

many people don't realize, being that their nests are less than three inches across, is that they are so easily hidden in the brush. So prior to trimming your spruce tree, hedges or brush pile, always do a thorough search for hummingbird nests, other bird nests and other signs of wildlife. Who wouldn't love finding a hummingbird nest that they could place a live camera near and record the beginnings of life for the tiniest species of bird?

Hummingbirds are also one of our pollinators, and like bees and monarch butterflies, their numbers

have drastically reduced. So I urge you if you are able to, please help these wee birds out. Having a feeder or flowers out in spring, ready for them when they arrive, is your greatest chance of attracting them. Remember, bright red colours. Even if you do not attract any over the next summer, I would urge you to still keep trying. If some birds find your garden prior to their fall migration during August or September, there is a great likelihood they will return the following spring. Sometimes it takes a couple of years to for the birds to initially find your garden. However,

let's give these little sprites a chance to make a comeback while enjoying one of the tiniest wonders of nature. They are, after all, innately unique!

*Kimberly Epp is an environmental educator/writer with more than 25 years of experience in environmental research, writing, enforcement and education, including various volunteer environmental board positions within Moose Jaw and the Moose Jaw area. She is currently President of Nature Moose Jaw, and can be contacted at kepp@shaw.ca. 🐦*

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# IMPACT OF GRAZING HISTORY ON POLLINATOR COMMUNITIES IN FESCUE PRAIRIE

**Diana B. Robson**  
Manitoba Museum  
190 Rupert Avenue  
Winnipeg, MB R3B 0N2  
drobson@manitobamuseum.ca

**Cary Hamel**  
Nature Conservancy of Canada  
200-611 Corydon Ave.  
Winnipeg, MB R3L 0P3  
Cary.Hamel@natureconservancy.ca

**Rebekah Neufeld**  
Nature Conservancy of Canada  
207-1570 18th Street  
Brandon, MB R7A 5C5  
Rebekah.Neufeld@natureconservancy.ca

## Abstract

In fescue prairie, cattle grazing can alter soil characteristics and plant communities. However, whether these alterations have a subsequent impact on pollinators has not been extensively studied. The flowering stem density and pollinator visitation patterns over the growing season at three sites

with different cattle grazing histories were documented. The most recently grazed site had higher flowering stem densities and pollinator visitations in June, but these metrics were much higher at the ungrazed site in late summer. If these differences are due to cattle grazing, it could be considered both beneficial, for increasing floral resources in spring, and detrimental, for decreasing them in late summer.

## Introduction

It is well known that grazing by large mammals can affect the composition of a plant community.<sup>1-3</sup> As grass density, particularly of Foothills rough fescue (*Festuca campestris*), tends to decrease and forb density increase with light to moderate grazing in fescue (*Festuca* spp.) prairie, it has been suggested that pollinators and other insects that feed on forbs may benefit.<sup>4-8</sup> In one study, the abundance, number of species and Shannon's diversity (i.e. an index that combines the number

of species and the evenness of their distribution) of bees all declined linearly on fescue-dominated prairie as grazing intensity increased, although some groups of bees (i.e. bumble bees of the genus *Bombus*) were more sensitive than others (i.e., sweat bees of the genus *Lasioglossum*).<sup>9</sup> Bee diversity was positively impacted by intermediate grazing on fescue-dominated grasslands in the U.S.A. as it increased the number of forb species.<sup>10</sup> However, in Alberta, grazing decreased forb diversity on fescue prairie although ultimately it appears to have no impact on the abundance and diversity of bees; differences in landscape were determined to be more influential.<sup>11</sup> Thus, the results regarding the impact of grazing on pollinators in fescue prairie so far are mixed.

Pollinators require floral resources throughout their active period.<sup>12</sup> Some species are only active as adults for a few weeks while others are active as adults from spring through autumn.<sup>13</sup> Ecosystems that lack appropriate flowers at certain times may be

unable to support healthy pollinator communities of species with long periods of adult or colony activity, primarily colonial (i.e. eusocial) species such as bumble bees and many sweat bees.<sup>12,14</sup> A lack of flowers early in the year limits the ability of wintered queens to produce a worker brood for colony initiation and growth, while low floral resources in late summer negatively affects the production of males and next seasons' queens.<sup>12,15</sup> Thus, when assessing the ability of a prairie to sustain a pollinator community, temporal variation in floral resources is an important variable to measure.

