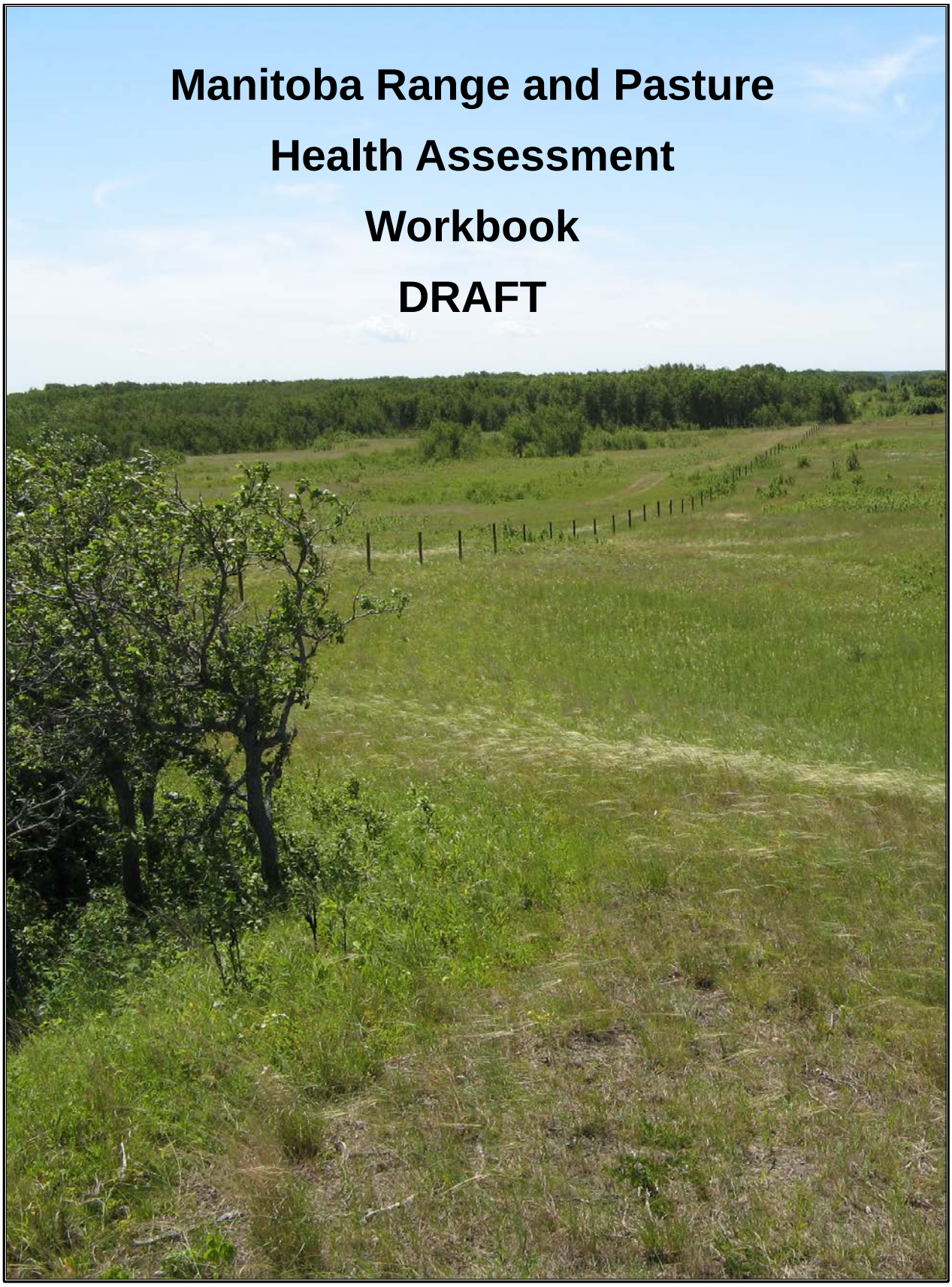
Manitoba Range and Pasture Health Assessment Workbook DRAFT



Draft Manitoba Range and Pasture Health Assessment Workbook

Native Grassland, Tame Pasture, and Forested Rangeland

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This workbook is currently only available electronically through the Manitoba Forage and Grassland Association website. Hard copies will be published at a later date.

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Development of the Manitoba Range and Pasture Health Assessment Workbook was led by the Manitoba Forage and Grassland Association.

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The Manitoba Ecosite and Rangeland Health Project Steering Committee gratefully acknowledges the reproduction of text and graphics from the Alberta Rangeland Health Assessment for Grassland, Forest and Tame Pasture Field Workbook (2016 Edition). Manitoba's workbook has been modified from this version with the permission of Alberta Environmental Protection.

Manitoba's range and pasture health assessment methodology is based on Alberta's Rangeland Health Assessment protocol with the following modifications:

The exotic plant species limit for a <u>modified</u> native grassland was reduced to 50% from 70% for the Integrity and Ecological Status - Plant Community Composition indicator, consistent with stakeholder consensus that Alberta's limit was too high and less suitable for Manitoba range and pasture conditions.

Common rangeland plants' grazing responses (decreaser, increaser and exotic invader) are provided in an Appendix to aid in determining the successional status of a community where plant community data are unavailable or insufficient.

Woody encroachment is introduced as an additional structural indicator on native and modified native grasslands with a corresponding reduction from the litter indicator. Encroachment is deemed of concern on Manitoba range and pastures by stakeholders. No other indicator was considered appropriate for scoring reductions.

Four categories are applied for scoring the native grassland Hydrologic Function and Nutrient Cycling – Litter indicator, similar to the tame grassland pattern of the Alberta Guide. The native grassland scoring of the Alberta Guide has three categories. Stakeholders sought applicable Manitoba descriptions and the addition of upper limits of litter accumulation; Alberta has no upper limit. Stakeholders agree that in many of Manitoba's ecosites, too much litter can stifle plants and show inefficiency in nutrient cycling.

The Invasive Weeds indicator is modified to consider noxious weeds designated Tier 1 and Tier 2 under Manitoba's Noxious Weeds Act, selected Tier 3 species and some additional unregulated invasive species. Alberta uses "noxious" in a generic sense, but specifies Restricted and Noxious weeds as designated in respective provincial legislation.

The citation for Alberta's Rangeland Health Assessment workbook is:

> Adams, B.W., G. Ehlert, C. Stone, M. Alexander, D. Lawrence, M. Willoughby, D. Moisey, C. Hincz, A. Burkinshaw, J. Richman, K. France, C. DeMaere, T. Kupsch, T. France, T. Broadbent, L. Blonski, A. J. Miller. 2016. Rangeland Health Assessment for Grassland, Forest and Tame Pasture. Alberta Environmental Protection - Rangeland Resource Stewardship Section.

This Manitoba Range and Pasture Health Assessment Workbook is a draft, with only the grassland health assessment completed. Health Assessments for tame and forested pasture are expected to be produced in a future draft. The Manitoba Ecosite and Rangeland Health Project Steering Committee welcomes any suggestions for improvements. Please forward your ideas and comments to the Manitoba Forage and Grassland Association.

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About This Workbook

Why Use This Workbook?

Rangeland and pasture systems are complex and diverse. Through practical field training it is possible to evaluate the health of a rangeland or pasture site accurately and consistently. This methodology provides a visual system that allows users to recognize early warning signs indicating that management changes may be needed, and to see improvements in range and pasture health over time.

Who Is This Workbook For?

This workbook is for livestock producers, land owners, resource managers, environmental consultants, students, industrial companies, protected area managers and anyone with an interest in conserving and maintaining healthy range and pastures.

What Will The Workbook Do For Me?

The workbook can be used as an aid to field training and a field reference for on-the-ground range and pasture health assessments. Health assessments provide an indication of sustainability and resiliency. Observations highlight the impacts of disturbance, indicate management issues, guide management changes and evaluate outcomes. Assessments are a snapshot in time of disturbance and/or management impacts on a particular site and provide a means of tracking and communicating successes or arising issues.

Where Does It Apply?

Although the current version provides only the grassland assessment, the workbook will be designed for application on native or modified grasslands, forest and tame pastures across Manitoba. It will help you evaluate the level of impact that disturbances are having on range and pasture health. The wording of the workbook emphasizes grazing disturbances, however any disturbance such as fire, and trails or roads, could be evaluated. It also considers the impacts of lack of disturbance.

Draft Manitoba Range and Pasture Health Assessment Workbook

Chapter One – Introduction

What are Rangelands and Pastures?

Rangeland (or range) is land supporting indigenous or introduced vegetation that is either grazed or can be grazed, and with proper management, functions as a natural ecosystem. Rangeland includes grassland, grazeable forestland, shrubland, pastureland and riparian areas.

Pasturelands, more specifically, are grazing lands that are planted primarily to introduced or domesticated native forage species, and which receive (or have received) periodic renovation treatments such as tillage, fertilization, mowing, weed or brush control and irrigation. Pastures may revert to a native or modified native rangeland when regular maintenance ceases.

Rangeland and pasture ecosystems are valued as an important source of forage for the livestock industry. Healthy rangelands and pastures also provide other important ecological goods and services that benefit all of Manitoba including wildlife habitat, water retention, fertility, and carbon storage.

This field workbook is intended as a tool to measure range and pasture health and help producers and all other users manage rangelands and pastures in a sustainable manner.

What is Range and Pasture Health?

We use the term “health” to mean the ability of rangeland or pasture to perform certain key functions so that all parts that make up the ecosystem are present and work together. Range and pasture health is akin to the health of the human body. When we are ill or under stress, important functions like circulation, immunity or cell growth may be impaired. Similarly declines in indicators of range and pasture health alert the range manager to develop alternate management strategies. For example, managers may seek to address pastures invaded by non-native plants, low forage productivity or soil erosion.

Why Does Range and Pasture Health Matter?

Healthy rangeland and pasture have the ability to respond to disturbance by resisting damage and recovering quickly. Healthy soils, diverse plant composition, and plant community structure all help to support this resiliency. Healthy rangelands also sustain a broad range of values and benefits. When range health declines so does the flow of values and benefits we might otherwise enjoy.

Healthy range and pastures help to support strong forage supply. They also provide important wildlife habitat including meeting the requirements of numerous species-at-risk. For instance certain breeding birds like short-eared owls prefer open grasslands with taller grasses and wetlands, while Sprague’s pipits favour lightly grazed native

range with few (if any) shrubs. To this end, the range and pasture health assessment may serve as a tool to assess habitat quality and to gauge desired outcomes. See Appendix A for a complete federal and provincial list of rare, threatened and endangered species in Manitoba.

The key functions of healthy rangeland and pasture (Table 1) include: net primary production, soil/site stability, capture and slow release of water, nutrient and energy cycling and plant species diversity. Healthy rangelands and pastures provide a broad range of ecological goods and services such as sustainable grazing opportunities, wildlife habitat and recreation (Table 2).

Table 1 - Functions of healthy rangelands and pastures and why they are important

Rangeland and Pasture Functions	Why Is the Function Important?
Productivity	Healthy rangeland and pasture plants use water and solar energy more efficiently for stronger growth and biomass production
	Healthy rangeland and pasture plants provide forage for livestock and wildlife
	Healthy rangeland and pasture plants provide abundant food for all life forms (e.g., insects, decomposers etc.)
Site Stability	Stable sites maintain potential productivity
	Stable sites protect soils that have taken centuries to develop
	Stable sites support stable long-term biomass production
Capture and Beneficial Release of Water	Healthy rangeland or pasture stores and filters water and release it slowly
	Captured and stored water is available for plant growth and other organisms
	Captured water results in less runoff and potential for soil erosion
	Water storage and capture enable more ecosystem stability during drought
Nutrient Cycling/ Carbon storage	Conservation and recycling of nutrients provides for healthy soils supporting plant growth
	Rangelands and pastures are thrifty systems not requiring the input of fertilizer
Plant Species Diversity	Healthy rangelands and pastures maintain a diversity of grasses, forbs, shrubs and trees – creating resilience in the event of climatic events such as drought or flood
	Diverse plant assemblages include high quality forage plants for livestock and wildlife
	Diverse plant communities support high biodiversity and abundant wildlife habitat

Table 2 - Values and benefits of healthy rangelands and pastures

Rangeland and Pasture Users	Values and Benefits of Healthy Rangeland and Pasture
Livestock Producers	Lower feed costs
	Renewable and reliable source of forage production
	Stability of forage production during drought
	Greater flexibility and efficiency for alternate grazing seasons (e.g., autumn or winter where appropriate)
	Lower maintenance costs like weed control
	No need for inorganic fertilizers and other soil amendments and additives
	Reduced noxious weed invasion
Resource Managers	Quality wildlife habitat
	Fisheries habitat
	Grazing opportunities
	Prevention of soil erosion
	Timber production
The Public	Esthetic landscape
	Watershed protection
	Water quality
	Large soil carbon sinks
	Biodiversity
	Recreational opportunities like hunting and tourism
Socio-Economics and Governance	Increased total benefits to society with fewer conflicts to resolve, less regulation and enforcement

How Is Range and Pasture Health Measured?

This range and pasture health assessment builds on the traditional range condition approach (that only considered plant community composition) by adding important indicators of natural processes and functions of healthy range and pasture.

Five main indicators are considered to arrive at a range and pasture health assessment score: 1) plant community composition, 2) structure, 3) site/soil stability, 4) plant litter accumulation, and 5) invasive/noxious weed abundance/distribution. Each indicator is weighted according to relative importance to range and pasture function. The assessor is provided with an overall health score at the end of the assessment based on a percentage – see the score sheets in Appendix B.

The indicators are rated against a site's potential − the ecological site. The Task Group on Unity and Concepts (1995) defines an ecological site as "a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation". In Manitoba, our ecological sites, called "ecosites", are differentiated from one another by a broad list of soil and landscape characteristics which include soil texture, drainage, slope, proximity to bedrock, and degree of salinity or calcareousness. All ecosites fall within broader areas called ecoregions, which are based on climate patterns resulting from geographical position and geological history.

Ecoregions and ecosites support specific types of plant communities. A reference plant community (RPC) is the climax plant community that would become established on an ecosite under current climatic conditions. Manitoba's Rangeland Plant Communities: Aspen Parkland Ecoregion is a draft document that includes plant community descriptions for the Aspen Parkland Ecoregion. It will provide further information about which plant communities may be found on different ecosites; how they may have arisen from historical grazing and land management practices; how different plant communities fit into successional pathways; and how they respond to grazing. Plant community guides for other ecoregions in Manitoba will be developed over time.

