*Research Report*

**BC Journal of Ecosystems and Management**

# Native and non-native plant species in grazed grasslands of British Columbia's southern interior

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## Abstract

Herbaceous vegetation on 17 native grassland sites in southeastern British Columbia were assessed for their proportion of native and non-native plant species. All sites were on grazed Crown rangeland, and found within the Ponderosa Pine and Interior Douglas-fir biogeoclimatic zones. Vegetation cover values for individual species were aggregated into native and non-native categories. Values for non-native herbaceous species at the 17 sites ranged from 0 to 84% of total herbaceous cover, with an average of 35%. When compared to ungrazed controls, results varied by site. Managers of these grasslands should review and adjust current practices to discourage not only noxious weeds, but all non-native species.

**KEYWORDS:** *plant species origin, floristic diversity, British Columbia grasslands, native plant species, non-native plant species, species invasion, grazing impacts.*

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Gayton, D. 2004. Native and non-native plant species in grazed grasslands of British Columbia's southern interior. *BC Journal of Ecosystems and Management* 5(1):51–59. URL: ***www.forrex.org/jem/2004/vol5/no1/art6.pdf***

## Introduction

Natural grasslands occupy less than 1% of British Columbia's land base (Grasslands Conservation Council of British Columbia 2003). In spite of their limited extent, grasslands play an important ecological, economic, and cultural role in the province. Additionally, there is a high correlation between natural grasslands and endangered species: 30% of federally listed endangered species in British Columbia occupy grasslands for some or all of their life cycle; 137 provincially endangered plants, 87 animals, and numerous plant associations are also grassland dependent (G. Scudder, Professor Emeritus, Biological Sciences, University of British Columbia, pers. comm., 2002). Human settlement, agriculture, industry, transportation routes, and recreation facilities have tended to concentrate on valley grasslands of the Southern Interior, leading to reductions in areal extent, and prompting management concerns for the condition of the remaining grasslands.

The ecological integrity of Interior grasslands is also a concern. Ecological integrity is defined as the condition of an ecosystem where structure and function are unimpaired by human-caused stresses, and ecosystem biological diversity and its supporting processes are likely to persist (Parks Canada 1998). Overgrazing by wild and domestic ungulates, weed invasion, forest ingrowth/encroachment as a result of fire suppression, and habitat fragmentation all pose present threats to the integrity of Interior grassland ecosystems.

Long-term monitoring of vegetation conditions and trends is an appropriate response to these threats, but monitoring of native grasslands in British Columbia has been sporadic and inconsistent. The process of monitoring grassland vegetation is inherently difficult, and high levels of species, community, and temporal variability make statistically valid studies prohibitively expensive.

The establishment of a series of permanent grassland monitoring sites in British Columbia (British Columbia Ministry of Forests 1996) provided an opportunity to do a quantitative assessment of the relative amounts of native and non-native species on Crown rangeland. Cover of non-native species is a fundamental component of range condition analysis (Dyksterhuis 1949) and an indicator of local ecosystem integrity. I undertook a study of selected sites to determine the proportion of total herbaceous cover occupied by non-native plant species, and the influence of grazing on that proportion.

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## Site Description

To derive an initial estimate of the proportion of native and non-native species, 17 grassland sites were chosen from southeastern British Columbia. Eleven sites were located in the Columbia/Kootenay river valley of the southern Rocky Mountain Trench, and six in the Kettle/Granby valleys of the Boundary region (see Figure 1). All sites are on Crown rangelands, and are used by domestic livestock and wild ungulates, primarily elk (*Cervus elaphus*) and whitetail deer (*Odocoileus virginianus*), in varying amounts. The provincially blue-listed Rocky Mountain bighorn sheep (*Ovus canadensis canadensis*) also use a few sites. Livestock use is generally rotational (spring/summer/fall) in the range units where the 17 sites are located. All sites are within the Ponderosa Pine and Interior Douglas-fir biogeoclimatic zones (Braumandl and Curran 1992), and range between 570 and 1010 m in elevation (see Table 1). The sites are either treeless, or have tree cover of less than 5%.