Information about how grazing in fescue prairie affects the plant-pollinator community is needed to identify a grazing management regime that is beneficial for native species. The purpose of this study was to document plant and pollinator abundance and composition at two privately owned fescue prairie conservation areas and one parcel of provincial crown land in southwestern Manitoba. Although the overall flower density and insect visitation rate was similar between the sites, there were some temporal differences over the growing season that may be due to the different cattle grazing histories.

## Methods

Three prairie conservation sites within 2.5 km of each other, just south of Riding Mountain National Park, MB (50.8305° N 100.7880° W), were surveyed. The Cleland property, which has been owned and managed by the Nature Conservancy of Canada (NCC) since 2009, was grazed by cattle the year before this study began (1 May to ~ 30 Sept. 2013) and was therefore called the "recently grazed" site. The Elk Glen property has been owned and managed by NCC as a nature preserve since 2002 and hasn't been grazed since 1997; it was referred to as the "historically grazed" site. The "ungrazed" site was a parcel of Crown land managed by the

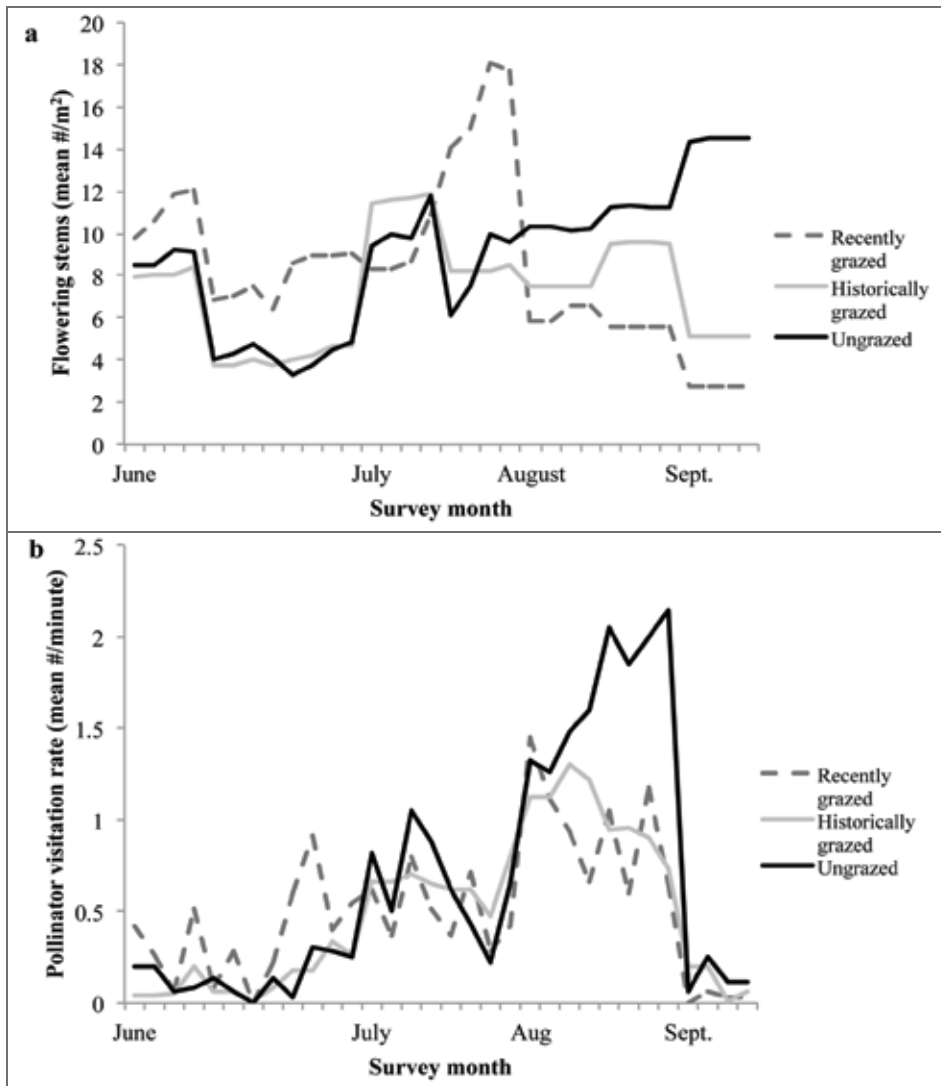
Manitoba Government for its wildlife and agricultural value. Although the exact grazing history of this land was unclear, there were no fences around it, and no fecal pats were observed, so it may have never been grazed by cattle, or was grazed a very long time ago (several decades). At the very least, no grazing has occurred on it for eight years as NCC staff had not observed any cattle on this land since they obtained the adjacent Elk Glen property.

