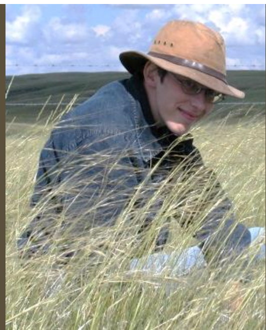

Simple Rotational Grazing System Effects

2017 EXT 17

Assessing and demonstrating effects of a simple rotational grazing system on forage production and soil fertility

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MBFI Location(s): First Street Pasture

Collaborating Partners: Jane Thornton, Farm Production Extension – Forage and Pasture, Manitoba Agriculture

Start Date: 2015 Status: Concluded

Introduction

In spring of 2015, under the direction of Jane Thornton of Manitoba Agriculture (project INT18), a 10-field simple rotational grazing system was developed at the First Street Pasture using single-strand interior electric fences and solid posts. The exterior perimeter is 4-strand barbed wire in solid posts. A shallow buried PVC pipeline with several spigots provides water to the fields, from a well at the southwest part of the pasture. This rotational system was implemented to improve the distribution of livestock use across the landscape, thereby improving efficiency of both forage growth and harvest. It now accommodates between 50 and 60 head of cattle (mix of cows and yearlings) for over 140 days from mid May to early October.

Simple rotational grazing schemes often involve only a single pass through each field during the growing season. Intensive rotational grazing systems take this a step further by dramatically increasing the number of fields (a.k.a. cells or paddocks) with the intent of concentrating livestock onto a smaller area to produce “herd effect” while providing a large proportion of time for a field to rest after use. The rotational grazing system designed for the First Street Pasture lies in between these two types of rotational grazing strategies.

Improving livestock distribution provides better nutrient distribution[1], accelerates incorporation of forage biomass into the soil in all parts of the pasture, and promotes more even regrowth of forage throughout the pasture[2], all of which can all lead to improved overall forage productivity, provided the forage supply is balanced with forage demand (i.e. not uniformly overgrazing). However, it is not necessary to adopt an intensive rotational grazing system to improve livestock utilization. This can be done simply by reducing distance to what attracts cattle most – water – either by pasture subdivision and water developments[3] or by water development alone[4]. This is the justification for the simple rotational grazing system installed at First Street Pasture.

Until 2015, some areas of the First Street Pasture had been underutilized, leading to an accumulation of old, weathered forage. Grazing stimulates soil and plant processes; it halts the tie-up of nutrients in decadent forage of underutilized grasslands that leads to diminished productivity[5]. However, we don't want to defoliate too much forage at one time: in a study in central Alberta[6], moderate levels of clipping (4" residual) produced higher total biomass, grass biomass and forb biomass than light or heavy clipping and it produced the highest crude protein yield. First Street Pasture's rotational system, with its multiple smaller fields, will confine cattle in areas they normally would not spend enough time in if they had free range over the whole pasture (i.e. approximately 50 animals over 161 ha or 398 ac). This is expected to improve the freshness of the grass in all parts of First Street Pasture, resulting in more efficient sunlight capture, better feed quality, and more biological activity in the soil.

The hallmark of the rotational system designed for First Street Pasture is that it provides each field a significant period of rest from grazing during the growing season. Effective rest is important because it allows forage plants to regrow leaf material so that they can replenish energy reserves and proceed to reproduce and maintain their existence within the stand.

No historical grazing records or forage production data were kept by the previous users of First Street Pasture. Critical components for grazing records include count of type and class of livestock, and herd entry and exit dates to and from each field. This data allows a person to calculate a standardized level of forage utilization for each grazing season; with multiple years of this data, an expectation for annual grazing capacity can be developed (subject to annual growing conditions, of course). Without past grazing records from this pasture, it was difficult for MBFI and Manitoba Agriculture to know in 2015 how many cattle should be stocked at this pasture for the expected length of the grazing season.

The Grazing Response Index (GRI) concept[7] is very useful in explaining the potential for changes to soil health, forage productivity, and pasture health with the implementation of rotational grazing at MBFI First Street Pasture. By rating three subcomponents – Frequency, Intensity, and Opportunity – of a grazing system, GRI tells us how the grazing system is likely to affect key forage plants. If a positive score is achieved, then the forage plants are expected to have benefitted from the grazing regime. If negative, they are expected to have been harmed. Better GRI scores are expected for rotational grazing systems for the following three reasons: these grazing systems reduce the repetition of grazing on any single forage plant, for a better Frequency score; they increase the amount of time for effective rest of the plants, for a better Opportunity score; finally, the amount of forage utilized is under better control in any multi-field grazing system, thereby giving control over the Intensity score. Depending on how an intensive rotational system is applied, Intensity scores can vary from positive to negative, but any negative scores are off-set by positive Frequency and Opportunity scores, potentially leading to a positive overall score, meaning benefit of the grazing system to the forage stand.