The sampled grasslands are within the northern extension of the Pacific Northwest Bunchgrass grassland, typified by the late-seral native bunchgrasses, bluebunch wheatgrass (*Pseudoroegneria spicata*), rough fescue (*Festuca campestris*) and Idaho fescue (*Festuca idahoensis*) (Daubenmire 1970; Tisdale 1982). Sagebrush (*Artemisia tridentata*), which is frequent further south and in the grasslands of the Thompson and Okanagan river basins, was present at only one site. Antelope-brush (*Purshia tridentata*) was found in several of the Rocky Mountain Trench sites. Grazing management practices (intensity, frequency, duration) in the "grazed control" portions of these sites are identical to the management practices of the larger range unit in which each site is located.

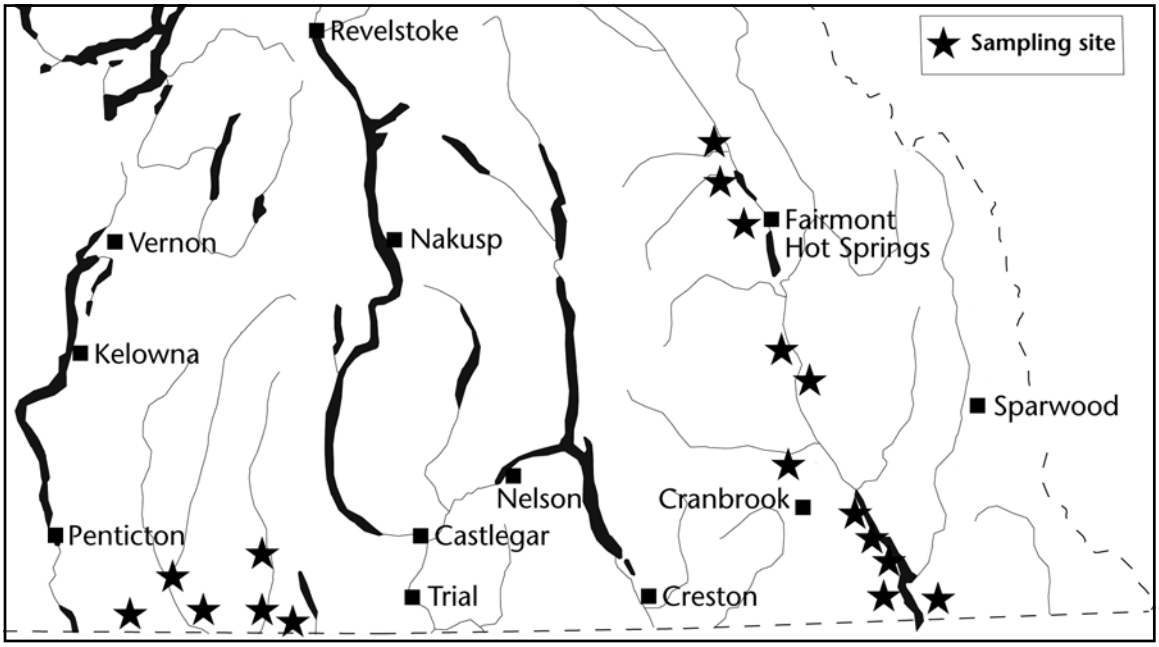


**FIGURE 1.** Location of sample sites.

**TABLE 1.** Description of the seventeen monitoring sites

| Site | Nearest community | Subzone | Variant | Elevation (m) | Aspect | Slope (%) | Monitoring year | Method[a] | Sample size[b] |
|---|---|---|---|---|---|---|---|---|---|
| **Bagleys Pasture** | Grasmere | PP | dh2 | 790 | nil | 0 | 1998 | PI | 1000[c] |
| **Buck Lake Ridges** | Baynes Lake | PP | dh2 | 860 | SW | 4 | 1996 | DFP | 150[c] |
| **Bunchgrass Hill** | Grand Forks | IDF | dm1 | 730 | SW | 32 | 1998 | PI | 1000[c] |
| **David Creek** | Westbridge | IDF | dm1 | 900 | W | 23 | 1998 | PI | 1000[c] |
| **Gold Creek** | Newgate | PP | dh2 | 780 | S | 4 | 1996 | DFP | 150[c] |
| **Johnstone Creek** | Rock Creek | IDF | xh1 | 950 | SSW | 10 | 1997 | DFP | 50 |
| **Murray Gulch** | Midway | PP | dh1 | 960 | WSW | 16 | 1996 | DFP | 150[c] |
| **Overton-Moody** | Grand Forks | PP | dh1 | 570 | S | 6 | 1998 | DCC | 50 |
| **Pickering Hills** | Bull River | IDF | dm2 | 980 | SW | 6 | 1998 | DCC | 50 |
| **Premier Ridge** | Skookumchuk | IDF | dm2 | 920 | SW | 11 | 1998 | DCC | 50 |
| **Rushmere Road** | Windermere | IDF | un | 850 | WSW | 15 | 1998 | PI | 1000[c] |
| **Sagebrush** | Wilmer | IDF | un | 910 | SSW | 9 | 1999 | PI | 50 |
| **Skookumchuk** | Skookumchuk | PP | dh2 | 810 | W | 2 | 1998 | DCC | 50 |
| **Standard Hill** | Cranbrook | PP | dh2 | 1010 | S | 15 | 1998 | PI | 1500[c] |
| **Sun Lakes** | Canal Flats | IDF | dm2 | 950 | S | 3 | 1998 | PI | 1500[c] |
| **Upper Gilpin** | Grand Forks | PP | dh1 | 850 | SSE | 30 | 1995 | DCC | 100[c] |
| **Whitetail Pasture** | Bull River | IDF | dm2 | 850 | S | 30 | 1998 | DFP | 50 |