The close proximity of the sites means that the climate, soil and landscapes were similar, although the historically grazed site was slightly drier due to the location of the plots on summits and upper slopes of hillsides. This was necessary because much of the prairie in flatter locations at this site was dominated by near monocultures of smooth brome (*Bromus inermis*). All sites contained both mixedwood forests and fescue prairie, although fescue was not necessarily the dominant grass due to some invasion by Kentucky bluegrass (*Poa pratensis*) and the presence of other co-dominant native grasses. No controlled or uncontrolled fires were known to occur at any of the sites for at least eight years so grazing was presumed to be the main land use variable.

We randomly established six plots in each of the three sites where the prairie was largely composed of native vegetation. Each plot was 2 m x 2 m in size and at least 10 m apart. In 2014, sampling was conducted for four consecutive days per site, which was repeated four times in mid-June, -July, -August and -September (16 days total). In 2015, sampling was conducted for four consecutive days per site, repeated four times at the beginning and at the end of June, in early July and in late August (16 days total). The number of flowering stems (=inflorescences) of each plant species in the plots was recorded each sampling day. Density was calculated by totaling the number of flowering

stems in each plot and dividing by the plot area (4 m<sup>2</sup>). The standard error (SE) was calculated for the overall flowering stem density to quantify the variation among the plots at each site. Voucher specimens of all plant species being visited by insects were collected and deposited in the Manitoba Museum's (MM) botanical collection.

Flower-visiting insect sampling occurred during the same days and in the same plots as the vegetation surveys: four consecutive days for four months in each of 2014 and 2015 for a total of 32 days. Each plot was surveyed for 10 minutes each sampling day, thus the total time spent surveying was 96 hours. Surveys were conducted when it was not raining, between 09:30 h and 17:00 h when insect foraging activity was likely at a maximum. The order in which the plots were visited was randomized each day. All insect visitations to any flowering stem in the plot were recorded, but the quality of the visit in terms of successful pollination of the plant was not assessed. The first time an insect was observed a voucher specimen was obtained and given a unique collection number. When the same (or what appeared to be a very similar) insect was observed later on, the collection number was used to link that insect visit to the plant. Although this technique does not allow for complete identification "on the wing" (resulting in an underestimate of insect taxa) it does enable evaluation of insect visitation frequency, which was then used to determine the visitation rate for each plant species. Using these data we determined the average visitation rate of each pollinator taxon per site over the field season. We grouped the insects into six functional groups to assess differences in composition over time and among sites: beetles (Coleoptera), butterflies and moths (Lepidoptera), flies (Diptera), long-tongued bees (Hymenoptera in the Apidae and Megachilidae), short-tongued bees (Hymenoptera in the



**FIGURE 1.** Flowering stem density (a), and pollinator visitation rate (b) at three fescue prairie sites with different grazing histories over the growing season.

Andrenidae, Colletidae and Halictidae) and wasps and ants (Hymenoptera in the Argidae, Crabronidae, Formicidae, Sphecidae and Vespidae). All insect voucher specimens were identified by qualified zoologists using reference specimens at MM and the Wallis Roughley Museum at University of Manitoba in Winnipeg, Manitoba; the specimens were deposited in MM's zoology collection. As some insect specimens could only be identified to genus, we refer to them as "taxon" not "species".

We used Analysis of Variance (ANOVA) to determine differences in flowering stem density and insect visitation rates among the sites using Analyze-it Software Ltd.

