

Invasive annual grass issues in Canadian rangelands

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Abstract

It has been understood for several years now that Canadian grasslands are among the world's most endangered ecosystems. While the endangerment of the world's coral reefs and rainforests may make the news more often, the increasingly fast decline of native Canadian grasslands is having a major impact on species diversity as well as global carbon supplies. In this paper, I will discuss the impact invasive annual grasses have had on two important rangeland ecosystems in Canada. Furthermore, strategies for protecting and restoring these invaluable lands will be discussed.

Introduction

Canadian natural grasslands, or native rangelands (Allen et al. 2011), are under constant threat from urban sprawl, conversion to cropland, and the spread of invasive species (Scholtz and Twidwell 2022). These factors contributed to the International Union for Conservation of Nature stating in 2008 that temperate grasslands are the world's most endangered ecosystem. Recent estimates confirm that over 70% of Canada's native grasslands have been lost (Kraus 2018). In fact, the Great Plains of North America have lost a larger proportion of their native grasslands than the Amazon has lost forest (World Wildlife Fund 2022). In Canada, most of these endangered grassland ecosystems can be found in the prairie provinces of Manitoba, Saskatchewan, and Alberta. However, substantial grassland areas can be found in central British Columbia (BC) and Ontario as well. While threats such as urban sprawl and the conversion to cropland are undeniable, in recent years the increased introduction of invasive species including annual grasses is having a larger and larger impact on species diversity, carbon supply (Hungate et al. 2017; Chang et al. 2021; Bai and Cotrufo 2022), and forage value within Canada's native rangelands. Fortunately, as more awareness around the importance of native rangelands is generated along with the development of new strategies we can protect and restore these valuable ecosystems.

Discussion

Species diversity in Canada's rangelands

While to the novice observer a rangeland may appear to be a monoculture, it has been estimated that a five-acre plot of Canadian native grassland can contain up to 100 different plant species. This plant diversity can in return support numerous species of insects, birds, mammals, reptiles, and more (Ducks Unlimited Canada 2020). Over 60 Canadian species at risk depend on grassland prairie habitats in Alberta, Saskatchewan, and Manitoba, including species such as plains bison, swift fox, and the burrowing owl. In BC, grasslands can be found throughout the Okanagan, the Thompson Nicola, the Fraser Canyon, the Cariboo Chilcotin regions, the Kootenays, and Northeastern BC but cover less than 1.5% of BC landmass. Yet, this land includes the largest remaining bunchgrass steppes in Canada and provides some of the only habitats for the province's most endangered and threatened wildlife (Leung 2002). In Ontario, the small remnants of the tall grass prairies in the south of the province represent less than 1% of the original area (Chan 2019). However, this area is vital in supporting a variety of at-risk species such as the Monarch butterfly, the northern cricket frog, Henslow's sparrow, the American Badger, and many more (Solymár 2005).

Threats to Canadian rangelands

There are many threats to the species diversity of the Canadian rangelands. The usual suspects such as urban sprawl and the conversion to cropland play a large role in the disappearance of the native Canadian rangelands. However, while conservation parks and land preservations have worked in slowing the decline of grassland areas (World Wildlife Fund 2022), invasive plant species do not respect these boundaries. In Canada, some of the worst invasive plants include the broadleaf species spotted knapweed (*Centaurea biebersteinii*), Canada thistle (*Cirsium arvense*), swallowworts (*Cynanchum spp.*), sweet clovers (*Melilotus spp.*), and leafy spurge (*Euphorbia esula*). However, it is the fast spread and devastating effects that the invasive annual grasses have had on the forage production value of the Canadian native rangelands that is the focus here.

Invasive annual grasses in Canada

In North America, the biggest threat from invasive annual grasses comes from three main species - downy brome (*Bromus tectorum*), medusahead (*Taeniatherum caput-medusae*), and ventenata (*Ventenata dubia*). In the Great Basin rangelands of the western United States, it is estimated that one-fifth (19.8%) of the land mass is dominated by these annual grasses (Smith et al. 2021). In Canada, the presence of medusahead has not yet been confirmed (Desmet and Brouilet 2013) and ventenata, while present, has had minimal spread (Government of BC 2021). However, downy brome has been present in Canada since the late 1800s and has spread to all Canadian provinces except Newfoundland (Upadhyaya, McIlvride, and Turkington 1986). The current infestation poses a major risk to native Canadian rangelands as it is particularly abundant in southwestern Alberta and southern British Columbia.