[a] PI = point intercept; DFP = Daubenmire foliar to the percent; DCC = Daubenmire cover class.
[b] Number of observations.
[c] Indicates combined treatments.

## Methods

Sampling layout at each site consisted of five permanent, 50-m transects placed within a selected 1 ha grazed area of consistent topography and aspect. Herbaceous vegetative cover was sampled at 10 observation points along each transect. Both transect and observation point locations were established using restricted randomization (no less than 2 m and no more than 10 m apart). A minimum 20-m buffer zone was established between all monitoring plots and any adjacent fencelines or terrain breaks. Vegetation cover sampling occurred between June 15 and July 15, 1995 through 1998. Shrubs, as well as non-vascular cryptogams, are a component of many of the sampled communities, but were not included in the calculations, as no non-native species have been reported for these categories of vegetation.

All sampling sites are associated with long-term, two-way or three-way grazing exclosures. Ten of the seventeen sites had newly constructed exclosures at the time of monitoring, and identical monitoring plots were established inside all exclosures. Since only a few months elapsed between exclosure completion and monitoring at the newly established sites, I was able to combine data from both exclosure and grazed control treatments to provide larger sample sizes for the new sites. For the seven older sites, only data from the grazed control were used (see Table 1). At three of the seven older sites, grazing exclosures had been in place long enough to warrant a comparison of native and non-native cover values between the grazed control and the ungrazed (exclosure) treatments.

There is no standard technique for monitoring grassland vegetation, and three different, but closely related, methods were used during the data collection period. Traditional Daubenmire canopy cover/cover class (Daubenmire 1959) was used at four of the 17 sites; a variant of the Daubenmire, which estimates percent foliar cover (Elzinga *et al.* 1998), was used on six; and point intercept (Bonham 1989) was used on the remainder. The two Daubenmire methods are based on making ocular percent cover estimates for each species found within a 20 × 50-cm frame. The point intercept method consists of extending a sharpened metal pin down through the vegetative canopy, and recording the number of species "hits" for each pin drop. All methods estimate the two-dimensional area of leaves and stems (cover) of each plant species encountered. These values are used as a proxy for the relative importance of each species in the sampled community. Sampling intensity is summarized in Table 2. Scale differences between the methodologies, as well as differences in total cover between sites, were eliminated by setting total herbaceous cover at each site to 100% and reporting native/non-native species data as percentages of the total.

*Grassland plant community assemblages are dynamic in time and space.*

More detail on plot layout and sampling can be found in Gayton, 2001. Vegetation cover data was entered and stored on the B.C. Ministry of Forests' Microsoft® Access-based Venus-Range software, and arithmetic manipulation (total cover and individual species cover means) was done in Microsoft® Excel.

The reference for plant identifications and place of origin (native or non-native) is Douglas *et al.* (1998a, 1998b, 1999a, 1999b, 2000, 2001a, 2001b, 2002). "Native" is a relative term, since at the end of British Columbia's last Ice Age, every plant found in the Interior valleys would have come from somewhere else (Pielou 1991). In addition, grassland plant community assemblages are dynamic in time and space, even in the absence of anthropogenic disturbance (Mueggler 1992). However, for the purpose of this paper, the following assumptions are made:

- All species that existed at the time of first European contact (circa 1800) were native to British Columbia.
- The pre-contact rate of plant species introductions and extinctions—from both natural causes and First Nations' activities—would have been extremely slow.