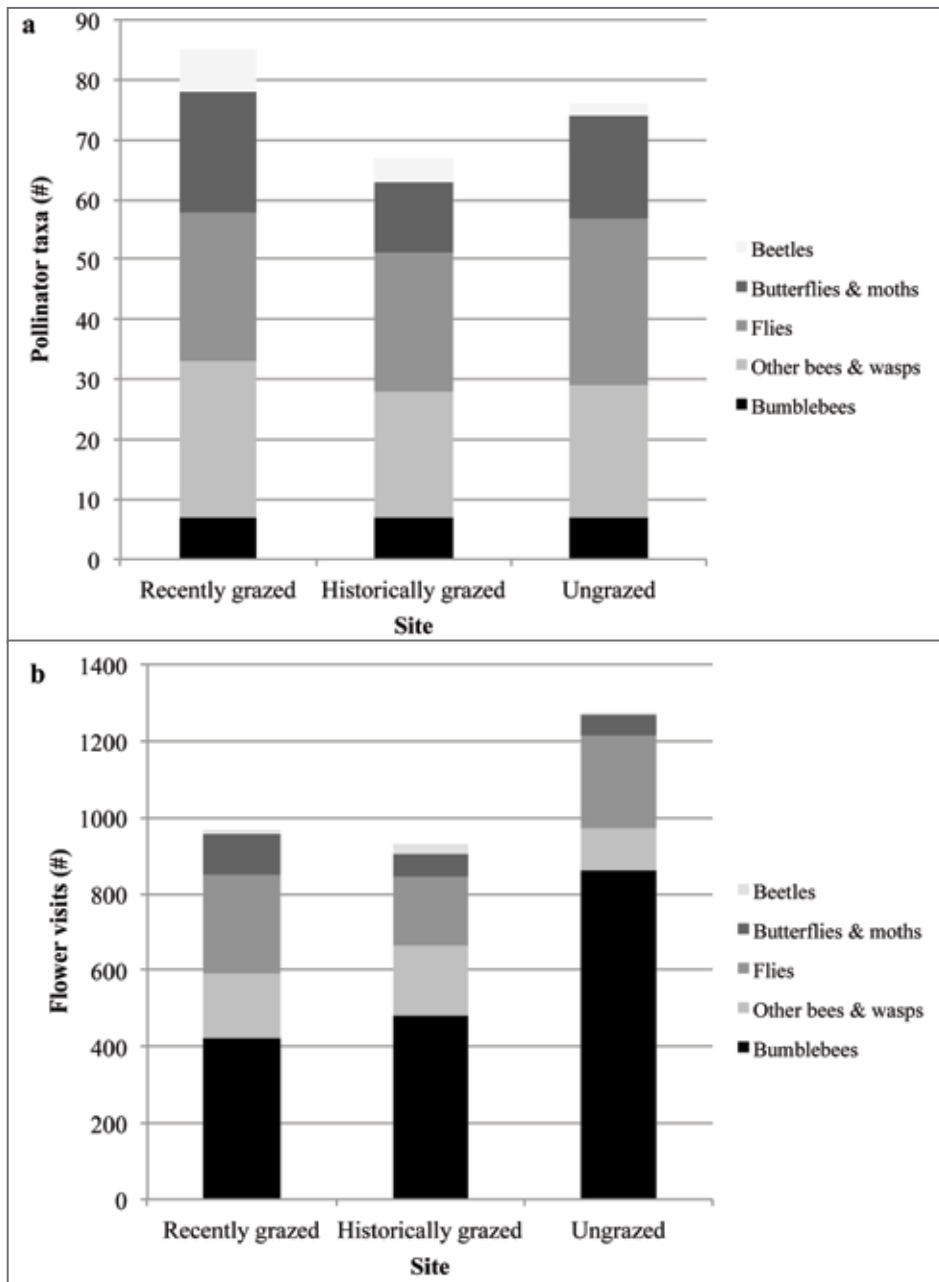
## Results

The overall average flowering stem density ( $\pm$ SE) was not significantly different between the three sites ( $F(2,573)=2.95$ ,  $p=0.08$ ) with the highest density at the ungrazed site ( $8.89\pm 1.8$  stems/m<sup>2</sup>) followed by the recently ( $8.35\pm 2.1$  stems/m<sup>2</sup>) and historically grazed ( $7.31\pm 1.2$  stems/m<sup>2</sup>) sites. Similarly, the average insect visitation rate was highest at the ungrazed site ( $0.66\pm 0.09$  visits/min) followed by the recently grazed ( $0.51\pm 0.06$  visits/min) and historically grazed ( $0.48\pm 0.09$  visits/min) sites; these rates were also not significantly different overall ( $F(2,573)=1.38$ ,  $p=0.28$ ). However, the temporal patterns were quite different (Figure 1). In June the

flowering stem density ( $F(2,213)=10.9$ ,  $p<0.0001$ ) and pollinator visitation rates ( $F(2,213)=16.13$ ,  $p<0.0001$ ) were significantly highest at the recently grazed site but by August the situation had reversed and the density ( $F(2,141)=5.47$ ,  $p=0.005$ ) and visitation rate ( $F(2,141)=8.45$ ,  $p=0.0003$ ) were significantly highest at the ungrazed site (46% of all August visits were at this site). The flower peak at the recently and historically grazed sites was in July, whereas it was in September at the ungrazed site. At all three sites, the peak of pollinator visitation occurred in August.

In terms of plant composition, field chickweed (*Cerastium arvense*) was common at the recently (1 stem/m<sup>2</sup>) and historically (0.6 stems/m<sup>2</sup>) grazed sites in June but hardly any was found at the ungrazed site ( $<0.1$  stems/m<sup>2</sup>). The most common June-flowering plant at the ungrazed site (3.6 stems/m<sup>2</sup>) was three-flowered avens (*Geum triflorum*). In August and September, the abundance of four plant species accounted for most of the differences in the average number of flowering stems between the sites: many-flowered aster (*Symphotrichum ericoides*), smooth aster (*S. leave*), rigid goldenrod (*Solidago rigida*) and showy goldenrod (*S. nemoralis*). The ungrazed site had 3.4 times as many stems of these species as the recently grazed site and 2.5 times as many as the historically grazed site.