Example reference plant communities in specific ecoregions on specific ecosites may include the following:

Tallgrass Prairie Moist Loam: big bluestem, little bluestem, switchgrass, sedges, awned wheatgrass, sunflowers, goldenrods, asters, and willows.

Aspen Parkland, Sand: plains rough fescue, Hooker's oatgrass, porcupine grass, bedstraw, sunflower, pale comandra, and crocus.

Interlake Plain, Shallow to Limestone: porcupine grass, timber oatgrass, sedge, plains rough fescue, kinnikinnick, and goldenrod.

When using the plant community guides, it is important to keep in mind how plant communities change over time – otherwise known as succession. How plant

communities respond to different types of disturbance or recovery, is influenced by both natural disturbances such as fire, herbivory, and extreme weather events and human disturbances including livestock grazing or suppression of fire and of grazing. Some plant community changes are reversible but others lead to stable states that are relatively resistant to change, and are different from the reference plant community or any of its early seral states. A plant community is said to have crossed a threshold when it cannot return to a state resembling the RPC or any of its early seral states.

Key Concepts

Ecosite is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation.

Ecological functions of this health assessment guide are net primary production, soil/site stability, capture and slow release of water, nutrient and energy cycling and plant species diversity.

Ecological status is the degree of similarity between the present plant community and the reference plant community.

Ecological processes include the water cycle (the capture, storage, and redistribution of precipitation), energy flow (conversion of sunlight to plant and animal matter), and nutrient cycle (the cycle of nutrients through the physical and biotic components of the environment). Ecological processes functioning within a normal range of variation will support specific plant and animal communities.

Indicators for range and pasture health are those components of the ecosystem whose characteristics are used as an index that would otherwise be too difficult, inconvenient or expensive to measure. To illustrate, litter is an indicator of hydrologic functioning and its characteristics indexed to complete the health assessment is the amount of litter present at the site.

Range and pasture health considers the degree to which the integrity of the soil, vegetation, water, and air, as well as the ecological processes of the range and pasture ecosystem, are balanced and working together.

Rangeland plant responses to continuous and heavy disturbance, for the purposes of this workbook, are grouped as decreasers, increasers and exotic invaders:

> Decreasers are plant species that decrease in relative amount as a result of continued heavy grazing. Examples include western wheatgrass, vetchling and red-osier dogwood.
>
> Increasers are plant species that increase in relative amount as a result of continued heavy grazing; some will eventually start decreasing as this pressure continues, while others will continue increasing. Examples include blue grama, goldenrod and wolf willow.

Exotic invaders are plant species that are alien to the site but have been introduced and increase in relative amount as continued heavy grazing weakens native plants. Examples include dandelion, crested wheatgrass, lamb's quarters.

Reference plant community (RPC) is interchangeable with the term potential natural community, and is the plant community that would become established on an ecosite under current climatic conditions.

Resilience is the ability of rangelands and pastures to respond to disturbance by resisting damage and recovering quickly.

Succession refers to gradual replacement of one plant community by another over time.

Successional pathways describe the predictable pathway of change in the plant community as it recovers from disturbance over time.

Seral stages are individual steps along a successional pathway. These can be limited by environmental conditions such as soil types and climate – for example dry, sandy soils will limit tree and shrub growth even in the absence of fire or grazing. Seral stages begin at the pioneer stage of early seral, and progress upward in succession to mid-seral, then late seral and finally reference plant community or climax.

Threshold is when a plant community cannot return to its state similar to the reference plant community or any of its earlier seral states.

What Are the Indicators of Range and Pasture Health?

Range and pasture health questions are based on the following 5 sets of indicators. Answering these questions allows the manager to see whether important ecological functions are being performed.

Indicator 1 - Integrity and Ecological Status - Plant Community Composition

Plant community composition refers to all plant species present in the community – those plant species that share a common environment – and the proportions of each (relative abundance). It is a fundamental consideration in range and pasture health assessment and therefore is one of the most heavily weighted indicators. High range and pasture health scores are generally achieved with a plant community composition that is similar to, or with minor alteration from, that of the reference plant community.

Native plant communities evolve within their environment and slowly change over time as environmental factors change. Significant short-term changes in plant composition do not normally occur unless caused by significant disturbances like continuous heavy grazing, high levels of recreational traffic, prolonged drought, water inundation, periods of high precipitation, exotic species invasion, frequent burning, or timber removal.

Plant species changes due to disturbance pressures are predictable:

- Perennial species that tend to be most productive and palatable (e.g. switch grass, big bluestem and plains rough fescue) are also the most sensitive and decline with increased disturbance. Conversely, they increase with improved management.
- With overgrazing, species that are better adapted to disturbance pressure will increase in abundance because they are provided opportunities to compete successfully. Some of our undesirable invaders, like Kentucky bluegrass and creeping bentgrass, are highly tolerant of trampling and defoliation. Some of the most adapted disturbance-induced species include pussytoes, yarrow, strawberry, dandelion and foxtail barley.

Plant species changes due to lack of, or infrequent, disturbance are also predictable:

- During early stages, plant species diversity may be lost, as dominant herbaceous species become excessively abundant, including but not limited to, smooth brome, plains rough fescue or big bluestem.
- In grassland sites of Manitoba that are not limited by soil moisture deficits or shallow rooting depth, succession will proceed to shrubland or forest if these are left undisturbed over time. Disturbance, whether through grazing, mowing or a prescribed burn (or some combination), is required to manage brush encroachment.

Management objectives for maximizing range and pasture health scores tend to favor a balance of disturbance and succession − typically through moderate stocking rates and

rotational grazing management practices and/or prescribed burns − to achieve a later seral plant community or reference plant community. Later seral plant communities are superior in capturing solar energy efficiently, in cycling organic matter and nutrients, in retaining moisture, in supporting wildlife habitat and in providing the highest potential productivity. As noted above, infrequent or no disturbance reduces plant community composition as dominant species outcompete many native grassland species.

Early seral plant communities are the result of either 1) continuous damaging disturbance such as frequent heavy grazing or 2) a single event that exceeded the system's resilience such as catastrophic fire or flood. These communities have diminished ecological processes, are less stable and more vulnerable to invasion by weeds and non-native species. As a result the quality of ecological goods and services, such as forage production, wildlife habitat and water quality, is reduced.

When disturbance impacts are reduced or removed, and depending on the current health of the rangeland or pasture and environmental circumstances, the plant community may react in a number of ways:

- It may remain static.
- It may be subject to shrub or forest encroachment.
- It may move toward a number of native plant communities including the reference plant community.
- It may move to a modified plant community type. Modified plant communities are dominated by non-native species with some native species present.

Figure 1 provides a simplified example of how ecological status can be recognized on the landscape through a successional pathway commonly found on rangelands in Manitoba's Aspen Parkland Ecoregion. The reference plant community and later seral plant communities on the upper left side of Figure 1 are entirely or primarily native. Often, however, minor amounts of non-native plants may be found on Manitoba range and pasture. Rangeland managers normally strive to maintain these communities, which in the example provided, are dominated by plains rough fescue and porcupine grass. With light to moderate levels of disturbance, and relatively stable climatic conditions, the plant community may move back and forth between these upper states.

With prolonged and heavy disturbance pressures, the plant community will shift to more disturbance resistant species that are dominant at successional stages termed mid to early seral, as in the lower left hand of Figure 1. The presence and abundance of disturbance resistant species, like blue grama grass, June grass and pasture sage, will help the manager to recognize these lower stages of ecological status. Mid or early seral plant communities can be further degraded with sustained heavy disturbance pressures and become dominated by unpalatable exotic grasses such as scratchgrass

and witchgrass and low-growing forbs such as pussytoes, three-flowered avens and fleabane.

If there are invasive species present, the plant community may proceed across an ecological threshold to become a modified community dominated by species like Kentucky bluegrass, as represented on the lower right side of Figure 1. The process in this example is not always reversible as represented by the “one-way” arrow. Once the plant community has crossed this threshold, the manager must work within the limitations of the modified state, striving towards the more productive community represented in the upper right side of Figure 1. Continuously heavy or catastrophic disturbance will result in communities dominated by weedy and disturbance-induced non-native species such as dandelion and Canada thistle. With appropriate changes to rangeland and pasture management practices, it may be possible to encourage a shift to more palatable and productive non-native species, like smooth brome and quackgrass, and possibly some favourable native species. Only in exceptional circumstances, however, with the right conditions, will a plant community return towards a native-dominated community.

Other ecological thresholds often exist along successional pathways such as brush encroachment and soil physical or chemical alteration. For more detail on these pathways and thresholds please refer to the Manitoba’s Rangeland Plant Communities guide for the ecoregion that you are working in (see Reference section).

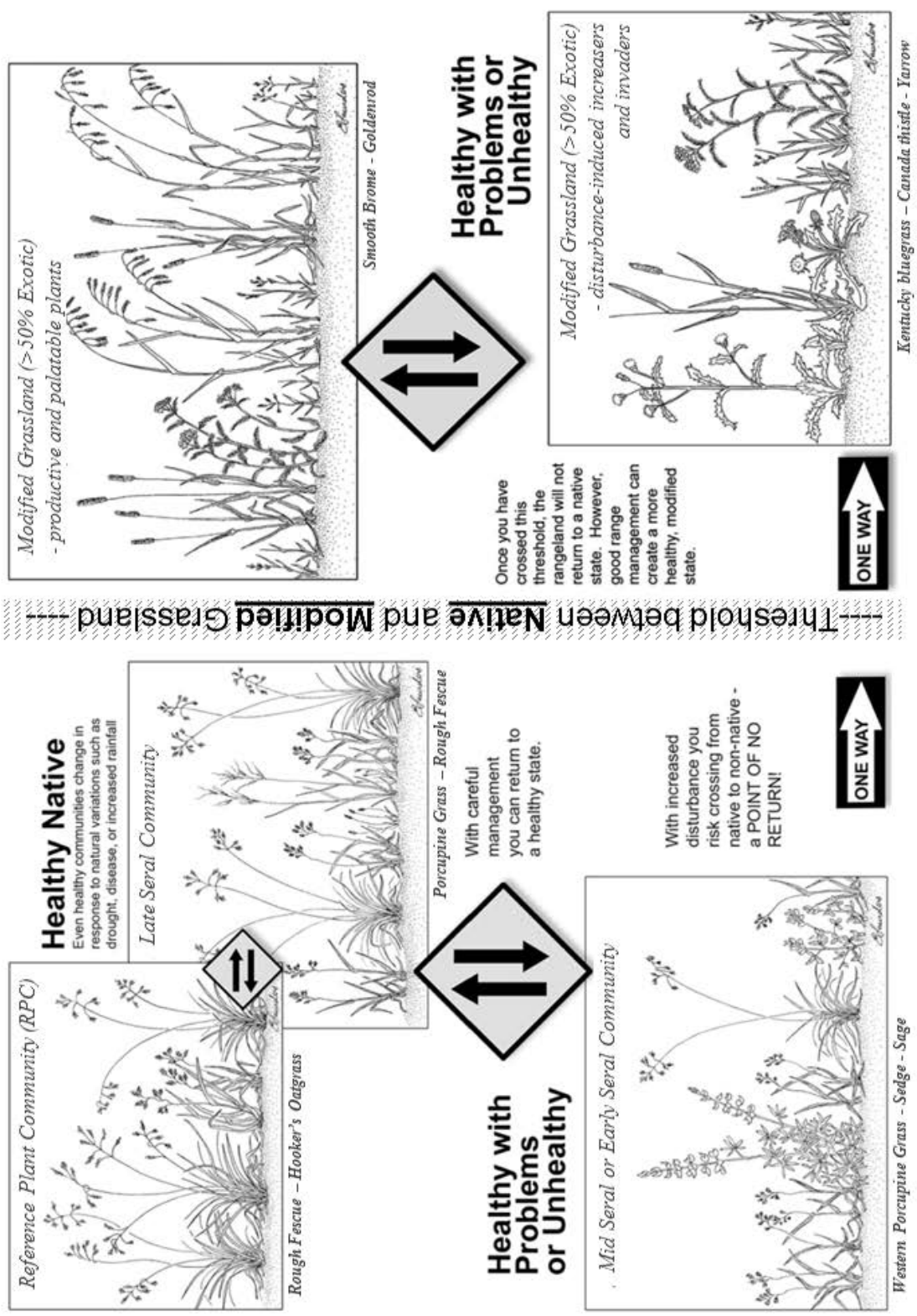

Figure 1 – Changes Among Various Native and Modified Grassland Plant Communities

Indicator 2 - Community Structure

Structure refers to plant size, height and the spread and depth of roots and branches. Healthy plant community structure has a variety of structural combinations. The greatest productivity is directly associated with the greatest diversity in structure. When plants occupy different layers, they are able to use sunlight, water and nutrients from different zones in the vegetation canopy and soil profile. Diversity in structure provides for efficient nutrient cycling and energy flow and supports forage production and wildlife habitat.

Plant community structure is particularly important in maintaining net primary production in forested rangelands. It is therefore the highest value indicator on the forest range health score sheet.

Grassland layers include moss, lichen, short and tall grasses and forbs, and shrubs. High community structure scores would typically have the same layers, with similar coverage, as found in the reference plant community. To illustrate, a Dune Sand Ecosite within the Aspen Parkland Ecoregion may feature vegetation of diverse structure: moss, little bluestem, blue grama, chickweed, sunflower, pasture sage, juniper, kinnikinnick, and wild rose.

Structural layers become reduced or absent with unsuitable levels and frequencies of disturbance or lack of disturbance. For example a continuously heavily grazed pasture will lose its taller grass and herb layers and become dominated by very low growing plant and moss layers, resulting in a low community structure score. Conversely, an area not exposed to grazing, mowing or fire will become dominated by tall layers that shade out shorter ones in the understory.