**TABLE 2.** Site sampling intensity

| Method | Transects per treatment | Observations per transect | Total observations per treatment |
|---|---|---|---|
| Daubenmire (foliar and canopy) | 5 | 10 | 50 |
| Point intercept | 5 | 100 | 500 |

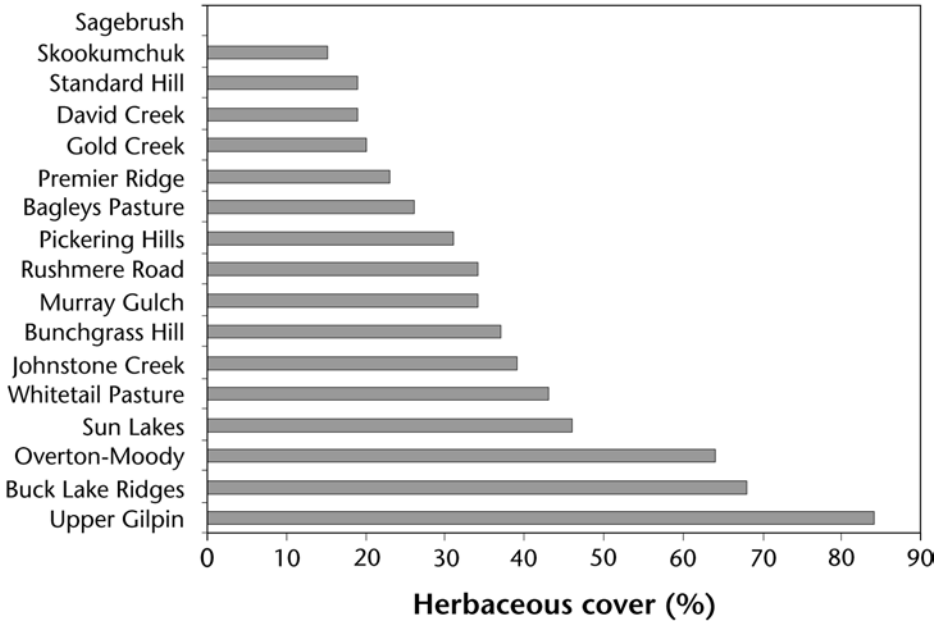


**FIGURE 2.** Non-native species as a percentage of total herbaceous vegetation cover on 17 grazed sites, southeastern British Columbia.

## Results

Cover of non-native species, as a percentage of total herbaceous vegetation cover, ranged from 0 to 84% on the 17 sites, with an average of 35% (see Figure 2).

Kentucky bluegrass (*Poa pratensis*) had the highest average relative cover value of all the non-native species and was found at 15 of the 17 sites. Other non-native species with significant cover values were Canada bluegrass (*Poa compressa*), common dandelion (*Taraxacum officinale*), the knapweeds (*Centaurea diffusa* and *C. biebersteinii*), the annual bromes (*Bromus tectorum, B. hordeaceus, B. japonicus*) and sulphur cinquefoil (*Potentilla recta*). Table 3 lists the non-native species encountered. Additional non-native species were noted during floristic surveys at each site, but only those recorded during sampling are reported here.

The total number of all herbaceous plant species per site varied from 15 to 50, with an average of 33 species per site. Total native species per site varied from 4 to 39, with an average of 25 per site.

The three sites with long-term, ungrazed treatments provided some indication of the effect of grazing on proportions of native and non-native herbaceous species cover (see Figure 3). Of the three sites, two from the East Kootenay portion of the Rocky Mountain Trench (Premier Ridge and Pickering Hills), showed little variation between grazed and ungrazed treatments over a 7-year period. However, treatments at the Murray Gulch site, located in the Kettle River drainage near Midway, varied substantially, with non-native cover increasing in the grazed and decreasing in the ungrazed treatment. Even though the starting percentage of non-native cover was similar between treatments at all three sites, management factors apparently favoured non-native species in the Murray Gulch grazed treatment.