Objectives

The first of three objectives is to study and document plant productivity, composition, pasture health, and soil fertility changes through time, resulting from the implementation of a rotational grazing system. The second is to demonstrate a method for keeping grazing records to help in future grazing decisions (timing of grazing periods, herd size, start and end dates). The third and final objective is to demonstrate the Grazing Response Index method of assessing and adapting to current year's grazing management impacts.

Project Design and Methods

The first objective required manual forage harvest, plant species data collection, and shallow soil testing, followed by analyses of this data. It is necessary to start with baseline data collection so that we have a “before-and-after” comparison. To collect this data, permanent monitoring points at First Street Pasture (Fields D, E, and I) were established (Fig. 1). A Dry location and a Moist location were selected in each field for the full duration of this study.

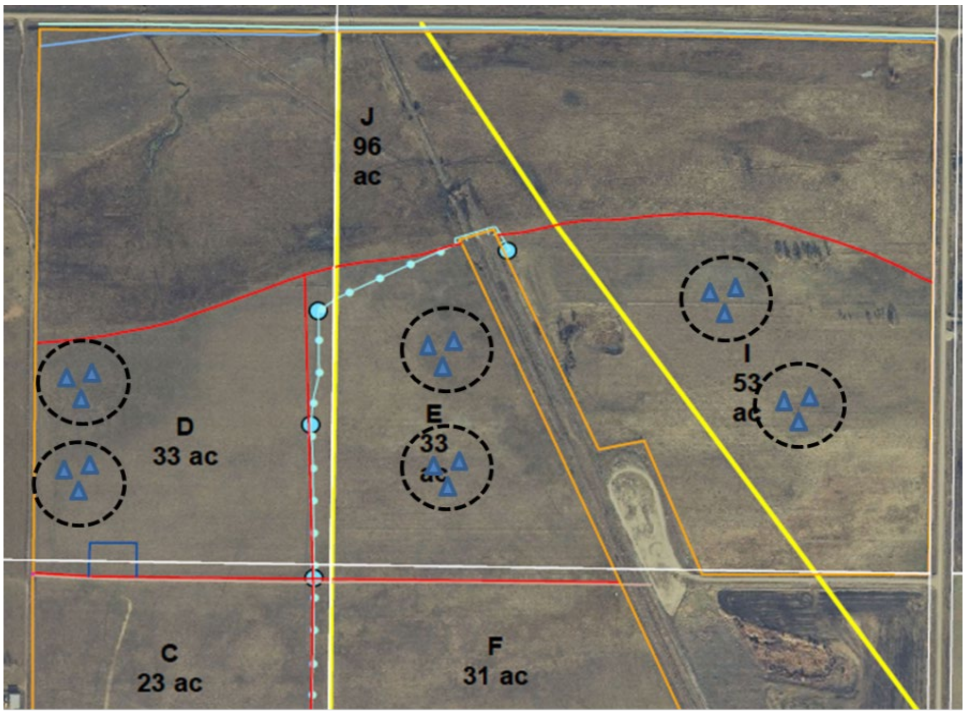

Fig. 1. Permanent monitoring areas at First Street Pasture; each triangle represents one grazing exclusion cage from which forage yield samples are taken; the dashed circle represents the vicinity from which forage composition and soil samples are taken and GRI scores are judged

Three temporary grazing exclusion cages were installed at each permanent monitoring location. They are rebar and mesh pyramids with a square, 132 cm (53”) base, fastened with 25 cm (10”) rebar pegs in each corner. Forage biomass is protected from grazing with these cages, and then collected each September, when forage has reached at least 95% of its growth. It is harvested from within a 50 x 50 cm frame placed in the center of the cage. Forage is clipped to within 2” of the soil surface. No sorting is done to partition out legumes, weeds and grass. Dead litter from previous years’ growth is removed, or a deduction is noted that represents a percentage of old growth content. This step is important to prevent inflated forage productivity values due to forage left behind in the previous year that was ungrazed. Old growth in 2015 comprised a considerable amount, ranging from 15 to 50% for the harvested plots. It was less in 2016 and 2017 (0 – 10%) due to the influence of grazing pressure and trampling.