Integrated rangeland and pasture resource management objectives may require that management techniques allow for middle or lower scores for community structure. This can contribute to greater diversity in the overall landscape or heterogeneity of structure to better meet the habitat requirements for a greater variety of wildlife. As an example, structure comprised of tall and dense grasses provides cover for such wildlife species as the northern harrier. Sharp-tailed grouse, on the other hand, prefer areas of high structural diversity for nesting in proximity to areas of low or sparse vegetation for spring lekking. Additionally, some plants and invertebrates better tolerate cool, moist, shady vegetation cover, while many others tolerate warm, dry, and unshaded environments of short patches. The presence of over- and under-grazed patches allows both habitat requirements to be met in one field.

Indicator 3 - Site Stability

Rangelands and pastures show varying degrees of natural soil stability depending on climate, soil type, topography and plant cover. The amount of sediment produced naturally by water and wind erosion is termed geologic erosion. Human-caused erosion due to land management practices is an accelerated level of erosion and can be prevented by maintaining adequate vegetation cover and minimizing exposed soil. Adequate vegetation cover protects the soil surface from the impact of raindrops, detains overland flow, maintains infiltration and permeability and protects the soil surface from erosion.

Soil loss is a serious concern since erosion tends to remove the finer lighter particles like clays, silts and organic matter which are most important to soil fertility and moisture holding capacity. These particles may have nutrients (e.g. phosphorus) and contaminants (e.g. pesticides, *E. coli*) attached to them. Long term studies show that ongoing soil loss due to overgrazing or other disturbances will eventually transform the soil into a shallower, drier, less productive and less stable soil type.

To obtain high scores for this indicator, assessors look for minimal to no evidence of human-caused bare soil or erosion. The scoring excludes naturally occurring processes: some ecosites normally have some bare soil and some wind and water erosion (e.g. Dunes or Eroded Slopes ecosites), but levels of bare soil and erosion in excess of these amounts must be considered in the scoring. Naturally unstable sites tend to exhibit significant exposed soil and have shallow soil profiles, for example seepage and slumping areas, thin breaks, saline lowlands and some sandy soils.

RANGE HEALTH HINTS

Vegetation Protects Soil

- Like a tent or umbrella, vegetation protects soil from the erosive impact of raindrops.
- Most healthy rangeland plant communities are stable and normally have adequate vegetation to prevent soil erosion.
- Some rangelands like badlands, certain steep river slopes and sand dune environments have naturally occuring bare soil and erosional processes.
- On any type of rangeland, managers should strive to prevent erosion beyond the geologic or natural extent.

Indicator 4 - Hydrologic Function and Nutrient Cycling - Litter Levels

This indicator deals with abundance and distribution of dead plant material (litter) on the assessment site. Litter is the foundation for soil fertility, enabled by a soil food web containing fungi, bacteria, protozoa, and invertebrate plant residue decomposers or predators. Plant residue also promotes moisture retention and nutrient cycling. Litter (including standing, freshly fallen or slightly decomposed plant residue on the soil surface) is important for slowing runoff and creating a path into the soil, moderating soil temperatures, as well as reducing soil erosion, evaporative losses and raindrop impact. Litter removal reduces forage yields significantly in drier ecoregions and ecosites. Conversely, excessive litter accumulation can inhibit plant growth and flowering.

Plant residue on forested sites is different from grasslands, consisting of collective organic layers of litter, fermenting and humified residues above the mineral soil (shortened to LFH). LFH affects both the water and nutrient cycles, protects the soil surface, and provides habitat for fungi, bacteria and other soil microbes. It is also an important germination and rooting medium for many plants.

Manitoba growing conditions are unique. The expected minimum and maximum amounts of litter required to achieve healthy scores for this indicator are not yet developed. In the interim litter thresholds developed for Alberta serve as an estimate.

Indicator 5 - Invasive Weeds

Invasive weeds tend to be rapid-growing or rapidly reproducing plants alien to the rangeland and pasture plant community. They degrade productivity as well as threaten biological diversity and sustainability. Management and control of invasive weeds are time-consuming and expensive. Their presence indicates a threat to the health and integrity of the existing stand if left uncontrolled.

Invasive weeds typically invade where high disturbance has created niches such as bare soil. They can be less of a problem where plant vigour and cover are maintained, but some invasive weeds are highly aggressive and choke out vegetation even in well-managed healthy stands. Introduction of invasive weeds is often the result of seeds deposited along traffic and disturbed areas by various means: on the hair or in the digestive tracts of livestock and wildlife, caught on vehicles and equipment, or as a contaminant in reclamation seed (among others).

The eradication and control of most invasive weeds are regulated at the provincial level by *The Noxious Weeds Act* and *Noxious Weeds Regulation*. See Appendix A for the list of invasive weeds of greatest concern to Manitoba rangelands, pastures and riparian areas. The list includes Tier 1, Tier 2 and selected Tier 3 noxious weeds as designated by regulation, as well as additional invasive plants deemed of concern.

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Chapter Two – Getting Started with the Range and Pasture Health Assessment

How to Use the Field Workbook

The field workbook is a training and awareness tool and a guide to facilitate rapid, repeatable and consistent health assessments. Some basic training and familiarity with ecosite identification and local plant community information is required to use the workbook effectively. It is intended for producers and resource managers as a tool to identify the presence, scale and magnitude of rangeland and pasture resource issues and problems. It can also be used to measure disturbance effects and impacts of management changes as well as help formulate management objectives and practices to address specific issues.

The field workbook can be used at three levels:

Awareness - Basic training will better "tune your eye" to the elements of range and pasture health so that you can recognize general health impacts on the land.

Rapid Assessment - With study and repeated field training you can utilize the rapid assessment method provided in this field workbook.

Range and Pasture Inventory - With expert training this method can accompany a detailed inventory and assessment of the resources and management of rangelands and pastures.

Before You Go to the Field

Range and pasture health assessment requires that you understand the land that you plan to evaluate. This includes physical growing conditions, expected plant communities, history of management and various uses of the land. The Rangeland Classification for Agri-Manitoba lays out the physical conditions (ecoregions and ecosites) of land within Manitoba's agricultural areas. It gives instructions on how to predict the most likely ecosites of the land that you will be assessing and how to confirm them in the field. PDF maps of ecosites are available but will only contain the dominant ecosite. If you are able to use GIS data, the full ecosite classification is available for mapping the three most likely ecosites for most locations in the agricultural areas of Manitoba. Once the expected ecosites have been predicted, refer to the Manitoba's Rangeland Plant Communities guide for the appropriate ecoregion to determine which plant communities can be expected for those ecosites. See the Reference section for the availability of these resources.

In addition to the ecosite and plant community guides, other reference materials to help in your assessment may include:

- Soil survey reports and GIS data
- Aerial photography and other imagery
- Forest Ecosystem Classification of Manitoba field guide
- Plant and weed identification books
- Previous assessment or inventory data, pictures, maps and reports
- Previous reports on management recommendations
- Grazing data (entry and exit dates, field sizes, numbers and types of animals)
- Locations of fence lines, trails, water sources, and other infrastructure
- Climate and weather data

An interview with land owners and land management staff is always a good idea as not all considerations are documented. Anecdotal information on historical management and disturbance, grazing patterns, and management concerns can be helpful for the assessment. In addition, meeting with people on-the-ground will assist with safety and logistics.

When Should I Assess Range Health?

Generally the best assessment is achieved when plants have had time to grow and are identifiable. Different plants mature and flower on different dates. Generally most cool season species are evident by the middle of June and most warm season species by the middle of August. Cool springs and wetter or drier than average conditions will require that you modify these assessment windows.

In a grazed rangeland or pasture, timing the assessment for during or just past a grazing event will make species identification more challenging and risk biasing the assessment towards lesser palatable species, more bare soil, and temporarily reduced structure and litter. Repeated assessments over a series of years should be done at similar time periods and grazing utilization levels.

Picking and Observing Sites for Range Health Assessment

Part of the task of picking locations for rangeland or pasture health assessments can be accomplished at home or in the office. Use aerial images, ecosite and soil maps, and historical reports to map and stratify the land into units at an appropriate scale and to prioritize sampling needs. If a pasture or field has a significant, uneven distribution of weeds or woody regrowth, you may want to consider dividing the pasture into smaller assessment areas. Make initial selections of health assessment locations. The scale

and locations that you choose for the assessments will depend on your needs, constraints, and the complexity of the land.

Consider the purpose of the assessment – what do you want to accomplish? Determine the amount of time, money and labour you can apply to conduct your work.

The field workbook has been designed to assess the health of range and pasture at any scale (field or pasture, management unit or polygon). It is important to follow the principle of sampling "like-with-like" – making sure the sampling area for each health assessment is not crossing boundaries of ecosites, plant communities, and land management history. Assessment locations can be targeted: Is a chosen site an area of concern that you want to improve over time, or is it meant to be broadly representative of multiple fields in a section of the pasture, or the pasture as a whole?

In the field, you need to confirm the assignment of the ecosite. A spade or 50 cm soil probe is essential in gathering evidence of the depth to seasonal or permanent water and soil texture. Without this equipment, a seasoned observer can use topographical position, plant species, and soil surface evidence. The Rangeland Classification for Agri-Manitoba guide contains full details on how to assign the specific ecosites based on field observations.

It is recommended that you walk through a representative distance of the landscape or crisscross the plant community, management unit, or polygon to get a thorough impression of key health indicators. Some assessors will walk a fixed line containing 5 to 10 samples observed with up to 20 paces between each one. Pasture plant communities are rarely uniform or homogenous – each place that you step will have different composition, structure and cover. This patchiness affects the number of samples required to represent it, with a greater number of samples required to adequately represent the community. Usually 5 to 10 samples are needed depending on the variability among samples gathered. Make mental notes of variability before you complete the assessment. A good idea is to record information in pencil and refine as you gather more information. Variability is normal on rangelands and pastures. No matter how hard you try to assess within seemingly homogenous areas, you will find variation in the assessment parameters and other factors such as present or historical grazing pressure. Don't worry about this. What is important is that you sample across your delineated assessment area and select the "best fit" of scoring criteria.

A plotless method, visually estimating cover within the whole sample area, is less accurate than using a small number of plot frames (50 cm X 50 cm) to focus your eye and reduce bias when estimating cover. When certain plants are flowering they can seem like they make up more of the composition than they actually do. Plots can be placed along a transect or pattern crossing the assessment area (Figure 2).

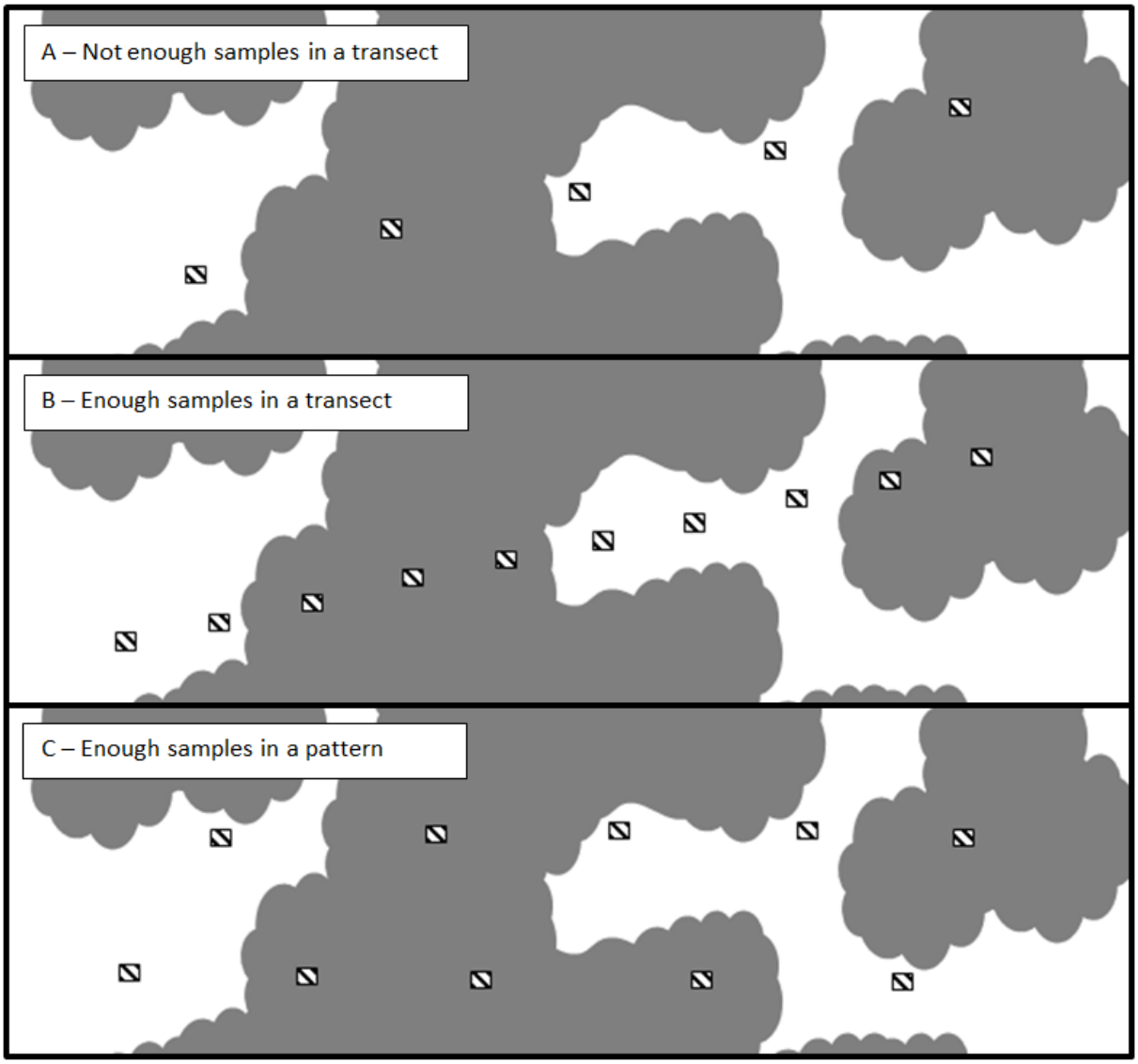


Figure 2 – Selected Quadrat Sampling Patterns in the Same Grassland Plant Community but with Patchy Grazing

How Much Time Does an Assessment Take?