The composition of the pollinator communities at the three sites indicated that there were some differences. The recently grazed site had more total taxa than the ungrazed and historically grazed sites but the proportions were fairly similar (Figure 2a). However, the ungrazed site had more than 300 more insect visits than the other two sites, primarily because the number of visits by long-tongued bees was much higher (Figure 2b). Almost half of all the visits by colonial bumble bees (*Bombus* spp.) observed



**FIGURE 2.** Number of (a) pollinator taxa, and (b) flower visits to six functional groups of insects at three fescue prairies with different grazing histories.

were at the ungrazed site; most of these visits (68%) occurred in August and September. Indeed ANOVA showed that the visitation rate of long-tongued bees was significantly higher at the ungrazed site in August than at the other two sites (Table 1). However, in June long- and short-tongued bees, flies and butterflies made significantly more visits at the recently grazed site than at the other two sites. Butterflies made significantly more visits overall at the recently grazed site. Significant differences between the sites were not observed

for the other two functional groups of pollinators (e.g. beetles, and wasps and ants). The short-tongued bee and butterfly visitation peaked in July but fly visitation peaked in August at all three sites. Long-tongued bee visitation peaked in July at the recently grazed site but in August at the historically and ungrazed sites.

All of the long-tongued bees and almost all of the short-tongued bees observed were polyleges, meaning they forage at a variety of flowers; only one oligolege, which specializes on alumroot (*Heuchera* spp.), was

observed (i.e. *Colletes andrewsii*).<sup>11</sup> Most of the short-tongued bees were solitary nesters (but *Lasioglossum succinipenne* may be colonial) as were half of the long-tongued bee taxa (i.e. *Anthophora*, *Megachile* and *Osmia* spp.).<sup>11</sup> However, the solitary nesting long-tongued bees were responsible for less than 6% of all long-tongued bee visits; most were by colonial bees.