The biomass is placed in a paper bag, and dried in a high capacity oven for 48 hours at 95°F to 100°F. It is weighed immediately afterward because it will take up moisture from the air. Weights are multiplied by 40 to give forage production value in kg/ha (multiplying this by 0.89 gives results in lb/ac). The grazing exclusion cages are moved the following spring to a patch that has received typical use by cattle in the past year. Fall re-installation is not valid because they will catch snow and bias the potential biomass production for the following year. Cages are installed in a spot that represents the area being sampled, with no set distance apart (they are typically 5 to 15 m apart).

Plant species composition was sampled on Aug. 3, 2016 to give a baseline for long-term monitoring. Each species' proportion of total biomass is estimated in the field, from five 50 x 50 cm frames placed around the cluster of grazing cages at each location. At the same time, eight indicators of pasture health were evaluated from each location according to the method set out by Adams et al. in Alberta's Rangeland Health Assessment for Grassland, Forest & Tame Pasture[8]. These indicators include representation by desirable and productive forages, representation by disturbance-induced weeds or low productivity species, amount and cover of plant litter, soil cover and erosion, and presence and abundance of noxious weeds (e.g. leafy spurge).

Soil samples (nutrient and organic matter content) were taken by Manitoba Agriculture staff on June 10, 2015, to give a baseline for long-term monitoring of soil fertility. They were pulled manually with a 32 mm soil core from the vicinity of all permanent monitoring locations, plus within the 2 fenced grazing exclosures in D and H. Five subsamples were taken from each location and composited to form a single sample for each site and for each depth. Two depths were sampled: 0 - 6", and 6 - 12", because that is where most of the nutrient and organic matter change is expected to take place (this is where the majority of the plant roots exist, with the first 6" separated out because most soil biological activity is expected to take place in that zone). Analysis was completed by AgVise. Due to expected unlikelihood of detectable and significant change in soil attributes over only a two-year duration (June 2015 to June 2017), effort and cost was not expended in taking the soil samples at the start of the third grazing season. More value will be gained from soil study after a longer duration of the new grazing system.

In order to achieve <u>the second objective</u>—the implementation of grazing records—presentations, and dialogue with MBFI staff and cooperators, were used as a means of helping people to understand how and why to record grazing data. In 2015, the grazing report form that was used for the Prairie Farm Rehabilitation Community Pastures (PFRA Pastures) was presented to the Manitoba Agriculture collaborator, and MBFI. It includes the field name, what type of animal grazed it, herd size, and entry and exit dates for this field. MBFI has made a digital form and reported on the 2016 and 2017 grazing seasons using this format, and has added additional calculations, some of which will be used for analysis in this project.

In each field, numbers of animals of each type are converted to Animal Units using conversion tables (1 cow/calf pair = 1.4 AU; 1 bull = 1.5 AU; one yearling = 0.75 AU). Where animal weights are available, they are used to determine Animal Units instead of the assumed conversion factors above, using the formula: $\text{weight(lb)}^{0.75} \div 1000\ \text{lb}^{0.75}$. Animal Units are added together for each grazing period in each field and multiplied by the number of days to give Animal Unit Days (AUD). These data can be used to calculate a standardized forage utilization level for each field, and have the potential to be a start for a long-term stocking rate data set that can be used to identify the long term sustainable grazing capacity of First Street Pasture.

In order to achieve <u>the third objective</u>, we are using the Grazing Response Index (GRI) method that has been introduced in western Canada for native pasture, and has been studied and adapted by AAFC and Ducks Unlimited in Saskatchewan for tame pasture. Basic methods are presented here and further details can be found in reading the background paper by Reed et al.[7].

The GRI score for a field in a certain year is totaled from the ratings of 3 subcomponents – Frequency, Intensity, and Opportunity – as they pertain to how grazing affects key forage plants. Scores range from -4 to +4; if a positive score is achieved, then the forage plants are expected to have benefitted from the grazing regime; if negative, they are expected to have been harmed. Consecutive years of negative scores in one field is expected to damage the health and production potential of the stand. Management decisions can be made based on these scores. A field with a negative score could gain some relief if grazing pressure or duration is shifted in following years to a field that tends to have positive scores.