This is what needs to be accomplished for each range or pasture health assessment:

- Walk or quad to the area to be assessed
- Become familiar with the area to be represented
- Confirm the ecosite assignment by gathering physical evidence
- Finalize the sampling area
- Collect the data needed to answer the indicator questions
- Score the indicators
- Collect any additional data or photographs (e.g. detailed individual weed counts, bird observations, forage clippings)

In the training phase, it may take 45 to 60 minutes just to complete the observations and indicator questions at a single site. With experience, these can be completed in much less time. Additional time will be spent travelling to and around the location, confirming the ecosite, and performing other duties or data collections at the site.

What Sampling Equipment and Resources Do I Need?

- This field workbook, a pencil and eraser, and the field score sheets in Appendix B.
- GPS receiver to navigate and record the location of the health assessment for mapping and future monitoring. Alternatively a permanent marker may be used.
- A spade or soil sampler.
- The Rangeland Classification for Agri-Manitoba guide and a Manitoba's Rangeland Plant Communities guide to identify ecosites and reference plant communities.
- A 50 x 50 cm plot frame for estimating litter amounts, plant community composition, and soil exposure. Alternatively you can use a measuring tape or string marked at 50 cm increments and nails to mark off a square of this size or you can estimate the size with your feet (boot size).
- Plant identification field guides.
- Plant litter reference kits are also an option – bags of litter that allow you to compare the site's litter to known amounts of litter in lb/ac.

Using the Range and Pasture Health Assessments and Score Sheets

Score sheets are provided in Appendix B to allow you to record the date and location of your assessment including GPS coordinates and the answers to the indicator questions. Carefully document and describe the area you have sampled for future reference. Space is provided to list dominant grasses, forbs, shrubs and trees and record the estimated vegetation cover. Plant species abundance will help you to identify the plant community.

Use Figure 3 on the next page to determine if you need a grassland, tame or forested health assessment. Currently only the Native Grassland assessment and score sheets are available for Manitoba.

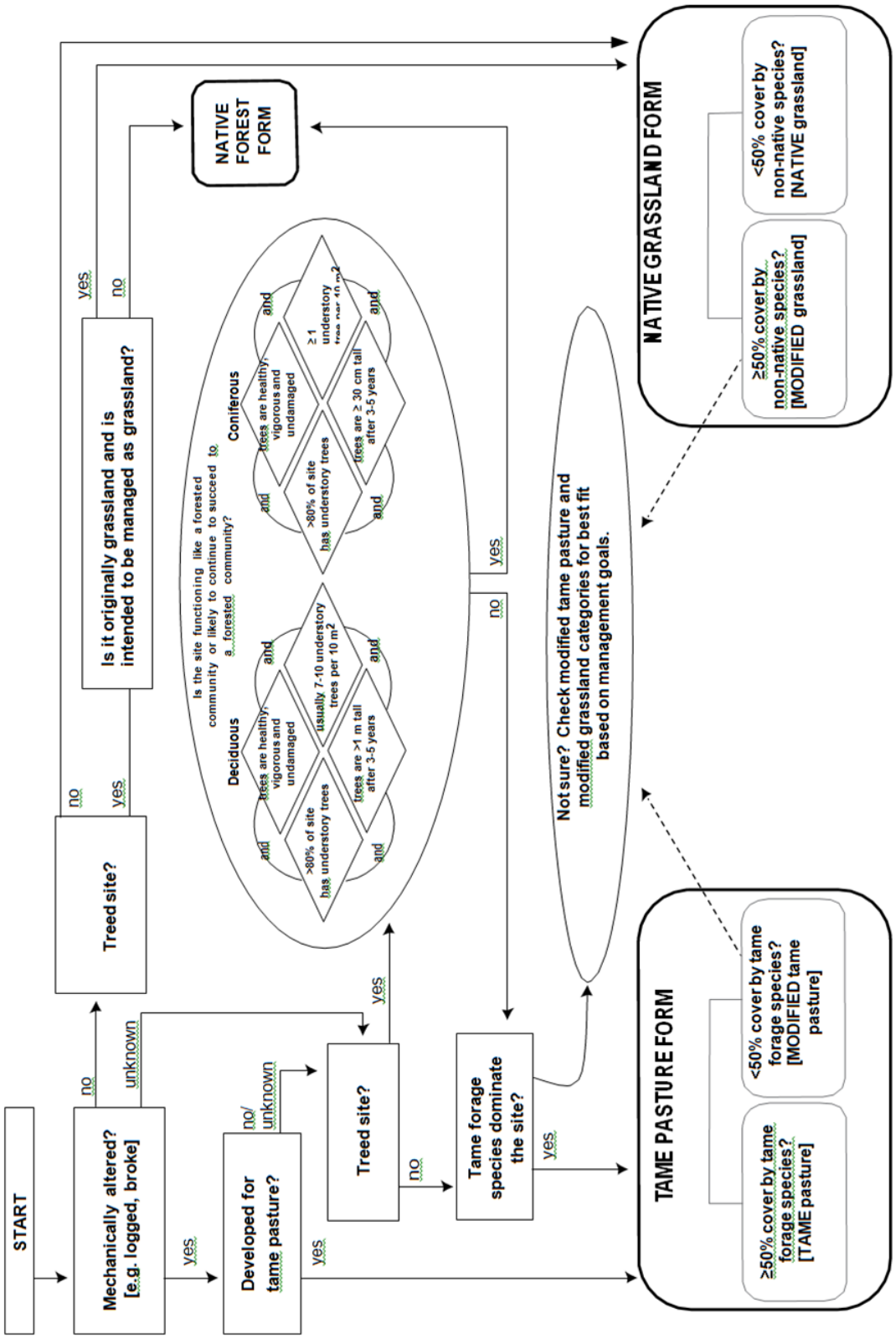


Figure 3 – Selection Guide for Grassland, Tame and Forest Assessments

Estimating Vegetation Cover and Soil Exposure

The ability to estimate the cover of plant species and the extent of soil exposure is a valuable skill for accurate range and pasture health assessment. Cover is defined as the vertical projection of the crown or shoots of a plant species to the ground surface, expressed as a percent of the area of reference (e.g. a plot frame). It can be estimated for an individual plant species, groups of plants, litter or bare soil. The total may exceed 100% because of overlapping foliage from multiple species when cover values of all individual plant species are added up. Bare soil exposure is measured by the percent of the area of reference where mineral soil is not protected by live or dead vegetation or rocks (greater than 6.4 cm or 2.5 in), from erosion by wind, mechanical movement (e.g., hoof shear), raindrop impact or overland flow of water.

Most people start out with the basic concept of canopy cover as illustrated by the white plus grey areas on the left in Figure 4 below, where a line is drawn about the leaf tips of the undisturbed canopies with this line projected onto the ground, much like an umbrella. With experience, the normal progression is to use foliar cover as illustrated on the right side of Figure 4. This workbook uses the foliar concept when assessing vegetation cover. Foliar cover is where vegetation canopy is estimated with a similar projection of the canopy onto the ground below but the spaces within the vegetation canopy are subtracted from the estimate. The score sheets have space to record cover estimates for four grasses and/or grass-likes, four forbs, four shrubs and four trees to help you establish the major components of the plant community under evaluation.

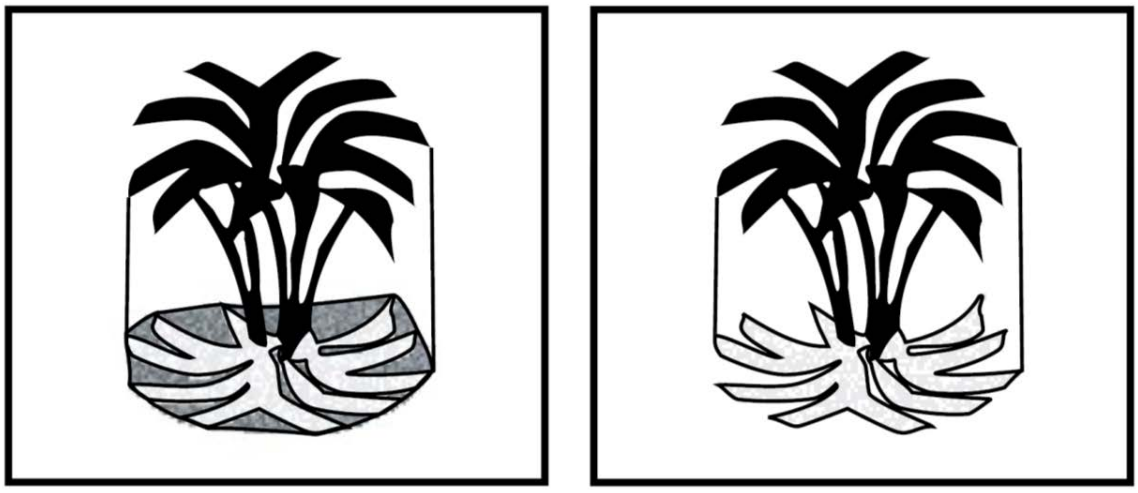


Figure 4 - Two different approaches to estimating vegetation cover are canopy (left) and foliar cover (right).

Estimating the proportions of vegetation cover or soil exposure requires training and experience to achieve repeatable observations. Everyone sees proportions in different ways. Some people think of it as slices of a pie or cake. Some people put marks on their frame to help visualize tenths or quarters of the area covered and see if they can push the covered spots into a certain area.

The size of outstanding colours can be deceptive. It is known that different colours look larger than others to the human eye (e.g. white cars look larger than black ones of the same model). It is especially difficult when the cover is in scattered amounts of odd shapes and sizes. Figure 5 demonstrates different proportions of black and white blots in a reference area.

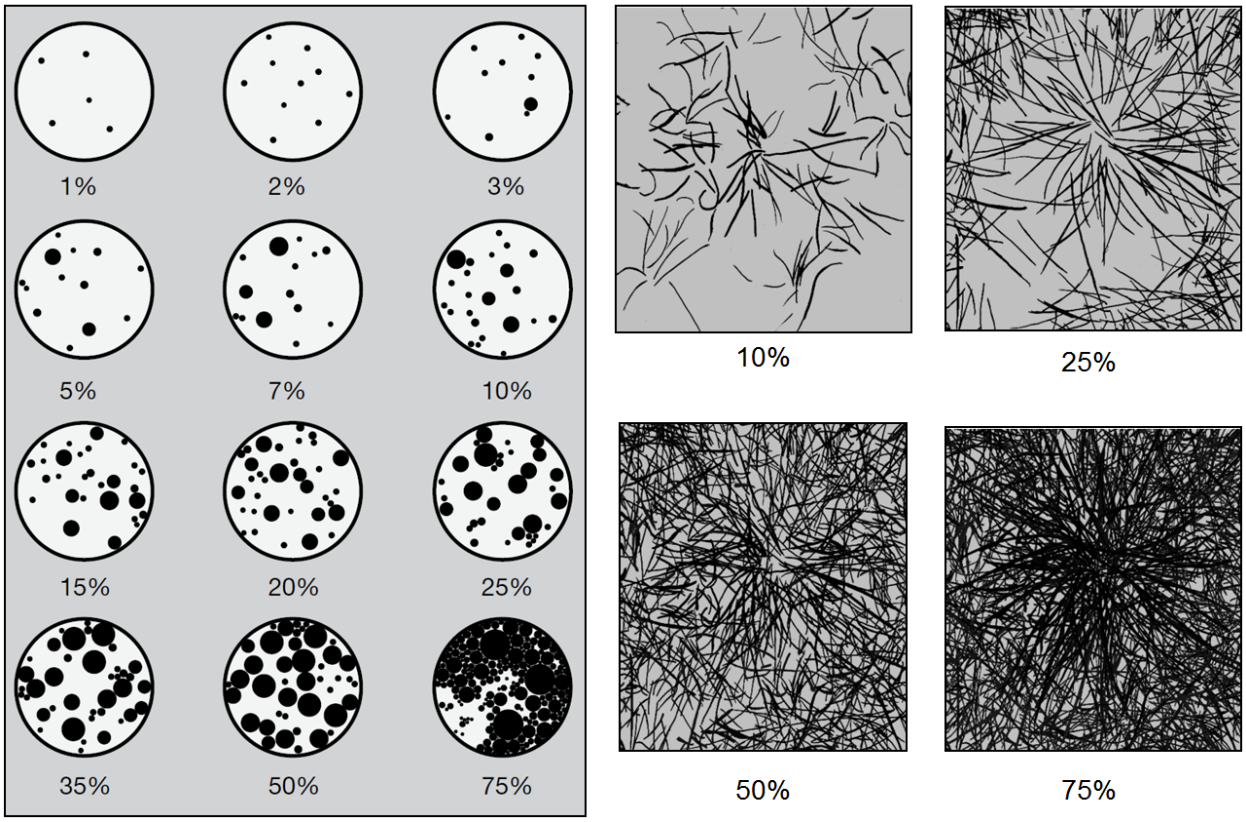


Figure 5 - Example cover percentages of black dots or lines.

Estimating Litter Amounts

This range and pasture health assessment guide recommends hand raking litter at the site and comparing it to photographs or reference bags of known litter amounts in order to determine how much litter is on the site. To make your own litter reference bags, collect some plant litter, oven dry it and weigh it into the amounts of grams which correspond to desired levels of kg/ha (grams x 40) or lb/acre (grams x 35.6) that help you to answer the litter indicator question. An example set of litter reference bag weights is shown below.

Examples of sample weights (g) from a 50 cm x 50 cm frame, converted to lb/ac:

Sample A	25.5 g	= 910 lb/ac
Sample B	21.8 g	= 780 lb/ac
Sample C	18.2 g	= 650 lb/ac
Sample D	16.4 g	= 585 lb/ac
Sample E	10.9 g	= 390 lb/ac
Sample F	7.3 g	= 260 lb/ac
Sample G	4.5 g	= 160 lb/ac

These values are the same as those portrayed by the images of litter amounts in Figure 10 in Chapter 3.

A Few Words of Caution

As with any field workbook, this is just a guide that must be used with good judgment. A complex mosaic of community types will require that you subdivide your sampling area into smaller units. In addition you may wish to make written comments to support the differences. If something does not make sense to you ask more questions and consider them carefully before proceeding.

This is the first iteration of a Draft Range and Pasture Health Assessment Workbook for Manitoba. Alberta has revised their guide at least 4 times since first printing it in 2003. We are interested in your feedback. This workbook will improve with your questions and comments. It will be an ongoing process as we strive to complete all of the assessment techniques and improve them to make this assessment method work in a real and complex world.