## Discussion

Despite locating plots randomly at the three fescue prairie sites, differences in the flowering stem density over the growing season were apparent. At the recently and historically grazed sites the flowering peak was about a month earlier than at the ungrazed site. Further, although the sites were surveyed for the exact same length of time on the exact same days, differences in the pattern of pollinator visits over the summer occurred, with the ungrazed site receiving significantly more visits by long-tongued bees in late summer than the others. In contrast, most of the June insect visits were at the recently grazed site. This pattern was puzzling as the plots at the recently grazed site were very close to the ungrazed site (less than 30 m away) and should have been virtually identical. In three ungrazed Manitoba tall grass prairie preserves the flowering stem and pollinator visitation peaks occurred in late August to early September, similar to the pattern we observed at the ungrazed site.<sup>16,17</sup> A study in the U.S.A. also observed that the floral peak in ungrazed tall grass prairie occurs in September but that the peak in grazed prairie occurs in May; they did not provide an explanation for why this would be.<sup>18</sup> Since land use legacies can affect ecosystem function, we reasoned that some aspect of the previous land management may have altered the soil and plant community, which in turn may have affected the pollinator community.<sup>19,20</sup>

**Table 1. Monthly and overall mean visitation rates ( $\pm$ Standard Deviation) by four functional groups of pollinating insects at three fescue prairie sites with different grazing histories, and Analysis of Variance (ANOVA) test results where significant values of  $p < 0.05$  are in bold.**

INSECT VISITS (MEAN #/MINUTE $\pm$ SD)						
FUNCTIONAL GROUP	MONTH	RECENTLY GRAZED	HISTORICALLY GRAZED	UNGRAZED	MEAN	ANOVA RESULTS
Long-tongued bees	Jun	0.09 $\pm$ 0.17	0.03 $\pm$ 0.07	0.08 $\pm$ 0.19	0.20	$F(2,217)=3.42, p=0.04$
	Jul	0.65 $\pm$ 2.26	0.59 $\pm$ 2.03	0.89 $\pm$ 3.09	0.71	$F(2,144)=0.2, p=0.82$
	Aug	0.53 $\pm$ 0.67	0.76 $\pm$ 1.34	1.26 $\pm$ 1.01	0.86	$F(2,144)=6.14, p=0.003$
	Sep	0.03 $\pm$ 0.08	0.05 $\pm$ 0.03	0.12 $\pm$ 0.23	0.07	$F(2,69)=2.33, p=0.12$
	Mean	0.32 $\pm$ 4.97	0.36 $\pm$ 5.52	0.59 $\pm$ 9.19	0.42	$F(2,579)=0.52, p=0.59$
Short-tongued bees	Jun	0.05 $\pm$ 0.11	0.03 $\pm$ 0.06	0.01 $\pm$ 0.04	0.03	$F(2,217)=5.38, p=0.005$
	Jul	0.11 $\pm$ 0.38	0.21 $\pm$ 0.74	0.05 $\pm$ 0.20	0.12	$F(2,144)=1.27, p=0.28$
	Aug	0.09 $\pm$ 0.32	0.09 $\pm$ 0.31	0.02 $\pm$ 0.07	0.07	$F(2,144)=1.17, p=0.31$
	Sep	0.0 $\pm$ 0.0	0.01 $\pm$ 0.03	0.01 $\pm$ 0.04	0.01	$F(2,69)=1.19, p=0.31$
	Mean	0.06 $\pm$ 0.84	0.08 $\pm$ 0.96	0.02 $\pm$ 0.24	0.06	$F(2,579)=1.22, p=0.29$
Flies	Jun	1.2 $\pm$ 2.3	0.5 $\pm$ 1.2	0.2 $\pm$ 0.6	0.63	$F(2,217)=8.24, p=0.0004$
	Jul	0.4 $\pm$ 0.6	1.2 $\pm$ 1.9	1.1 $\pm$ 2.4	0.90	$F(2,144)=2.51, p=0.08$
	Aug	3.2 $\pm$ 3.8	1.5 $\pm$ 1.7	3.6 $\pm$ 3.3	2.77	$F(2,144)=6.20, p=0.0026$
	Sep	0.0 $\pm$ 0.0	0.3 $\pm$ 0.9	0.2 $\pm$ 0.6	0.17	$F(2,69), p=0.27$
	Mean	1.2 $\pm$ 2.6	0.88 $\pm$ 1.7	1.28 $\pm$ 2.5	1.12	$F(2,579)=2.09, p=0.12$
Butterflies	Jun	0.7 $\pm$ 1.9	0.0 $\pm$ 0.2	0.1 $\pm$ 0.4	0.27	$F(2,217)=7.95, p=0.0005$
	Jul	0.8 $\pm$ 1.5	0.8 $\pm$ 1.5	0.5 $\pm$ 1.0	0.70	$F(2,144)=0.85, p=0.43$
	Aug	0.7 $\pm$ 2.8	0.4 $\pm$ 0.7	0.4 $\pm$ 1.0	0.50	$F(2,144)=0.61, p=0.54$
	Sep	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0	n/a
	Mean	0.6 $\pm$ 1.9	0.3 $\pm$ 1.0	0.3 $\pm$ 0.8	0.37	$F(2,579)=4.42, p=0.01$