Frequency represents the number of times a key forage plant could be grazed consecutively while cattle are in a field during the growing season, based on evidence that key grasses can re-grow in 7 to 10 days to a height where they can be regrazed[7]. Grazing only once (index value = +1) will positively affect plants. Grazing twice in sequence (index value = 0) would have relatively little effect. Continuing to graze 3 or more times in sequence (index value = -1) will negatively impact plants. Livestock in a field for a period of 13 days during the growing season could have grazed a key forage plant up to 2 times, generating a frequency index value of 0. We can rate Frequency at the end of the grazing season based on the grazing record.

Intensity is a measure of how much leaf material has been removed during the grazing period, and is described using three levels of defoliation – light, moderate and heavy – for index ratings of +1, 0, and -1, respectively. As GRI was designed, moderate grazing for native stands is between 40 and 55% of forage removed. Ducks Unlimited – Saskatchewan Region, in their adaptation for tame pasture, defined moderate as 61 to 85%[9]. We should rate Intensity immediately after the cattle leave the field, as it is hard to judge intensity at the end of a season for a field that was grazed early and was followed by substantial regrowth.

Opportunity relates to how much time plants have for growth prior to grazing, or for regrowth after grazing. Quality of the growing conditions while plants are resting is important to consider: if a plant is trying to recover from grazing, but it is too dry or grasshoppers are eating the plants, then that is not good Opportunity. If plants appear ungrazed at the end of the season, or if it was observed that plants had reached full growth before grazing, then the rating would be +2. Under a continuous grazing system, the site would score -2. If there was a small chance for growth or regrowth it could rate as a 0 or -1. In our rotational system, with most of the season available for forages to grow or re-grow, we would expect a rating of +2 or +1. Opportunity is deemed to be the most important of the three components and therefore has double the magnitude of the others. We can rate Opportunity at the end of the grazing season based on the grazing record, and observations of seasonal growing conditions or other growth-limiting factors such as grasshopper infestation.

Results and Discussion

It is important to keep in mind that three growing seasons is likely too small of a duration for detectable changes in the forages and soils at First Street Pasture with the implementation of this simple rotational grazing system. What this project highlights is the exercise of collecting meaningful information and data for decision-making and monitoring change.

Forage production is strongly influenced by moisture regime, as influenced by amounts and monthly patterns of precipitation, and spatial patterns of soil moisture retention. We now have three different years in terms of growing conditions (Table 1). Weather data from 2014 to 2017 at Brandon Airport[10] show that in 2015 and 2017, growing season precipitation was 28% and 41% below average, respectively, and in 2016 it was 11% greater than average (279.1 mm: Brandon Airport Station 30-year normal[11]). In 2017, growing season precipitation was quite a bit less than in 2015, but it had the benefit of 76% higher than average antecedent precipitation (September to April 195.3 mm: Brandon Airport Station 30-year normal[11]) as a result of unusually heavy September and October rainfall. Our study also tracks representative moist areas and representative dry areas in each field through all three years, although the actual moisture was not quantified in this study. The Dry monitoring sites in each field appear to be similarly very well drained throughout the three fields, but their Moist counterparts vary considerably in wetness: mesic in field D; imperfect drainage in field E; occasionally saturated in Field I.

Table 1. Precipitation regime for First Street Pasture (Brandon Airport Station)[z]

	Precipitation (mm)		
Year	Fall/Winter (Sept. to April)	Growing Season (May to Aug.)	Total Ag. Year (Sept. to Aug.)
2014/2015	136	201	337
2015/2016	193	309	503
2016/2017	343	165	508

[z]weather data from Environment and Climate Change Canada[10]

Forage production has been very responsive to moisture variation in time and space (Table 2 and 3 and Fig. 2). The contrast in production between Dry and Moist monitoring sites was very distinct in all years, but the difference among years was greatest for the Dry sites. In the wettest year, the average production in the Dry monitoring sites was more than twice their production in the drier years, but the difference among years for the Moist sites was generally less severe. Although 2017 was drier than 2015, yields were greater, most likely due to the higher moisture stored the previous fall/winter.