Draft Manitoba Range and Pasture Health Assessment Workbook

Chapter Three – Native Grasslands

Grassland Health Assessment Indicator Questions - Instructions

This assessment can be used for any grassland throughout Manitoba. Before you proceed with the assessment, be sure you have reviewed Chapters 1 and 2, including the parts on the *Indicators of Range Health* and *Getting Started*. The *Getting Started* chapter (Chapter 2) provides information on desktop preparation, site selection, ecosite confirmation, and sampling strategy. You can also find out how to estimate plant and soil cover and the amount of plant litter.

Blank score sheets are provided in Appendix B which can be used to record dominant plant species, associated cover values, indicator scores, and comments for each of the range health indicator scores. This section also includes an optional form for recording the locations, cover and distribution of specific invasive weeds. Chapter 4 can be used to learn more about what your health assessment and individual indicator scores mean and how you can incorporate this information into your land management plans.

Grassland health is measured by comparing the functioning of ecological processes on the area of rangeland being assessed to a reference plant community (RPC) of a similar type of land (ecosite). Thus this health assessment workbook is not a stand-alone tool. Some background knowledge about the ecosites and plant communities that you plan to evaluate is required. Identifying the ecosite of the land you are dealing with can be done with the Rangeland Classification for Agri-Manitoba report and the possible plant communities for each ecosite can be found in the Manitoba's Rangeland Plant Communities set of guides (see Reference section).

Indicator 1.0 Integrity and Ecological Status - Plant Community Composition

1A. How does the plant community composition compare to the reference plant community (RPC)?

1B. If the plant community is heavily modified by exotic species, is it still dominated by productive and palatable decreaser plants?

Plant community composition refers to all plant species present in the community and is determined by relative abundance, that is, the proportions of different species making up all live vegetation. Plant community composition is the most valued indicator of rangeland integrity and ecological status. It carries the most weight in a native grassland health score.

Ecological status, or stages of plant succession, is based on the dominant plant species and how they respond to disturbance. These stages are called "seral stages" and they reflect the amount of disturbance to the plant community. With practice, you can use seral stages to recognize ecological status. Review the discussion in Chapter 1 and the successional pathway illustrated by Figure 1.

The ecological status concept, as applied in rangeland management, reflects the response of different rangeland plants under continued and heavy disturbance such as overgrazing. Types of rangeland plant responses are grouped as decreasers, increasers and exotic invaders. See Appendix A for a list of commonly encountered plant species and their grazing responses.

> Decreasers are plant species of the original vegetation that will decrease in relative amount with continued disturbance. They may be highly palatable to livestock and sought out or they may lack the physiological attributes to recover from disturbance. Decreasers will make up the most cover in plant communities that are similar to, or lightly altered from, the reference plant community.
>
> Increasers are those plant species that exist in the reference plant community in small amounts, but increase in relative amount, at least for a time, under continued disturbance such as heavy defoliation, fire or drought. They may be less palatable to livestock or possess physiological attributes that allow them to recover quickly from disturbance.
>
> Exotic invaders are plant species not native to the area being assessed and that increase with disturbance or heavy grazing pressure. Often these are weedy species but they can also include tame forages like smooth brome and Kentucky bluegrass.

To assess a grassland site, first determine whether the plant community is predominately native or modified. A modified grassland is dominated by exotic invaders through one of 2 pathways: 1) invasion by aggressive exotic grasses such as Kentucky bluegrass or smooth brome or 2) having been seeded long ago to tame forages but not

regularly rejuvenated and having developed a native species presence. The objective for modified grasslands is to manage for grazing potential and other ecological functions with beneficial land management practices that encourage growth of palatable and productive plant species (both native and tame) and prevent bare soil, erosion, and undesirable forage and weedy species.

If the plant community is a **native** grassland, answer **Question 1A** which requires a comparison with the appropriate reference plant community. If you do not have a reference plant community to work with, determine the relative abundances of decreasers, increasers and exotic invaders, and their descriptions on the previous page. If the species composition is over 50% non-native, the plant community is **modified** and answer **Question 1B** which requires an evaluation of the relative amounts of palatable and productive plants.

Question 1A (If the plant community is a NATIVE GRASSLAND):

Scoring: (Some examples are provided – *Ecoregion Ecosite: dominant plants*)

40 The plant community closely resembles the reference plant community (RPC) for the ecosite. Alteration of the plant community composition from disturbances is minimal. Examples:

- *Aspen Parkland Sand: Rough fescue – Hooker's oatgrass – Porcupine grass*
- *Aspen Parkland Loam: Rough fescue – Porcupine grass*

30 Compared to the RPC, alteration of the plant community composition from disturbance or exotic invasion is apparent but light. Decreaser plants are abundant. Examples:

- *Aspen Parkland Sand: Porcupine grass – Sedge – Blue grama*
- *Aspen Parkland Loam: Western wheatgrass – Porcupine grass – Sedge*

20 Compared to the RPC, alteration of the plant community composition from disturbance or exotic invasion is moderate. Decreaser plants are common, but there is an elevated level of disturbance-induced increaser plants or invaders. In some cases, desirable, later seral grasses may be dominant or co-dominant with invasive grasses. Examples:

- *Aspen Parkland Loam: Rough fescue – Bluegrass – Bedstraw*
- *Aspen Parkland Loam: Big bluestem – Bluegrass – Western snowberry*
- *Aspen Parkland Sand: Western porcupine grass – June grass – Bluegrass*

15 Compared to the RPC, alteration of the plant community composition from disturbance or exotic invasion is significant. Disturbance-induced increasers, possibly in combination with exotic invader species, have become most abundant. (If >50% cover is non-native, the plant community is considered **modified** and answer question 1B instead). Examples:

- *Aspen Parkland Sand: Bluegrass – Porcupine grass – Sage*
- *Aspen Parkland Loam: Bluegrass – Awned wheatgrass – Strawberry*

0 Compared to the RPC, alteration of the plant community composition from disturbance or exotic invasion is severe. There is no match with the RPC. Decreaser plants are very uncommon, if present, and the community is almost entirely dominated by a combination of disturbance-induced increaser and exotic invader species. (If >50% cover is non-native, the plant community is considered **modified** and answer question 1B instead). Examples:

- *Aspen Parkland Sand: Sedge – Juniper – Sage*
- *Aspen Parkland Loam: Bluegrass – Smooth brome – Western snowberry*

***Scoring Notes for 1A*:**

For grassland plant communities, the reference plant community (RPC) is considered to be the potential natural community for the site under light grazing or disturbance. Refer to the appropriate Manitoba's Rangeland Plant Communities guide for the composition of the RPC and the other early to mid-seral plant communities for the ecoregion and ecosite that you are dealing with. Assign a score based on the most appropriate comparison with the RPC for your native grassland. The additional mid to early seral plant communities presented in the guide will help you determine the level of historical impacts of grazing or other disturbances.

Not all ecoregions in Manitoba have a Manitoba's Rangeland Plant Communities guide, so consider the relative abundances of decreasers, increasers and exotic invaders, and their descriptions. A list of these plants and their grazing responses will help - see Table 3 in Appendix A. Plant communities dominated by cover of decreaser species with minimal amounts of increaser species cover generate the best Integrity and Ecological Status score.

The reference community in grasslands is not assumed to be those plant communities that develop under prolonged periods of rest. The natural system evolved under cyclic disturbances such as fire and grazing and needs these disturbances to be healthy. Prolonged rest allows a few competitive grass species to become dominant and to shade out other grasses and forbs that are important in the plant community.

Question 1B (If the plant community is a MODIFIED GRASSLAND):

Scoring:

15 Site is dominated by palatable and productive species. These plants are vigorous with tall stems, large healthy leaves and reproductive as evidenced by seed stalks. Examples:

- *Smooth brome – Bluegrass – Western snowberry - native forbs*
- *Smooth brome – Bluegrass – Needle and thread grass – native forbs*

8 Site is a mixture of palatable/productive and weedy/disturbance-induced non-native species. Productivity is reduced due to the abundance of lower quality species. The most palatable plants show evidence of reduced vigour (e.g., shorter stems, smaller leaves and reduced seed heads). Less palatable plants are generally vigorous. Examples:

- *Bluegrass – Rough fescue - Bedstraw*
- *Bluegrass – Rough fescue – Awned wheatgrass*

0 Site is dominated by weedy and disturbance-induced non-native species. All remaining forage plants have reduced vigour. Examples:

- *Example: Dandelion – Plantain – Absinthe*
- *Bluegrass – Sedge – Goldenrod*
- *Bluegrass - Dandelion*

***Scoring Notes for 1B*:**

To function well, modified grasslands must be dominated by desirable species with all other health parameters receiving top health scores. A healthy score for a modified plant community recognizes that despite changes in the plant community's integrity, the site is being managed as well as can be expected based on current knowledge.

The maximum score is less for a modified plant community than a native community. A healthy modified plant community is not equal in ecological function to a healthy native plant community. While many introduced species have fair to good value for forage, litter accumulation, water capture, and nutrient capture, they may be shallow-rooted and/or possess traits that allow them to outcompete native species resulting in a loss of diversity. For example, Kentucky bluegrass and smooth brome hold a competitive advantage against native species and may take over a site through improper management or idleness.

Indicator 2.0 Plant Community Structure and Woody Encroachment

2.1 Are the expected plant layers present?

2.2 Is the site subject to brush encroachment?

Grasslands normally have a diversity of plant species that vary in size, height and rooting depth – moss, lichen, grasses, forbs and shrubs. This characteristic of plants to grow in different layers is called structure. When plants occupy different layers, they are able to use sunlight, water and nutrients from different zones in the vegetation canopy and soil profile – see block 1 in Figure 6 on the next page. In some cases, land managers will prefer a diversity of vegetation structure – of different ages and heights – that can be achieved with a patchy disturbance regime (some patches of light disturbance and some with heavy disturbance). Always compare structural layers to the reference plant community in your Manitoba's Rangeland Plant Communities guide.

Structural layers in grasslands may include:

- low shrubs
- tall graminoids and forbs
- medium graminoids and forbs and
- ground cover (graminoids, forbs, moss, lichen)

Determine the structural layers expressed in the reference plant community. Look for the presence and amount of these layers – not the species – in the community that you are assessing. This applies to a modified community as well. For example where the RPC is dominated by big bluestem which is a relatively tall grass, but now dominated by a vigorous stand of timothy and brome, it still has a tall grass layer and would get credit for that tall layer. Do not include invasive weeds as a layer. Keep in mind that if one structural layer expands too much, it will reduce the presence of the other structural layers, and marks will need to be deducted. For example if a reference plant community has 25% cover of a short grass layer, but it is reduced or missing due to shading from tall species at the assessment site, then short grass will be considered reduced or absent.

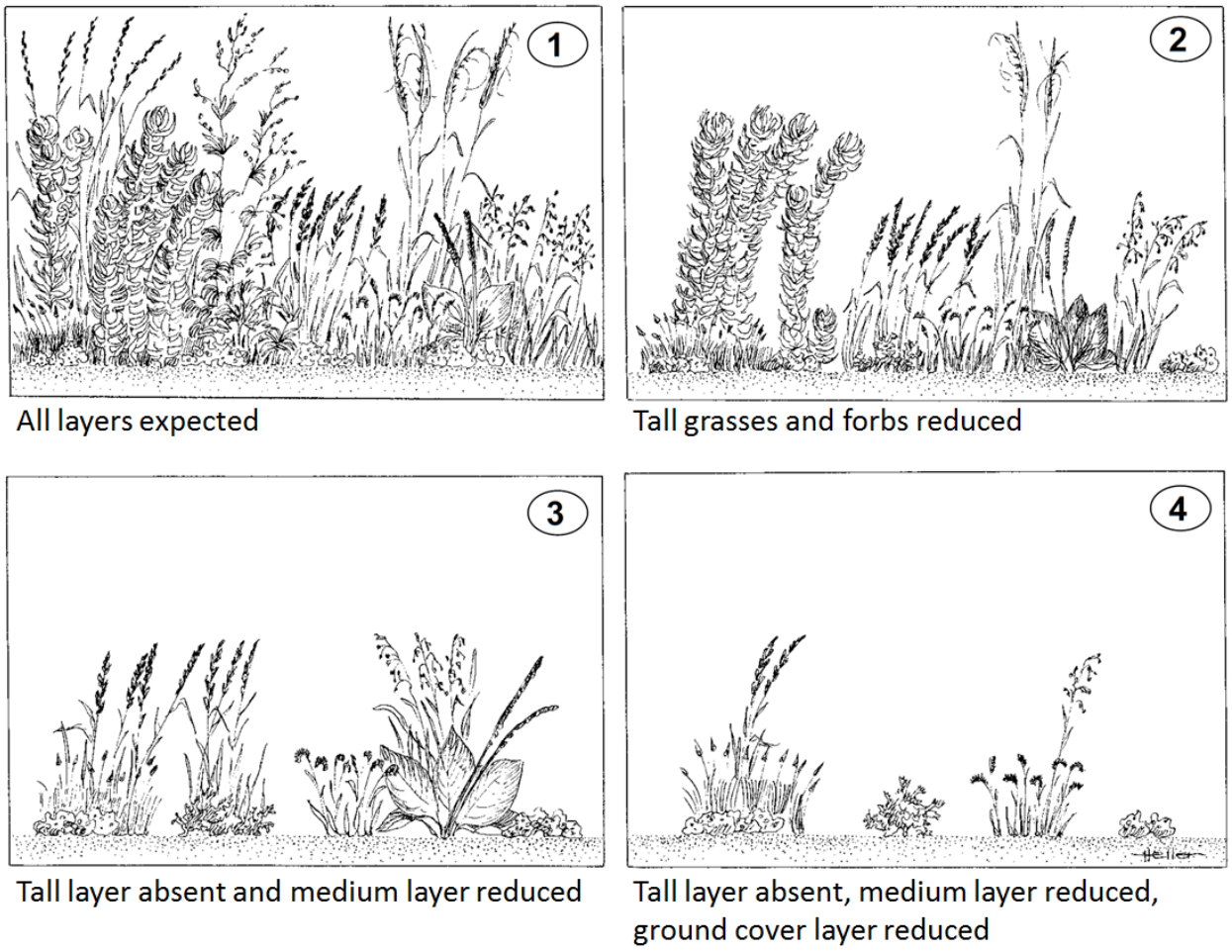


Figure 6 – Changes in Plant Community Structure as Disturbance Levels Increase

Some grasslands, especially ones on moister ecosites, naturally succeed to woody species, and rely on fire or grazing to keep them at low levels. However, if woody growth takes over grasslands, it can result in losses both in terms of plant community diversity and available forage. It also reduces habitat available to grassland species that depend on open areas. In Manitoba, trembling aspen, balsam poplar, oak, hazel, willow, wolf willow, and western snowberry pose significant challenges for land managers. Due to reduced light from woody species, grassland species will be replaced by shade tolerant brush and herb species. Brush encroachment diminishes grazing capacity of grasslands and overcomes the good intentions of setting aside grasslands in protected areas.