## Discussion

The 17 sites varied greatly in degree of invasion, but with one exception all contained substantial cover of non-native species. The single site with a completely native flora, Sagebrush, had no nearby water and difficult ungulate access due to steep terrain. Two of the sites with the highest percentages of non-native species, Upper Gilpin and Overton-Moody, are both in an area that has experienced prolonged and intensive multiple-species grazing, as well as intensive human disturbance (Gayton 2002). A third site with high non-native cover values, Buck Lake Ridges, appears to be favoured by both livestock and wildlife because of its topographical position.

**TABLE 3.** Common and scientific names of non-native species encountered at the 17 monitoring sites

| Scientific name | Common name | Status[a] |
|---|---|---|
| *Apera interrupta* (L.) Beauv. | interrupted apera | |
| *Berteroa incana* (L.) DC. | hoary alyssum | R |
| *Bromus inermis* Leys. | smooth brome | |
| *Bromus japonicus* Thunb. | Japanese brome | |
| *Bromus tectorum* L. (also *B. hordeaceus, B. japonicus*) | cheatgrass | |
| *Camelina microcarpa* Andrz. *ex* DC. | littlepod flax | |
| *Centaurea biebersteinii* DC. | spotted knapweed | P |
| *Centaurea diffusa* Lam. | diffuse knapweed | P |
| *Chenopodium album* L. | lamb's-quarters | I |
| *Cirsium arvense* (L.) Scop. | Canada thistle | P |
| *Convolvulus arvensis* L. | field bindweed | I |
| *Cynoglossum officinale* L. | common hound's-tongue | P |
| *Echium vulgare* L. | viper's bugloss | R |
| *Elymus repens* (L.) Gould | quackgrass | R |
| *Euphorbia esula* L. | leafy spurge | P |
| *Hypericum perforatum* L. | common St. John's-wort | I |
| *Linaria genistifolia* (L.) P. Miller | Dalmatian toadflax | P |
| *Medicago sativa* L. | alfalfa | |
| *Medicago lupulina* L. | black medic | |
| *Melilotus officinalis* (L.) Lam. | yellow sweet-clover | |
| *Neslia paniculata* (L.) Desv. | ball mustard | |
| *Phleum pratense* L. | common timothy | |
| *Poa compressa* L. | Canada bluegrass | |
| *Poa pratensis* subsp. *pratensis* | Kentucky bluegrass | |
| *Potentilla norvegica* L. | Norwegian cinquefoil | |
| *Potentilla recta* L. | sulphur cinquefoil | R |
| *Rumex acetosella* L. | sheep sorrel | I |
| *Sisymbrium altissimum* L. | tall tumble-mustard | |
| *Sonchus arvensis* L. | perennial sow-thistle | P |
| *Taraxacum officinale* G.H. Weber *ex* Wiggers | common dandelion | |
| *Tragopogon dubius* Scop. | yellow salsify | I |
| *Trifolium pratense* L. | red clover | |
| *Trifolium repens* L. | white clover | |
| *Verbascum thapsus* L. | great mullein | I |
| *Vicia cracca* L. | tufted vetch | |

[a] Status code: P = classed as noxious within all regions of the province (Weed Control Regulation, B.C. Reg. 66/85); R = classed as noxious within specified regional districts (Weed Control Regulation, B.C. Reg. 66/85); I = invasive (Meidinger *et al.* 2004)