Due to the absence of recent fires, we reasoned that differences in the grazing regimes were the most likely (but not exclusively) causes of the differences we observed between the recently grazed and ungrazed sites. The differences at the historically grazed site could be partially due to grazing but also potentially moisture differences, as the slopes were steeper at that site than at the other two. Different life histories of the insects affected when their visitations peaked but cannot explain why there were significant differences between the sites in June and August.

Grazing could have impacted the vegetation both directly and indirectly. In a direct way, cattle may have preferentially consumed certain palatable forb species and avoided unpalatable or toxic plants, altering their abundance. Indirectly, grazing could have altered the soil characteristics; in fescue prairie grazing is known to reduce pH, percent organic matter, available

nitrogen and soil moisture but increase soil temperature.<sup>21,22</sup> Soil differences may have also affected nesting habitats for the insects.<sup>3,9</sup> Although we did not measure any soil variables at our sites, it is likely that the impact of grazing would be similar to what was observed at other sites in the fescue prairies. Soil temperature may be particularly influential in such far northern grasslands; soil at the grazed sites would likely have warmed up sooner in the spring due to less litter, favouring plant species that bloom in early spring. Less litter cover is also advantageous for species whose seeds are unable to germinate and grow in partial shade, such as field chickweed.<sup>4,5</sup>

Regarding pollinator visitation, they spent more time foraging at the recently grazed site than the ungrazed site in spring likely due to the greater abundance of floral resources at the former site. Short-tongued bees and butterflies were particularly abundant at the recently and historically grazed

sites foraging on small, open flowers such as field chickweed and white cinquefoil (*Drymocallis argute*). The most abundant June flower at the ungrazed site, in contrast, was three-flowered avens (*Geum triflorum*), a species that can only be accessed easily by long-tongued bees; this may explain the low percentage of visits by short-tongued bees and butterflies at this site. In July, when there was little difference in floral density between the sites, insect visitation was similar. However, by August the colonial bumble bees, which typically reach their peak abundance in late summer, spent more time foraging at the ungrazed site due to its higher floral abundance.<sup>16,17</sup> This movement of insects from the recently grazed to the ungrazed sites over the year in response to floral resource abundance explains why the pollinator composition was fairly similar between these two sites but the visitation rate different. Alternatively, the ungrazed site could instead have larger bee colonies than the two previously grazed sites.

Although firm conclusions regarding the impact of grazing on plant pollinator communities cannot be made from this study due to a lack of replication at other sites, researchers are encouraged to look closer at the temporal variation in these communities in northern grasslands. Abundant forage in spring is important for the nesting activities of queen bees but a lack of late summer forage may negatively affect bumblebee reproduction.<sup>12,15</sup> If grazing reduces or increases floral abundance at certain times of the year having large swaths of land under a single management regime (either grazed or not) may result in inadequate resources for pollinators.

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## POETRY

### A Winter Puzzle

I puzzle over thirsty bird  
outside my kitchen window.  
It's not a shrike — beak is wrong,  
colour not quite right.  
Robin-size, but longer tail,  
white wing-patches when it flies.  
Perplexed, I page  
through bird books,  
browse internet —  
a mockingbird!

**Donna Gamache**

Box 453

MacGregor, MB

(204) 685-2574

lucgam@mymts.net