Effect of fire on invasive annual grasses – Waterton Park Front

The Waterton Park Front, located in southern Alberta, extends from the Montana border to the town of Pincher Creek. The drive from Picher Creek to the Waterton Lakes National Park Gate has often been described as one of the most beautiful drives in Canada. Unfortunately, on August 30 of 2017, a large fire was ignited by a lightning strike. Fuelled by high temperatures and strong winds the fire burned for over a week uncontrolled. Over 35,000 hectares including 1000s of hectares of native rangelands were burned (Parks Canada 2018). While wildfires fulfil important ecosystem functions (Leung 2002), in this case, they resulted in the uncontrolled spread of downy brome into the native rangelands creating near monocultures within the fire zone (Fig. 1). The spread was not a surprise as studies have shown that fire promotes the spread of invasive annual grasses such as downy brome (Mealor et al. 2012; Monty et al. 2013). Furthermore, once a site has been infested with invasive annual grasses the risk of repeat wildfire is higher (Fusco et al. 2019). Lindsey Davidson, the Waterton Park Front Natural Area Manager for the Nature Conservancy of Canada, works closely with the rangeland managers in the area and reports that the spread of downy brome since the fire is unprecedented and has successfully invaded critical native landscapes.



Figure 1: Monoculture of Downy brome on the Jenkins Ranch outside of Pincher Creek, AB.

Wild sheep territory of BC

Bighorn sheep (*Ovis canadensis*) are an iconic species of the east Kootenays of BC however they are currently Blue-listed provincially, meaning that they are a species of special concern. Over recent decades, bighorn sheep populations in this region have experienced declines due to wildlife health issues, loss of habitat, and diminished function of that habitat exacerbated by the increase of invasive plant species in their winter ranges. The invasive plants include yellow hawkweed, St John's Wort, Sulphur cinquefoil, spotted knapweed, and downy brome.

While herbicide treatments have had some success on the broadleaf species (Habitat Conservation Trust Foundation 2019), the distribution of downy brome has continued to expand across much of southern BC, partly in response to successive, recent years of wildfires that have affected perennial grass communities and have also created favourable conditions for this species of annual grass. Furthermore, downy brome reduces the overall forage quality and quantity across wild sheep ranges and specifically in important winter habitats. Efforts by organizations such as the Wild Sheep Society of BC to recognize and address the threats that invasive plant species, and specifically downy brome, have on the critical winter range, are the first step in protecting these magnificent animals.

Strategies for protecting Canada's rangelands from invasive annual grasses

The key to controlling the spread of annual grasses is to understand the physiology of the grass itself. What we know about downy brome is that it relies exclusively on seed reproduction, with its seeds surviving in the soil for up to five years (Upadhyaya et al. 1986). Therefore, the management goal should be focused on eliminating seed production and exhausting the soil seed bank. To this end, preemergent herbicide treatments are often used to control annual grasses (Holfus et al. 2021). However, in Canada, there are currently no preemergent herbicides registered for use in native rangelands. Current control measures for downy brome include grazing, cultivation, mechanical removal, and post emergent herbicides. However, while these control measures may work in the short term for limiting seed production, the timing of control is critical, and they have no effect on seed germination in the spring. In the US, the chemical indaziflam has shown great promise in controlling annual grasses in rangeland and pastures (Brabham et al. 2014; Sebastian et al. 2017). Additionally, research has shown that indaziflam will control downy brome for multiple years without a reduction in perennial species richness or abundance (Clark et al. 2019). In Canada, indaziflam is currently registered by Envu under the trade name Esplanade™ SC and has been approved for the control of annual grasses and broadleaf weeds in non-residential non-crop areas such as railroad and rail yards, managed roadsides, fence rows, utilities, industrial sites, military bases, municipal and government sites and around farm buildings but not yet for range and pasture. However, trials throughout the western US and Canada (Fig. 2) have provided substantial data to prove the efficacy of indaziflam in controlling annual grasses in rangeland and pasture and a “use-case” label expansion has been submitted to the PMRA.



Figure 2: Indaziflam (Esplanade™SC) trial on downy brome near Medicine Hat, AB

Conclusions

There is no doubt that native Canadian rangelands are a threatened and declining ecosystem and, if not protected and restored, there will be a massive extinction of native grassland species. However, with continued work by

agencies like the Nature Conservancy of Canada and the Wild Sheep Society of BC along with the development of new chemistries for the control of these invasive annual grasses, we can start to restore these valuable ecosystems.

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