Table 2. Long-term forage yields at permanent dry monitoring sites at First Street Pasture[z]

Year	Field D	Field E	Field I	Average
2015	1,381 (*1,229*)	1,205 (*1,073*)	1,819 (*1,619*)	1,468 (*1,307*)
2016	3,531 (*3,142*)	3,750 (*3,338*)	2,988 (*2,660*)	3,423 (*3,047*)
2017	1,394 (*1,241*)	1,337 (*1,190*)	2,180 (*1,940*)	1,637 (*1,457*)

[z]yields measured in kg/ha (*lb/ac*)

Table 3. Long-term forage yields at permanent moist monitoring sites at First Street Pasture[z]

Year	Field D	Field E	Field I	Average
2015	4,136 (*3,681*)	4,959 (*4,413*)	4,147 (*3,691*)	4,414 (*3,928*)
2016	4,521 (*4,023*)	5,284 (*4,703*)	7,279 (*6,478*)	5,694 (*5,068*)
2017	3,845 (*3,422*)	4,745 (*4,223*)	7,165 (*6,377*)	5,252 (*4,674*)

[z]yields measured in kg/ha (*lb/ac*)

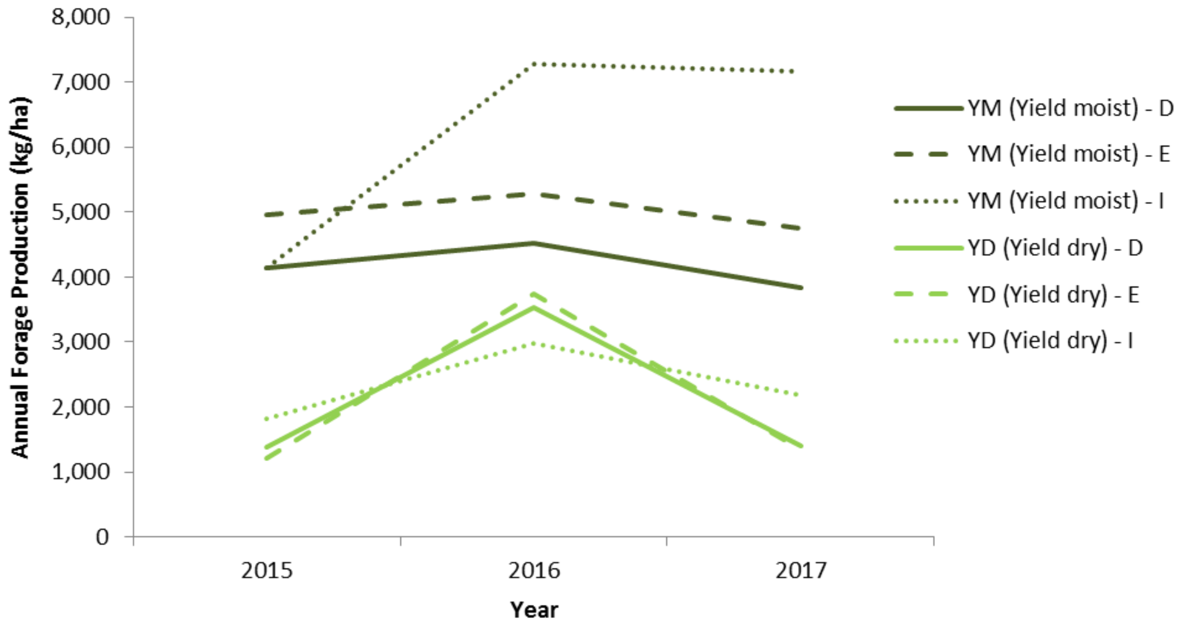

Fig. 2. Trend in annual forage production at permanent monitoring sites at First Street Pasture

Baseline species composition estimates in August 2016 (Table 4) showed that forage production at all study locations was dominated by exotic grasses (Kentucky bluegrass, smooth brome, and quackgrass). None of the locations had adequate amounts of highly productive exotic or native forages (smooth brome, quackgrass, green needle grass, or alfalfa), but Field D had the least degradation of its originally seeded composition: it had the highest abundance of smooth brome, a highly productive forage species (56 to 58%). Quackgrass, another highly productive forage species, was greatest in the Moist monitoring site of Field I, but only with 52% composition. Legume content (alfalfa, black medic, milkvetch) was inadequate, ranging from 3 to 13% of current year's growth. Leafy spurge ranges from 7 to 29% on average, or 5 to 70% on a patch by patch basis, with the lowest amounts being in field D and in the Moist monitoring site of Field I.