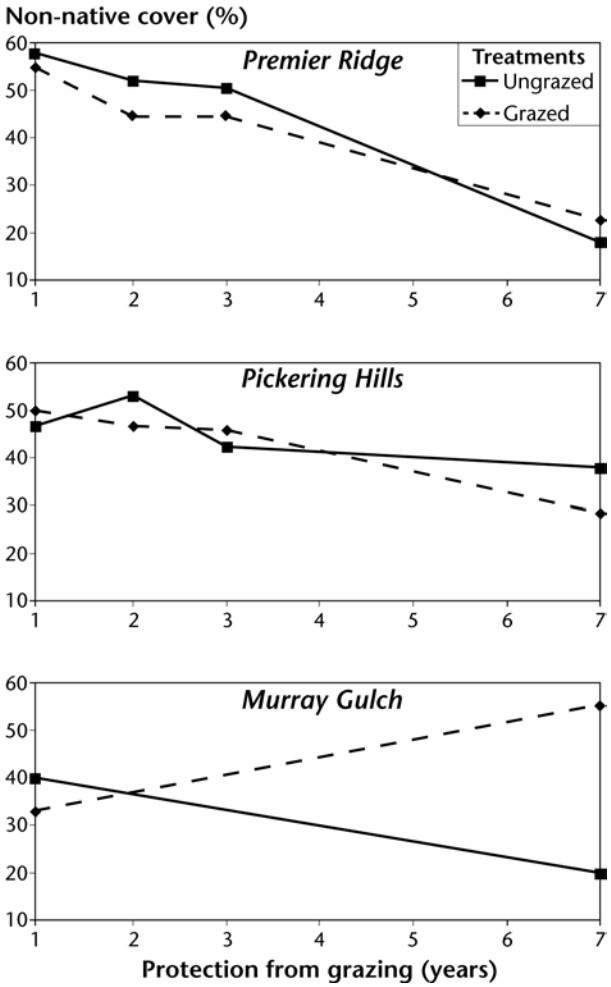


**FIGURE 3.** Trends in percentage of non-native cover in grazed and ungrazed treatments over a 7-year period at three sites. Year 1 represents first season of grazing exclusion for ungrazed treatments. The time period for Premier Ridge and Pickering Hills was 1992–1998; for Murray Gulch, 1996–2002.

The most dominant and widespread non-native species in this study, Kentucky bluegrass, bears some further examination. The origin of the species is uncertain, with some authors suggesting that both native and introduced strains can be found in North America (Moss 1996; Cronquist *et al.* 1977). Douglas *et al.* (2001) split the species into five subspecies, two of which are of interest here—*Poa pratensis* subsp. *pratensis* (a European introduction) and *Poa pratensis* subsp. *agassizensis* (native to semi-arid grasslands and forests of southeastern British Columbia). An examination of the taxonomic characteristics of 12 *P. pratensis* accessions from the regional B.C. Ministry of Forests Herbarium (five of which were from the sampled sites) put all in the subsp. *pratensis* category. This is not surprising since these sites have experienced long-term, multiple-species grazing pressure, and *Poa pratensis* subsp. *pratensis* is an "increaser species" noted for its ability to withstand heavy grazing (Harrison *et al.* 1996).

Tisdale (1982) described late seral, lightly grazed British Columbia southern interior grassland communities as being dominated by bluebunch wheatgrass, rough fescue, and Idaho fescue, with few or no non-native species present. This view is confirmed by various investigators (Eastham 1949; VanRyswyk *et al.* 1966; McLean and Marchand 1968; McLean *et al.* 1971; McLean and Tisdale 1972). However, the native bunchgrass community is very sensitive to overgrazing (Mack and Thompson 1982); once it has been degraded, reversal may be difficult. Daubenmire, in his detailed study of the adjacent steppe vegetation of eastern Washington, noted that after episodes of overgrazing, Kentucky bluegrass invaded mesic sites and cheatgrass invaded xeric sites. Both species essentially eliminated the native grasses, and did not relinquish dominance even after grazing ceased (Daubenmire 1970). Kentucky bluegrass is also reported to invade native grasslands in Nebraska and Minnesota, and cessation of grazing does not suppress it (Sather 2001).

A subsequent paper will examine the status and trends of the native bunchgrasses at these sites, but it appears the site or community "capture" process, which Daubenmire described, is at work in many of the locations surveyed in this project.

## Management Implications

The presence and extent of non-native species have a significant impact on ecological conditions and trends. Given the high percentage of non-native and weedy cover at these 17 sites, many would rate as "Early Seral" using the Potential Natural Community assessment (B.C. Ministry of Forests and B.C. Ministry of Environment, Lands and Parks 1995), or as "Poor Condition" using the Dyksterhuis (1949) methodology, even when including shrub cover in the calculation.

The variety and extent of the non-native plant presence reported on here is grounds for concern for the future ecological integrity of Crown-owned native grasslands. It is recommended that managers of these grasslands initiate periodic vegetation monitoring, and adjust grazing intensity, frequency, and duration to discourage not only noxious weeds, but all non-native plant species.

## Acknowledgements

We acknowledge funding support from the British Columbia Ministry of Forests through the Forest Investment Account, Forest Science Program, and Forestry Innovation Investment Ltd. Thanks to Rick Tucker and Anne Skinner of the B.C. Ministry of Forests, as well as anonymous reviewers, for comments on this manuscript.

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