On the other hand, woody species may serve to meet some land management goals. Aspen bluffs and buffers support wildlife habitat and provide shade for livestock. They help to maintain forage supply during dry years. Woody cover is especially important for the health and function of riparian areas.

Question 2.1 Plant community structural layers

Scoring:

10 The structural layers closely resemble the reference plant community (RPC).

7 Compared to the RPC, one life form layer is absent or significantly reduced.

3 Compared to the RPC, two life form layers are absent or significantly reduced.

0 Compared to the RPC, three life form layers are absent or significantly reduced.

Question 2.2 Woody vegetation

Scoring:

5 Woody vegetation is either absent, or present in expected cover amounts, compared to the reference plant community (RPC).

3 Woody vegetation is newly present or exceeds expected RPC levels by up to 15% cover.

0 Woody vegetation exceeds expected levels by over 15% cover.

Scoring Notes for 2.1

Use cover of major structural layers from the appropriate reference plant community in the Manitoba's Rangeland Plant Communities guide to answer this question. If this is not available or inadequate, review past assessments or inventories and other historical data or photographs, or compare adjoining moderately grazed areas to gain an understanding of expected plant layers. Where possible, compare the unit to similar sites in the area under different management or exclusion. Keep notes of the variety of species, life forms and age classes as you move across the unit and compare to the available data.

"Significantly reduced" implies that the structural layer is reduced by more than 50% compared to the reference plant community. If two layers show moderate reduction (25 to 50%), then reduce the score by only one category. If four layers show moderate reduction (25 to 50%), then reduce the score by only two categories.

If you think a structural layer is reduced, look to see if it has reduced vigour, is under stress, or is heavily browsed (low shrubs are squared off; taller shrubs are umbrella-shaped; 2nd year and older wood has been browsed).

If you are unsure how many structural layers should be present, check for grazing impact on the plants, especially shrubs. Browsing of unpalatable shrubs such as snowberry usually indicates more desirable shrubs have been reduced or eliminated by grazing or browsing. Conversely greater shrub encroachment may indicate

management efforts may be required and should be noted in the comments section.

Note that moss and lichens are important diagnostic layers. These layers can be reduced by trampling (hoof impact), recreation or excessive shading (non-use with heavy litter build up).

When a natural disturbance removes a structural layer, note the missing layer in the comments section and the likely cause, which could relate to insect damage, drought, fire, decadence, but don't downgrade the score.

If one layer appears to be more abundant than expressed in the RPC, confirm whether or not other layers may be reduced by this expansion.

In a modified plant community, agronomic grasses may be rated if they express as an expected structural layer. Do not rank invasive weeds as a structural layer because their contribution to functional structure is minimal and their presence may be short lived. Invasive weeds are listed in Table 4 in Appendix A.

Some site management goals may require that you manage for lower structural scores:

- to maintain the ratio of grassland: shrub: forest cover in the transition area between the grasslands and the boreal forest
- to maintain patch diversity for prairie breeding birds and other wildlife or plants (e.g. grazing practices adapted to reducing taller layers on a portion of the landscape)
- to manipulate woody cover adjoining certain riparian areas

Scoring Notes for 2.2

In this question the cover is estimated using absolute cover. Consider the total area being assessed and determine the actual percent of this area that is covered by woody regrowth. Refer to Chapter 2 for more guidance on estimating cover.

Make sure samples are representative of the entire assessment area, specifically within the same ecosite classification, plant community or management unit. If returning to an area that was assessed in the past, and brush encroachment has made the grassland smaller, make sure to use the same outer limit for the area that was originally assessed.

If woody regrowth is a problem, provide specific comments on the need for control measures. However bear in mind that a certain level of woody growth in particular areas may still support certain land management objectives. Consider the benefits of woody regrowth when making management decisions regarding brush control.

Shrubland communities are often transitional between grassland and forest plant communities, especially in parklands. The assessor may choose to evaluate these communities separately if they are to be managed separately for different habitat goals. The appropriate section in the Manitoba's Rangeland Plant Communities guide will show how these communities fit into succession.

Indicator 3.0 Site Stability

3.1 Is there human-caused bare ground?

3.2 Is the site subject to accelerated erosion?

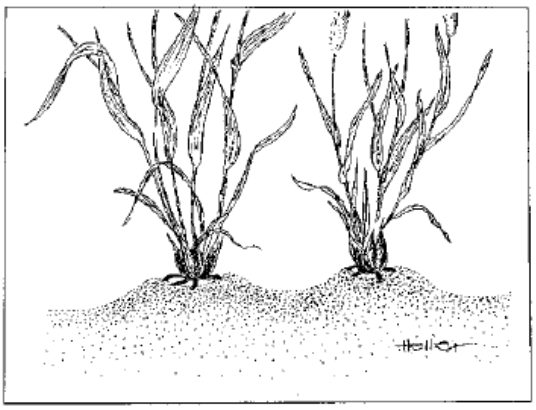
Accelerated erosion occurs when disturbance reduces vegetation cover and/or increases physical impact (e.g. hoof shear) on grasslands, resulting in increased rates of wind erosion and water erosion from rainfall and snowmelt over and above what is expected for the site. Possible increases in erosion of sites adjoining riparian areas from overland flow associated with streams and rivers is also considered accelerated erosion.

The normal erosion processes and soil exposure levels expected for your site need to be known first in order to recognize accelerated erosion and estimate "human-caused" bare ground. Refer to the appropriate reference plant community (RPC) in the Manitoba's Rangeland Plant Communities guide to determine expected levels of bare ground and erosion. Other than Dune, Moist Saline, Eroded Slopes, Alluvium, and Sand ecosites, sites in healthy condition in Manitoba have no natural soil exposure. If the ecosite is normally unstable, then you must determine the amount of human-caused erosion that exceeds normal or geologic rates.

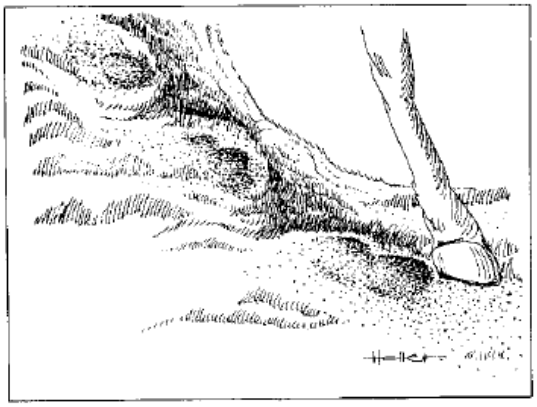
Early signs of erosion may require close observation by looking under green live plant cover to see if there is any movement of light surface material (litter or soil), and any roots or crowns exposed. Plant litter and fine soil particles may create little dams or deposits after they have moved from their original location. Look for evidence of erosion on any slope as shown by deposition of soil or litter particles at the bottom of slopes.

Abundant manure, hoof tracks, and hoof shearing often show that accelerated erosion is caused by livestock, perhaps under a heavy to very heavy grazing regime or poor livestock distribution across the landscape – see Figure 7 on the next page. However, in some areas, signs of hoof shearing and soil exposure may be attributed to wildlife trampling.

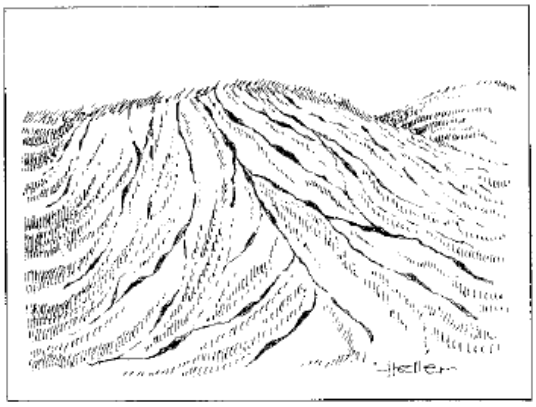
a) Pedastalling (Micro)



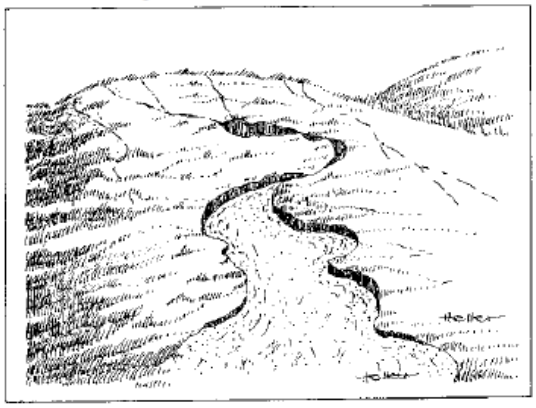
b) Hoof Shearing (Micro)



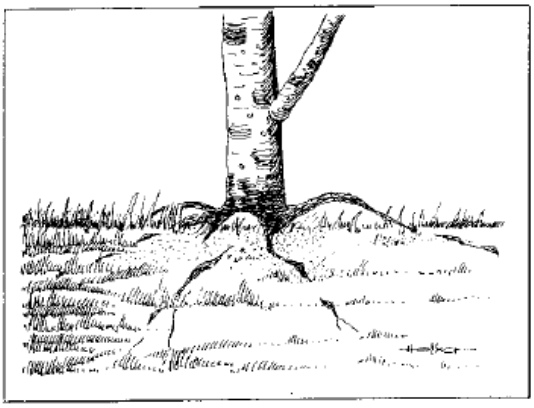
c) Rill Erosion (Macro)



d) Gully Erosion (Macro)



e) Root Exposure (Macro)



g) Trailing (Macro)

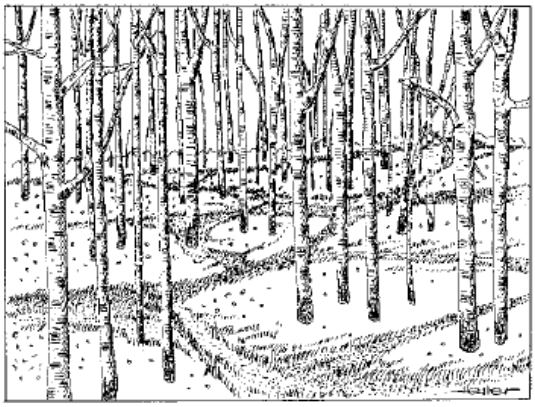


Figure 7 – Examples of Soil Erosion Features

Question 3.1 Human-caused bare soil

Scoring: (Use Figure 8 below to help visualize the categories of soil exposure)

5 Less than 10% cover of exposed soil is human-caused

3 Greater than 10% and up to 20% cover of exposed soil is human-caused

1 Greater than 20% and up to 50% cover of exposed soil is human-caused

0 Greater than 50% cover of exposed soil is human-caused

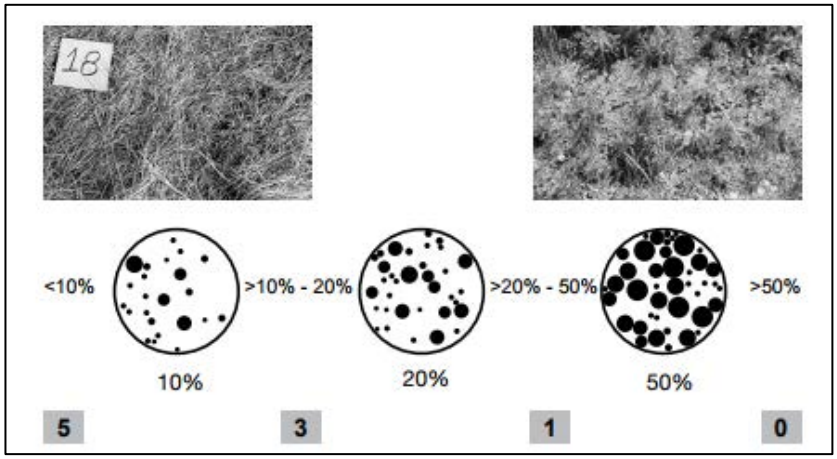


Figure 8 – Conceptual Diagram of How to Score Soil Exposure

Question 3.2 Evidence of accelerated erosion

Scoring: (See Figure 7 on previous page for examples)

10 No soil movement, deposition of soil/litter, coarse sand or aggregate remnants, plant pedestals, flow patterns, scouring, or hoof shear beyond the natural extent.

7 Some evidence of slight soil movement or deposition of soil/ litter, plant pedestalling, coarse sand or aggregate remnants, flow patterns and/or scouring that is human-caused and beyond the natural extent for the site. Old erosion features may be stable and vegetated. Flow patterns may be short and shallow.

3 Moderate amounts of soil movement, deposition of soil/ litter, plant pedestals, flow patterns, or scouring is visible across site. Erosion features are active but limited to the site with no off-site movement of material. Flow patterns have a well-defined branching pattern. Signs of hoof shearing may be evident in localized patches.

0 Extreme amounts of soil movement with material being carried off site. Flow patterns are obvious and fan deposits may be present. Rills are abundant and deep. Gullies are deep with sharp edges. Erosion features are active. Pedestalled plants with exposed roots and rocks exposed or sitting on the surface. Hoof shearing may be common across the site, beyond localized patches.

Scoring Notes for 3.1 and 3.2

Human-caused bare soil is the result of disturbance processes that are subject to human control. Examples include grazing, ATV, recreational impacts, wildlife overpopulation. Human-caused bare soil is that portion that is over and above what is normally expected for the site.

To estimate human-caused bare soil, first estimate total bare soil, subtract the amount considered to be expected or naturally occurring according to the reference plant community (RPC) description for the appropriate ecosite as found in Manitoba's Rangeland Plant Communities guide.

observed bare soil % – expected RPC bare soil % = human-caused bare soil %

The difference will be considered human-caused bare soil. Report this amount on the field sheet and note the source.