Table 4. Species composition at permanent monitoring sites at First Street Pasture[z]

	Field D		Field E		Field I	
	Dry	Moist	Dry	Moist	Dry	Moist
Smooth brome	56	58	26	18	34	2
Quack grass				11		52
Kentucky bluegrass	21	23	25.6	52	16	35
Junegrass			1		3	
Green needle grass			2.2			
Alfalfa				2		
Black medic	13	12	9		8	
Wild milkvetch				1	0.4	
Leafy spurge	9	7	29	15.6	21	8
Other herbs	1	0	7.2	0.4	17.6	3

[z]Values listed as estimated percentages of all forage biomass out of 100%

In the 2016 Pasture Health Assessment (Table 5), the D Field locations most closely resembled tame pastures seeded with productive forages, and thus were scored as a "Tame Pastures". The others in Fields E and I were scored as "Modified Tame Pastures" due to a shortage of seeded exotic species (smooth brome), and an increase in Kentucky bluegrass, quackgrass, leafy spurge, and/or native herbs. Only one tame pasture and one modified pasture were determined to be "Healthy". The others were "Healthy with Problems". Most deficiencies in health resulted from inadequate species composition, inadequate litter cover, and/or presence and abundance of exotic noxious weeds (leafy spurge). Minor deductions came from soil exposure and particle movement.

Table 5. Pasture health scores at permanent monitoring sites at First Street Pasture[z,y]

	Field D		Field E		Field I	
	Dry	Moist	Dry	Moist	Dry	Moist
Pasture Type	Tame	Tame	Modified Tame	Modified Tame	Modified Tame	Modified Tame
Species component	63	63	29	33	29	75
Litter component	33	100	67	100	67	100
Soil component	56	100	78	100	100	100
Exotic component	33	33	0	0	0	33
Final health score	55	78	50	63	53	83
Health rating	Healthy with Problems	Healthy	Healthy with Problems	Healthy with Problems	Healthy with Problems	Healthy

[z]After the method of Adams et al. (Alberta's Rangeland Health Assessment for Grassland, Forest & Tame Pasture)[8]
[y]All values listed as percentages of their total possible value

First Street Pasture's soils are infertile by standards for tame pasture. This is what we should expect for this pasture, with its coarse textured soils, with signs of historic cultivation, and no fertility inputs over many years (other than the small amounts added over time by small cattle herds). The 2015 baseline soil test shows very low values for nitrates, ranging from 5 to 13 lb/acre in the top 12" of soil. In the top 6", phosphorus was very low to low at 3 to 7 ppm, and sulfur was very low to moderate, ranging from 6 to 30 lb/ac in the top 12". Potassium is medium to high, ranging from 121 to 256 ppm. Organic matter levels are low compared to estimated pre-European levels in Manitoba (10 to 15%)[12]. Our organic matter values for the top 6" range from 2.6 to 5.7%.

This pasture's highest organic matter soils are in locations identified as having clay loam surface texture, and they have the highest cation exchange capacity rates. Cation exchange capacity, representing the ability of the soil to hold positively charged nutrients (calcium, magnesium, potassium, sodium, and-most other micronutrients), ranges from 12.2 to 22.1 meq, and is within expectations for the soil textures that we have. Better values would come from clay and organic matter. We can't change soil texture, so increasing organic matter is our best opportunity of increasing the soil's capacity to hold any nutrients that are added. Organic matter is also important for holding moisture, which, as we have determined above, is important for influencing forage yields.

In pursuing the second objective, MBFI has established a method for recording grazing data that includes number of head, type of cattle, and entry and exit dates for each field. We now have three years of grazing data to put towards a Historical Stocking Rate Record for each field at First Street Pasture. Table 6 is calculated based on the grazing reports provided by MBFI at the end of the grazing season. Grazing and forage production records were started in 2015 and have been useful as feedback in adjusting the stocking rates at First Street Pasture. Approximately 50 cow-calf pairs were rotated through the fields from June to September of 2015, 50 heifers plus five cow-calf pairs were rotated in the same months of 2016 with additional days in May. In 2017, based on 2015 and 2016 forage and grazing data from this project, field observations, and the growing amount of cattle owned by MBFI, the duration of the grazing season was heavily increased—approximately 32 cow-calf pairs and 26 heifers in 2017 for a heavier graze and longer duration (mid-May to early October). Operational requirements in 2017 also forced a small number of fields to be subdivided temporarily, resulting in an increase in density of animal impact in a few areas.

