the greatest number of which were in Alberta. The areal footprint of this oil and gas development exceeds 3 million ha, reducing net primary productivity of vegetation by 10 terragrams/year (Allred et al., 2015) especially in northern Alberta's boreal forests (see Allred et al., 2015 supplemental fig. S7). Across the globe, the Energy industry has been noted to have widespread effects on terrestrial biodiversity from songbirds, large mammals and ecosystem productivity (Bayne and Dale, 2010; Butt et al., 2013; Naugle, 2010; Northrup and Wittemyer, 2013).

Western Canada's boreal forest contains at least one third of the worlds proven oil reserves (Alberta Energy, 2015). The western sedimentary basin underlying Alberta, northeastern British Columbia, the MacKenzie valley in the Northwest Territories and Saskatchewan are one of the world's greatest sources of oil and gas reserves. Canada provided 37% of the US energy imports in 2014 (United States Energy Information Administration, 2015), or about 15% of total US energy consumption, the highest non-domestic source. Alberta's energy industry produces 25% of Canada's GDP by exporting >90%, primarily to the USA. With its vast oil sands totaling 173 billion barrels that are economically recoverable, Canada is second only to Saudi Arabia in oil reserves (Naugle, 2010; Nikiforuk, 2010). Yet the oil sands are amongst the 'dirtiest' sources of oil, requiring double the energy input to extract one unit of energy than conventional oil, as well as extensive water resources that are in decline (Nikiforuk, 2010; Sauchyn et al., 2015). The EU

labeled the oil sands a global environmental disaster as one of the worlds largest point sources of CO₂ (Brandt, 2011; Gailus, 2012; Song, 2012), and former NASA chief scientist, Jim Hansen, called future development of the oil sands 'game over' for climate change because of carbon emissions (Hansen, 2012). Yet, the Alberta Department of Energy's policy is to maximize revenue from oil and gas production in the province (Alberta Energy, 2015), underscoring strong provincial policy support for continued energy development.

To support the oil and gas industry, energy infrastructure permeates Western Canada's Boreal forests (Fig. 1) that has facilitated other forms of landuse change, notably forestry. Until 1994, Alberta's energy industry cut more timber than its forest industry, which has rapidly caught up, facilitated by energy infrastructure (Pratt and Urquhart, 1996; Timoney and Lee, 2001). In the last two decades, the forestry industry has grown extensively in the western Canadian boreal forest and now rivals the energy sector as a primary cause of landuse change (Timoney, 2003). Rates of landuse change due to forestry in parts of Canada's boreal forests now rival tropical rates (Hansen et al., 2013), with increasing forest edge, decreasing intact forest patch sizes, and increasing fragmentation (Pickell et al., 2015; Pickell et al., 2016). The cumulative effects of the oil and gas and forestry industries combined have transformed most of Alberta's crown (public) land into industrialized landscapes with a large network of energy-related infrastructure including roads, transmission lines, pipelines, seismic exploration lines, and well sites (Pickell et al., 2015; Timoney and Lee, 2001). The pace of cumulative landuse development poses serious negative consequence to aquatic ecosystems, water quality, human health, and terrestrial biodiversity (Gosselin et al., 2010; Jordaan, 2012; Sauchyn et al., 2015; Venier et al., 2014), including threatened woodland caribou.

2. Woodland caribou

There can be no better umbrella species for the Boreal forest than woodland caribou (Bichet et al., 2016; Hummel and Ray, 2008). More akin to a giant spotted owl (*Strix occidentalis*) than their abundant migratory barren ground cousins (*R.t. groenlandica*) they occupy a narrow and specialized niche, occurring at low densities in large patches of old-

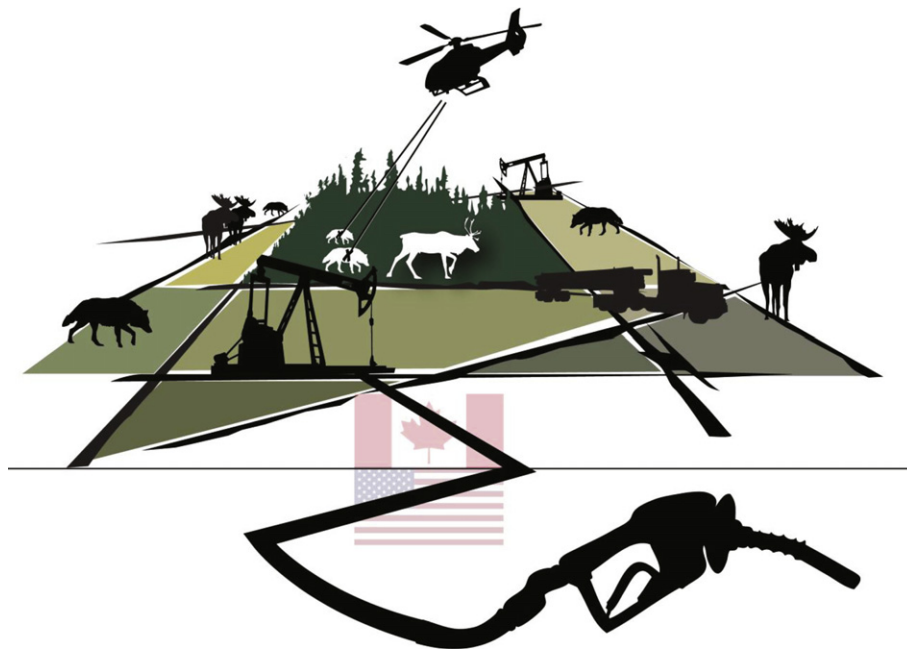


Fig. 1. Conceptual figure showing effects of increasing habitat destruction and fragmentation on woodland caribou in Western Canada's boreal forest. Habitat destruction caused by energy development and forestry leads to increased primary prey and predator abundance, which, in turn, causes apparent-competition induced declines. Since 2006, Alberta has killed >940 wolves through aerial shooting and poison in the only effective mitigation strategy used to date to prevent continued caribou endangerment. Most of the oil and gas produced in Alberta is exported to US refineries to meet US demand and for export. Credit: EHIllustration.com

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