Take time to record moss and lichen cover; this layer helps stabilize the site. Note that there is a place in the form to indicate estimated amounts of bare soil and moss/lichen.

These questions focus on increased soil exposure and the increased potential for soil erosion on ecosites that are normally stable and less of a concern where ongoing soil loss is a natural process.

Rodent Burrowing and Bare Soil

On healthy sites, rodent burrowing activity is normally limited in its extent and impact on the amount of bare soil.

Bare soil from rodent burrows tends to increase on modified and heavily grazed sites. Ground squirrel and pocket gopher activity increases in response to foraging opportunities associated with introduced and weedy species, especially tap-rooted forbs like dandelion. Therefore on modified and heavily grazed sites, a significant portion of the bare soil from rodent burrows should be considered human-caused and note the source of the impact in the comments section of the health assessment form.

Wildlife Impacts on Bare Soil

Large numbers of elk and deer may increase bare soil on preferred range sites. Winter ranges may be especially prone to hoof shear resulting in increased bare soil. When wildlife impacts result in increased soil exposure, treat it as human-caused and note the source of the impact in the comments section.

Earthworm casts

Although earthworms accelerate nutrient cycles and contribute to soil health, they are considered to be introduced species, and therefore their casts are to be counted as human caused bare soil and noted in the comment section. They appear different from normal soil exposure in that they are bumpy or "bubbly" aggregates, and often glossy.

Indicator 4.0 Hydrologic Function and Nutrient Cycling - Litter

4.0 Is the expected amount of plant litter present?

In grasslands, litter acts as a physical barrier to heat and water flow at the soil surface. Litter conserves moisture by reducing evaporation, improving infiltration and keeping the soil surface cool. It cycles nutrients and carbon back to the soil as it decomposes. Wild animals use it for cover and nesting. Excessive litter, however, inhibits germination and new growth, delays warming in the spring, stifles production and flowering of existing plants, and ties up nutrients. This indicator evaluates the ability of a site to perform these functions based on minimum amounts of plant litter, but also considers that there is an upper maximum limit.

Litter includes ungrazed residue from previous years' growth including standing stems, fallen stems and leaf material and partially decomposed material - see Figure 9. If assessment is in mid to late summer, some of this year's stems may appear dead but are yellow or bronze in colour. Usually previous years' growth is grey or with mildew.

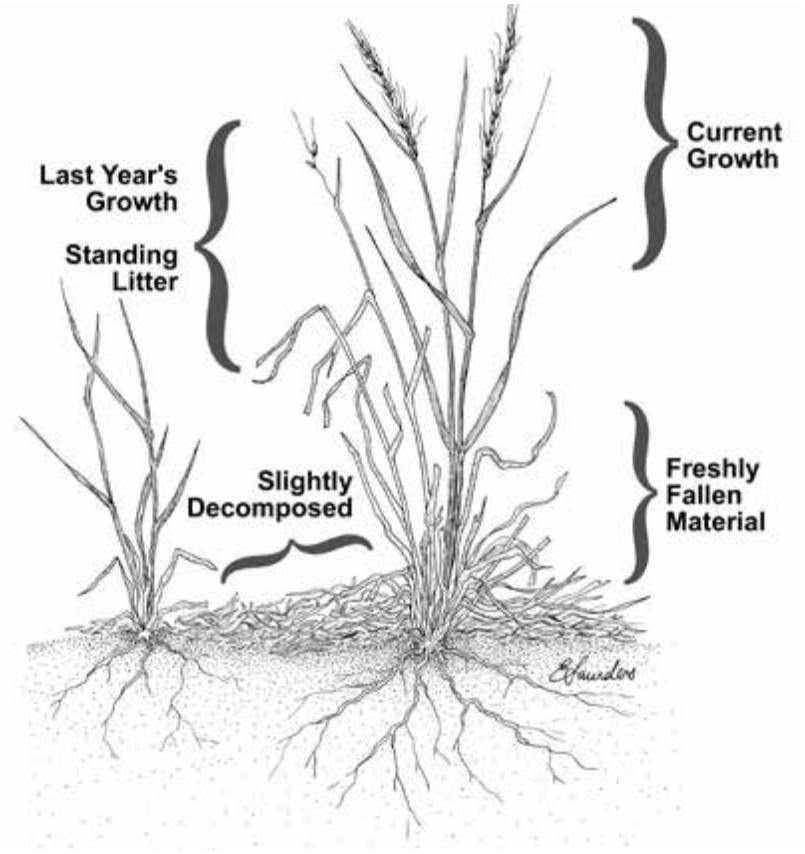


Figure 9. Types of Litter

“Litter normals” are amounts of plant litter (lb/ac) that are appropriate for the site being evaluated. Observers sample existing plant litter levels by hand raking from a number of representative 50cm x 50cm (20” x 20”) areas. These are compared to photographs or litter reference bags which indicate various amounts of litter in lb/ac.

Estimate litter across the entire assessment area. Look at the distribution, evenness and patchiness of litter across the site. If a reference area or benchmark site is available for comparison, it should be lightly to moderately grazed range with enough litter to retain moisture.

In drier grasslands, litter reserves are closely linked to forage yield. The extra effort it takes to estimate litter levels provides a strong prediction of such a site’s ability to retain moisture and support plant growth.

In moister grasslands with higher productivity, where litter may exceed a maximum acceptable amount, look for signs of stunted plants, low stem density below the litter mat, lack of flowering stems, and signs of rotting or stress.

In very wet grasslands that have short term or long term surface water, litter tends to rot on the ground before accumulating - although there is opportunity to accumulate standing litter. In such areas, if it is clear that there is sufficient moisture for plant growth, and nutrients are being returned to the soil; negative impacts from grazing and other disturbances on these moist soils will be manifested in the other indicators.

Compared to native plant communities, modified communities produce less forage during dry periods. Litter on modified sites is more subject to loss from weathering processes. As a result, modified sites may not be capable of sustaining litter reserves at the appropriate levels for maintaining a variety of ecological functions.

Data needed to produce litter normals for Manitoba are not yet available. Thus the litter limits developed for various ecosites in the Aspen Parkland of Alberta will be used until such data are collected – see Figure 10. Alberta’s litter normals are developed from long-term benchmark monitoring of healthy and productive sites under light to moderate grazing intensity and does not consider upper limits. Whether or not there is too much litter will need to be determined subjectively by observing plant stress due to shading.

4.0 Plant litter

Scoring:

20 Litter amounts are more or less uniform across site and include standing dead plant material, fallen dead plant material and variably decomposed plant material on the soil surface. Average litter amounts (lb/ac) are greater than 75% of the average amount expected under moderate grazing intensity but do not appear to be stifling productivity or reproduction.

13 In cases where litter is reduced, litter amounts are no longer uniform across the site, with 5 to 25% of the area having little to no litter. Fallen dead plant material and variably decomposed material on the soil surface are the dominant litter types. Average litter amounts (lb/ac) are 50 to 75% of those expected under moderate grazing intensity. In cases where litter is excessive, amounts exceed 100% of those expected, and negative impacts are beginning to show on the plants.

6 In cases where litter is reduced, acceptable litter accumulation tends to exist only in scattered patches. Litter is very thin across 25 to 67% of the area being assessed. Average litter amounts (lb/ac) are 25 to 50% of the average amount expected under moderate grazing intensity. In cases where litter is excessive, amounts exceed 100% of those expected, and negative impacts are very evident on the plants.

0 Litter amounts appear greatly reduced or absent over more than 67% of the area being assessed. The extent and distribution of exposed soil may have increased. Decomposing material on the soil surface is the main type of litter. Litter amounts (lb/ac) are less than 25% of the average amounts expected under moderate grazing intensity.

Scoring Notes for 4.0

Hand rake litter from representative areas (from 50cm x 50cm or 20” by 20” frames) and then compare the amount to your own litter reference bags or use the pictures in Figure 9. See the Estimating Litter Amounts section in Chapter 2 to learn how to estimate litter and create your own litter reference bags.

When hand raking litter, don’t include any herbage that grew in the current year, that is, green, yellow, or bronze material. Only include standing stems and fallen material that appear to be from previous growing seasons which will be grey or with mildew. Be careful to include all types of litter, even the fine bits on the ground.

Excessive litter will never fall into the 0 category, as it will still have soil protection, moisture conservation and habitat values.

Grassland Health Assessment – Litter Thresholds (lb/ac)

Ecoregion[1]	Ecosite[1]	Average Litter Accumulation[2] (100%)	Normal 25 (>75%)	Moderately Reduced 16 (75 – 50%)	Significantly Reduced 8 (50 – 25%)	Sparse or Absent 0 (<25%)
Aspen Parkland	Loam	1500	>1125	1125 – 750	750 – 375	<375
	Sandy Loam	1100	>825	825 – 550	550 – 275	<275
	Sand	800	>600	600 – 400	400 – 200	<200
	Dune	400	>300	300 – 200	200 – 100	<100

1 - Data not available for all ecoregions and ecosites
2 - Litter data from Alberta's long term rangeland benchmarks - under moderate intensity grazing

Figure 10 – Litter Categories for Scoring Question 4.0 and Example Photos

Indicator 5.0 Invasive Weeds

5.1 Are invasive weeds on the site?

5.2 If so, what are their cover, density, and pattern?

The presence of invasive weeds provides clues as to both the current health and function of the site and potential risks to future health. Invasive weeds are introduced when seeds or other propagules are deposited along traffic routes and in disturbed areas by various means: wind and water, on the hair or feces of livestock and wildlife, caught on vehicles and equipment, or as a contaminant in reclamation seed (among others). Once introduced, they can establish where excessive disturbance has caused bare ground to be exposed and increased availability of moisture and/or nutrients. Alternatively an otherwise healthy stand may be threatened by the presence of invasive species that are particularly aggressive, out-competing native plants. Early detection of invasive weeds, followed by regular management practices, limits their spread and impact, and reduces long term control costs.

This two-part question evaluates the cover, density and pattern of distribution of all invasive weed infestations collectively on the site. Invasive weeds to include in scoring are listed in Table 4 of Appendix A. This list includes regulated noxious weeds (Tier 1, Tier 2, and selected Tier 3 noxious weeds) as set out in Manitoba's *Noxious Weeds Regulation* (2017), as well as additional invasive plant species with elevated threats to the functioning of prairie ecosystems. Nuisance weeds and disturbance-induced species are not to be included.

Question 5.1 Cover of invasive weeds

Scoring: (Use Figure 11 to help visualize the percentage weed infestation)

5 No invasive weeds are present in the area sampled.

3 Invasive weeds cover <1% of the area.

1 Invasive weeds cover 1 - 15% of the area.

0 Invasive weeds cover greater than 15% of the area.

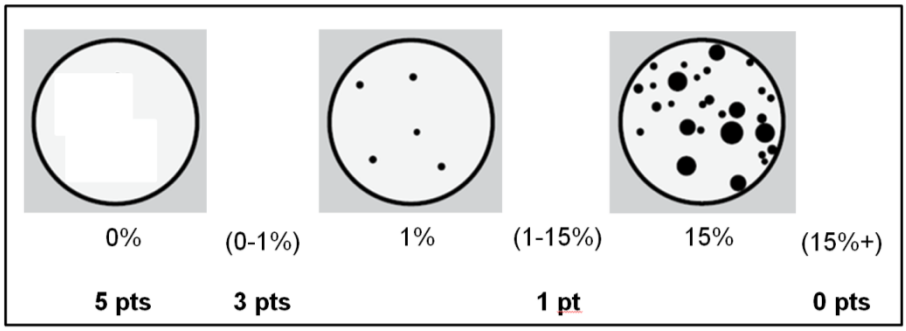


Figure 11 - Conceptual Diagram of How to Score Invasive Weed Cover

Question 5.2 Density and distribution pattern of invasive weeds

Scoring: (Use Figure 12 to determine density distribution category and weed score)

5 No invasive weeds are present in the area sampled.

3 Invasive weed infestation is low (class 1 to 3).

1 Invasive weed infestation is moderate (class 4 to 7).

0 Invasive weed infestation is heavy to severe (8 to 13).

Density Distribution

Class	Description of abundance in polygon	Distribution	Weeds Score
0	None		5
1	Rare		3
2	A few sporadically occurring individual plants		
3	A single patch		
4	A single patch plus a few sporadically occurring plants		1
5	Several sporadically occurring plants		
6	A single patch plus several sporadically occurring plants		
7	A few patches		
8	A few patches plus several sporadically occurring plants		0
9	Several well spaced patches		
10	Continuous uniform occurrences of well spaced plants		
11	Continuous occurrence of plants with a few gaps in the distribution		
12	Continuous dense occurrence of plants		
13	Continuous occurrence of plants with a distinct linear edge in the polygon		

Figure 12 – Density Distribution Patterns and Associated Scores for Question 5.2

Scoring Notes for 5.1 and 5.2

Space is provided on the indicator score sheet to record detailed information for each listed weed species and any control treatments applied historically. This data helps assess the risk of further weed expansion, evaluate the success of control measures, and guide weed control programs. If desired, more detail can be documented in the additional Invasive Plant Form that is provided in Appendix B.

In order to score the indicator questions the observer must consider all invasive weeds collectively. Add up the foliar cover of individual invasive plant species across the area for the first question and then select the appropriate cover score. To answer question two, consider all invasive weed cover when selecting the density distribution category from Figure 12. You may wish to comment on the total area (e.g. acres, m^2) of the assessed area affected by the combination of invasive weeds in addition to what was recorded for individual species. There is a place in the form next to the invasive species ratings to record the estimated cover and density-distribution category of each invasive weed species included in the assessment.

The density and distribution of dots in Figure 12 relates to the density and distribution of weeds in the sampling area. The score for Question 5.2 declines as infestation increases as indicated on the right side of the figure.

Do not include nuisance weeds or disturbance species such as dandelion, strawberry, plantain, yarrow. These disturbance-induced increaser species are covered under Integrity and Ecological Status (indicator 1.0).

If the assessment area has a clear division of infested and non-infested area for reasons of different ecosite, plant community, or historical management, you may want to consider dividing it into two smaller assessment areas.