Table 6. Grazing summary data for primary fields at First Street Pasture[z]

Field	Grazing Days			Grazing Use (Animal Unit Days)		
	2015	2016	2017	2015	2016	2017
A	8	11	21	561	488	820
B	3	12	13	219	530	470
C[z]	8	12	21	584	526	1,119
D	11	14	14	788	665	719
E	0	4+	25	0	178	714
F	9	12	19	651	567	864
G	13	8	14	919	362	803
H	13	16	10	911	725	556
I	14	16	37	1,002	704	1,640
J[z]	5	11+	40	358	502	1,584
E + J[y]	0	9	-	-	388	-
Total	86	126	146[x]	5,993	5,635	9,285

[z]data for experimental paddocks (EXT7 and INT13) are embedded within the primary fields that they occupy
[y]the west half of J was combined with E for a second grazing rotation in 2016
[x]herds were split in mid July, resulting in more days of pasture used than the length of the grazing season

The following is an example of how the grazing and forage production records can be used to evaluate how the pasture was stocked in recent years. Forage supply was calculated in Table 7 with the following formula:

avg. forage production (kg/ha) x area (ha) x 50% use factor ÷ feed required/day (kg)

Actual feed use for First Street Pasture is pulled from Table 6 and was calculated from the grazing records based on either of the following formulas (the second formula was used in 2017):

sum of all (#head of type x Animal Unit Conversion x days in each field), where AU conversion is 1.4 for cows and 0.75 for yearlings

sum of all (#head of type x average weight (kg) of type$^{0.75}$ *÷ 455 kg*$^{0.75}$ *x days in each field)*

In 2015 and 2016 forage consumption (Bulk Feed Use in Table 7) was less than the estimated forage supply for those years. For 2017, the feed use appears to exceed the supply, but 1,584 AUD of additional supply came from Field J which is not included in the supply calculation due to its unreliability in a wet year. The forage supply for included fields is actually less due to a large proportion of each plant being rejected by cattle (i.e. stemmy and overmature). The utilization is more likely 30 to 40% (consumption only, not including trampling). General observations of the pasture in 2017 suggest that many areas were used at close to or higher than their currently sustainable capacity this year, which was a dry year.

Table 7. Comparison of forage supply and bulk feed requirements at First Street Pasture

Year	Avg. Forage Production (kg/ha)[z]	Total Area (ha)[z,y]	Utilization Factor[x]	Supply (kg)[z]	Supply (AUD)[w]	Bulk Feed Use (AUD)[u]
2015	1,468	123	50%	90,282	7,524	5,993
	1,307	*303*		*198,620*		
2016	3,423	123	50%	210,515	17,543	5,635
	3,046	*303*		*463,132*		
2017	1,637	123	50%	100,676	8,389	9,285[v]
	1,457	*303*		*221,486*		

[z]values converted from metric to (*imperial*); kg to *lb* and ha to *ac*
[y]excluding Field J which can be unreliable due to flooding
[x]actual % consumption lower due to low overall palatability; does not include trampled vegetation
[w]Animal Unit Day, equivalent to 12 kg (26 lb) of dry matter per day
[v]1,584 AUD of this amount came from Field J
[u]from Table 6.

Working towards the third objective, the grazing data and general observations from 2015 to 2017 were used to assign Grazing Response Index scores to the six permanent monitoring locations at First Street Pasture. Table 8 shows the scores for the first and last years of the study. Ideally the Intensity component of the index should have been scored immediately after each grazing period, but general observation suggests that the intensity of forage harvest from each field was conservative for 2015 and moderate for some areas in 2017. The key difference between the first and last years of grazing is the amount of effective rest (Opportunity) in each field. What is significant to note is that no components scored negatively in any of the years.

Table 8. Grazing Response Index (GRI) scores for permanent monitoring locations at First Street Pasture[z]

	2015				2017			
Study Location	Frequency	Intensity	Opportunity	GRI Score	Frequency	Intensity	Opportunity	GRI Score
Field D - Dry	0	+1	+2	+3	+1	+1	0	+2
Field D - Moist	0	+1	+2	+3	+1	+1	0	+2
Field E - Dry	+1	+1	+2	+4	+1	+1	0	+2
Field E - Moist	+1	+1	+2	+4	+1	0	0	+1
Field I - Dry	0	+1	+2	+3	0	+1	0	+1
Field I - Moist	0	+1	+2	+3	0	0	+1	+1

[z]after the method of Reed et al.[7], with modifications for intensity[9]

Using Field I as an example of how the sites were scored, in 2015, the historical grazing record shows it was grazed once for 14 days with 49 pairs in August. That amount of grazing time leaves a chance for two consecutive defoliations of any single plant, for a Frequency rating of 0. The total amount of forage removed from either of the study locations in Field I was low to moderate, for an intensity rating of +1. The field had a full chance to grow before grazing, and some time after grazing for recovery, for an Opportunity rating of +2. Overall this leaves a 2015 GRI score of +3 which is very high (maximum score is +4; minimum is -4). In contrast, Field I in 2017 was used multiple times, more heavily, and without long enough rest periods. Cattle didn't spend too much time on the Dry area, which kept Intensity down. Quality of rest periods was dependent on available moisture, and since it was a dry year, except in the Moist site, Opportunity scores were less. Overall the 2017 GRI score was +1 which is still positive and therefore this year's grazing is expected to have a positive influence on the grass.

Economic Analysis

A detailed review of expenditures of the rotational grazing system implemented at First Street Pasture will be done for project INT18, as the purpose of EXT17 is more towards defining useful ways of monitoring and discussing the changes in forage production and pasture health over the long term. Costs should include fencing supplies, watering supplies, labour to install and maintain these, labour required to move cattle among fields, and time spent keeping and reviewing records as part of planning annual adjustments to the grazing strategy. Initial set-up costs should be divided among the expected number of years before severe repairs or re-installations are needed.

Three growing seasons is likely too small of a duration for detectable changes in the forage production and pasture health at First Street Pasture, as there is considerable variability in growing conditions affecting forage production from year to year. In the future, once a change in forage production per acre as a direct result of the change in grazing management can be confidently stated, it can be compared with the long-term expenditures per acre for establishing and operating this new grazing system to arrive at a cost: benefit ratio. However, care must be taken in making sure that realistic operational costs of this grazing system are teased out from the costs of additional research activities on this pasture (e.g. labour spent moving cattle from remote fields for monthly weighing is not reflective of actual livestock production practices).

The valuation of time required for keeping grazing records and determining grazing response index scores is minimal. After several hours in initial training, and using a 10-field rotational system like the one at First Street Pasture, a producer or practitioner can expect to spend only several hours per year, from making observations in a notebook when livestock are moved (+15 min/move x 12 to 16 moves), and at the end of the season when adding the information to digital records and contemplating the long term trends.

Summary

Baseline analyses show that soil fertility and forage productivity are unsatisfactory at the First Street Pasture. Thus, some action was required to improve the value of this land for grazing, and a 10-field rotational grazing system was implemented, with associated water supply additions.

There is considerable variability in growing conditions affecting forage production from year to year, and soil fertility, forage composition and pasture health take a long time to change. Therefore, three growing seasons is likely too small of a duration for detectable changes as a result the new rotational grazing system. What this project highlights is the exercise of collecting meaningful information and data for annual decision-making and monitoring long term change.

Long term records of actual grazing rotations, weather, and annual forage production can aid in determining the grazing potential that can be achieved for any field or the whole pasture in a wet, dry, or average year. Annual Grazing Response Index (GRI) evaluations can be used to adjust grazing pressure or timing of grazing in any field, in order to help alleviate overgrazing or underutilization of forage.

Comparison of stocking rates and forage yields from 2015 to 2017 suggest that the 2017 herd size and duration of grazing may be approaching the current carrying capacity of First Street Pasture. As the pasture improves, this capacity will increase. This suggestion is only related to bulk forage—the quality and palatability of the available forage holds back individual weight gains and consumption.

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Pictures

Prior to setting up the rotational grazing system, forage in this Moist permanent monitoring site has been underutilized, First Street Pasture, June 2015; AAFC File Photo

Example of grazing exclusion cages at permanent monitoring sites, First Street Pasture, June 2015; AAFC File Photo

This Moist permanent monitoring site in Field E produced an average of 4,996 kg/ha (4,620 lb/ac) of forage from 2015 to 2017, First Street Pasture, June 2015; AAFC File Photo.

This Dry permanent monitoring site in Field I produced an average of 2,329 kg/ha (2,073 lb/ac) of forage from 2015 to 2017, First Street Pasture, June 2015; AAFC File Photo.

Fertile soils in Manitoba should be black – coarse texture and historical cultivation have limited the potential of soil at First Street Pasture, September 2016; AAFC File Photo.

Vegetation protected by a grazing exclusion cage is harvested with a 50 x 50 cm sampling frame, First Street Pasture September 2015; AAFC File Photo.