Draft Manitoba Range and Pasture Health Assessment Workbook

Chapter Four – Understanding Range and Pasture Health Assessment Results

Range and Pasture Health Assessment - A Tool for Adaptive Management

Repeated range and pasture health assessments and an understanding of ecosite and plant community guides can ensure land management practices are sustainable. Ecosite and plant community guides allow you to select a plant community appropriate for your land to strive towards. Depending on your objectives, you'll likely choose a later seral plant community or the reference plant community for a productive, high quality grazing resource. The results from this range and pasture health assessment technique can reward you for good land management practices or show you why your land management practices need to be fine-tuned. Ongoing use of these tools, along with livestock grazing records, weather records, and photographs, can help you create a resilient ecosystem to help you manage through natural and man-made events.

Your Total Range or Pasture Health Score - What Does It Tell You?

The range and pasture health score is the sum of all the health indicator questions. It is a cumulative measure of the health and function observed and measured in your sample area. This assessment tool provides a snapshot at one point in time of the health of the site and possible impacts of disturbance and management. Range and pasture health monitoring alerts livestock producers and users to positive or negative changes on rangelands and pastures so that management changes can be made, if needed. To interpret your health assessment, consider the following health categories and what they mean.

Healthy (75 to 100%):

All of the key functions of healthy range or pasture are being performed. This is a positive message about your current land management practices. It may tell you that current stocking levels, livestock distribution, prescribed burning or mowing applications, and/or grazing practices are maintaining range and pasture health. Optimum grazing opportunities for livestock and wildlife habitat are possible.

Healthy with Problems (50 to 74%):

Some key functions of healthy range or pasture are not being performed to their fullest potential. This score is an early warning of the need for minor to major adjustments to management, followed by further monitoring. There may be a reduction in livestock grazing opportunities and support for some kinds of wildlife. Recovery to a healthy class can normally be accomplished within a few years.

For some modified native grasslands, recovery potential may be limited and healthy with problems may be the maximum attainable score (given the current knowledge about Manitoba's modified rangelands). A common example of this is in rough fescue grasslands invaded by Kentucky bluegrass or smooth brome, where the plant community composition indicator is hampered by overabundance of exotic grasses but the other key indicators are not affected.

Unhealthy (0 to 49%):

Few of the functions of healthy range or pasture are being performed satisfactorily. An unhealthy rating means urgent action is required. Current stocking levels, livestock distribution, grazing practices, improperly applied disturbance prescriptions, and/or idleness are limiting range and pasture health. Significant management changes are essential and it may take years to regain a healthy class. Livestock grazing and wildlife habitat opportunities are seriously reduced.

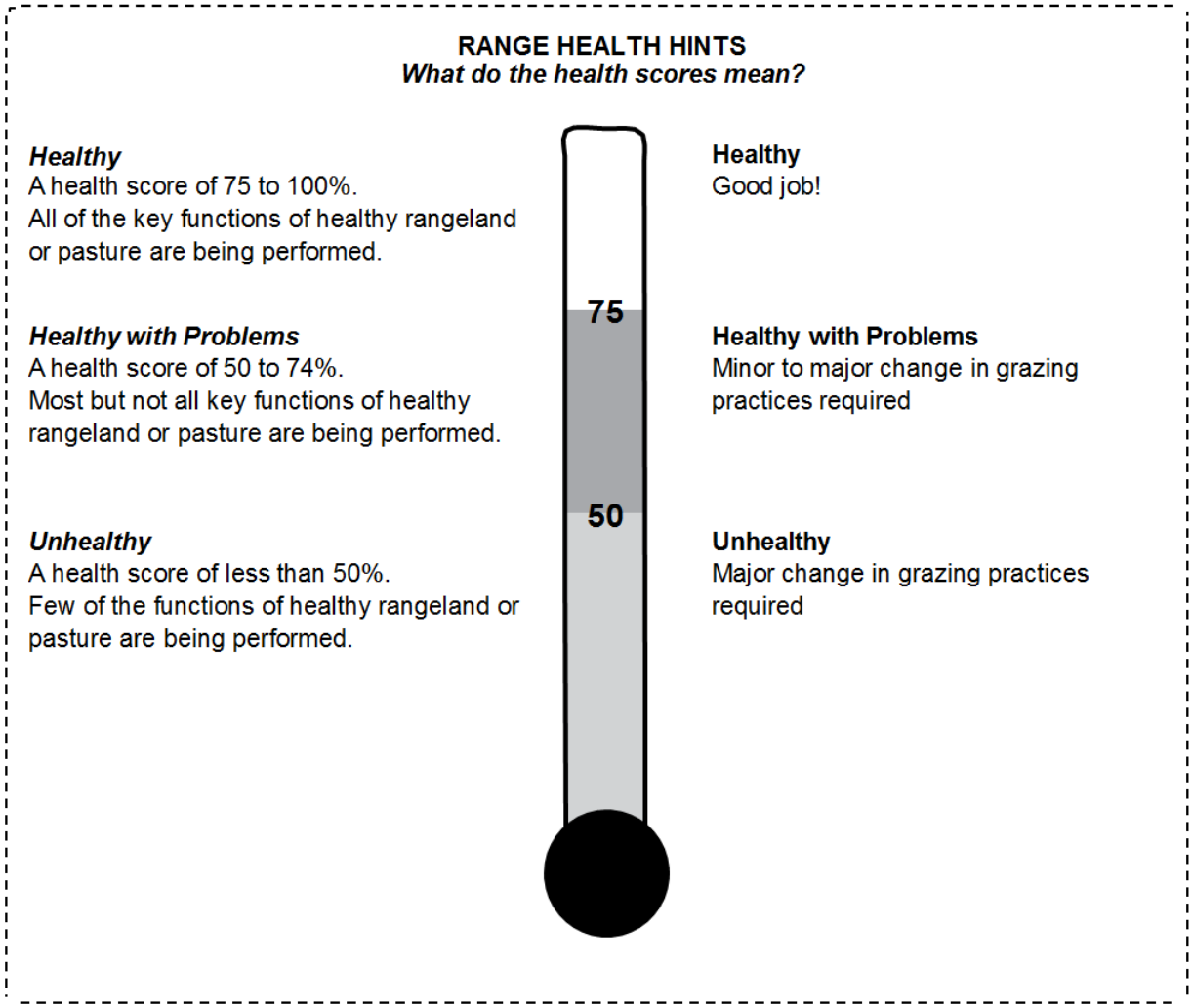


Figure 13 – Scale of Range and Pasture Health Categories

Individual Health Indicator Scores – What Do They Tell You?

Taking a closer look at the individual health indicator questions or combinations of indicator questions can help you uncover areas of greatest concern and to formulate management objectives and plans. Consider the possible score for each question; this tells you the relative importance of the question to the overall rating. For example:

- In grasslands, plant community composition, and in forests, plant community structure, are most important. High scores in these respective areas will most likely contribute most to a healthy rating. Low scores will indicate a large negative impact on the function of the site.
- In tame pastures, plant species shifts from productive and palatable species to disturbance induced or weedy species will be of greatest concern as they replace the more productive forage plants.
- In modified grasslands and tame pastures, retaining palatable and productive species and litter will be of greatest concern. Low scores in these areas indicate a large negative impact on the function of the site.

<u>Litter and LFH</u>

In native and tame pasture, litter scores provide significant insight into moisture retention, nutrient cycling, habitat functions, and plant community composition:

- High scores mean moisture is being retained and that conditions are favourable for water to infiltrate into the soil. Enough plant residue is being left after grazing to allow for abundant nutrients to be recycled from each year's annual growth. Plenty of coarse, medium, and fine fragments of litter are available for cover and nesting. There is a resistance to invasion by weeds due to shading, cooler soil temperatures and preventing bare soil.
- Medium scores mean that moisture retention and nutrient cycling are being measurably reduced. Patchiness of litter cover may actually enhance wildlife habitat function by supplying a diversity of nesting and foraging preferences. Patchiness of litter will also enhance plant diversity on a range or pasture wide scale.
- Low scores due to insufficient litter accumulation may indicate that too much of the seasonal production has been removed by grazing or other disturbance. Little moisture is being retained and fewer nutrients are being returned to the soil. Habitat availability is limited to those species who tolerate very little cover. With this reduced cover, the stage may be set for increased soil exposure followed by soil erosion from the site. Soil exposure provides niches and favourable environments for weed germination or invasion. Plant species (often less productive increasers) that prefer warm and dry soils may also increase in abundance.
- Low scores due to excessive litter accumulation could mean that new vegetative growth is being impeded, and there is a hold-up in nutrient cycling – nutrients are

remaining tied up in vegetative matter. Plant species that prefer warmer soils – very productive ones like bluestem and switchgrass – will be impeded.

In forests the LFH layer acts like a sponge to soak up and retain water and nutrients:

- A high score for LFH depth indicates that the litter layer has adequate pore space to hold water and nutrients for a steadier release to plants and soil microbes as needed. The sponge provides well-aerated conditions for a diverse soil food web.
- A low score due to compaction of LFH thickness from trampling or trailing indicates loss of moisture and nutrient retention. Many years of effective rest may be required to restore LFH thickness and sponginess.

Bare Soil and Soil Erosion

In most Manitoba environments we do not expect to see bare soil and erosion in healthy rangelands and pastures. The exception would be open sand dunes, some dry sandy areas, steep slopes along waterways, and river terraces. Any human-caused erosion and bare soil requires immediate attention and correction. Similar to the domino effect, allowing erosion processes to accelerate will have drastic impacts to the health and function of the plant community and site. Bare soil invites erosion or weed invasion, alters plant growth and soil microbial processes, and reduces the site's potential for water infiltration. Incorporating plenty of effective rest into a grazing rotation or halting vehicle and human traffic can correct this. In Manitoba growing conditions can be forgiving so that human-caused bare soil is generally covered with some kind of vegetation in very few years although such sites should be monitored to prevent the establishment and spread of invasive weeds. Erosion may be more difficult to correct than bare soil. Minor erosion features should settle out after bare soil is covered with vegetation. Moderate to severe erosion features that allow for continued water or wind erosion may require physical barriers or protection.

Invasive Weeds

An emerging population of invasive weed species is a key early warning sign that the system has been under stress and that both weed control measures and management changes should be considered. A well-established population of invasive weeds indicates longer term stress on the system. At such a stage it is more economically and environmentally harmful, and more difficult or next to impossible to correct.

Management that strives towards or maintains a productive plant community, healthy litter amounts, and stable soils limit invasion opportunities. Balancing utilization with production potential and providing adequate rest will set off a beneficial chain of events. Plant vigour will increase, improving the longevity and reproduction of desirable perennial plants. This leads to more vegetation cover which in turn adds more litter to the site, optimizes nutrient use and reduces bare soil. The outcome will be less niche space for weeds to establish.

Tree and Brush Encroachment

Woody regrowth levels are often a function of combined environmental factors and grazing management practices. In forested or semi-forested ecoregions like the Aspen Parkland, forest regeneration after pasture development is a natural occurrence just like after a wildfire. At low stem densities, woody regrowth may serve as complementary forage as livestock browse woody plants. However, if woody species are re-establishing or encroaching on native grasslands or pastures, they will outcompete or make the growing environment unfavourable for herbaceous plants. As the density, height and stem diameter of shrubs and trees increase, so does shading of grassland plant species which often require full sunlight. The woody encroachment indicator can help determine if control measures should be considered. Ineffective grazing systems or idleness facilitates woody regrowth.

Combined Indicator Questions

When the health assessment indicates problems, think about the questions as they relate to each other. This will help you to deal with the underlying symptoms of the problem. To illustrate, the total health score may be reduced by the individual scores of woody regrowth, disturbance-induced and weedy species and low litter accumulation. It won't be possible to heal one problem without addressing the others.

Often one management adjustment can mend multiple indicators. For example dividing a pasture into 4 paddocks to implement a rotational grazing system will result in more rest for the vegetation and more control of how much forage the livestock use and when they use it. Such a change could result in coverage of bare soil, followed by litter accumulation, then plant community structure recovery, and finally an increase in desired later seral plants.

Natural, Human-caused or Both?

It is important to recognize that a number of natural events and processes may affect a health rating. Drought, wildfire, insect damage, flood, disease and extreme winds can produce range and pasture health concerns. Maintaining historical records, particularly on moisture, disturbance and disease, and carrying out periodic range and pasture health assessments, can help you determine how much of the health impacts are attributable to either natural or human-caused events. It is difficult to prevent natural events but we can produce resilient rangelands and pastures that can recover quickly after potentially damaging events.

The Value of Heterogeneity or "Patchiness"

This guide encourages land managers seeking to assess the health of native rangelands and pastures to consider heterogeneity in helping to achieve certain land management targets. Heterogeneity refers to "patchiness": spatial variability in plant community composition, height and density of vegetation, amounts of soil exposure, and physical properties such as wet versus dry or soil textures. It can occur at any scale from a small grazing space, to the field or pasture level, landscape level and beyond. Heterogeneity can be achieved by manipulating disturbance (fire, grazing, mowing) at the desired scale (patch, field, pasture). A heterogeneous landscape is rich in plant species and structural diversity, thereby hosting habitat patches for a broad spectrum of wildlife and plants. For example some songbird species prefer having well-grazed patches available for nesting while others require the heavier cover provided by more moderate-intensity grazing. Some species, like sharp-tailed grouse, require open areas for one life stage and areas with taller vegetation for another life stage.

The Value and Use of Disturbance

Manitoba native prairie plants have evolved to rely on disturbance such as fire, grazing, flooding, drought and animal burrows for optimal habitat conditions. Plant diversity is likely to improve through the use of grazing or prescribed burns because these alter the growth environment – for example by addressing excessive shading and competition from other species. Also the seeds of some native prairie plants have evolved to require sunlight, inundation with water, digestion, or fire in order to germinate. A balance of disturbance is required for rangelands and pastures to remain healthy and sustain their ecological functions. Excluding grazing, fire or mowing from grasslands allows more dominant plant species (and possibly invasive weeds) to take over, reduces structural diversity, and slows nutrient cycles. Too much disturbance from overgrazing or a catastrophic event favours the growth of plant species resistant to grazing pressures, reduces structural diversity, exposes and destabilizes soils, slows nutrient cycles, and creates conditions for weed invasions.

Disturbance has three key qualities which can be manipulated to achieve various levels of impact on rangeland or pasture: intensity, frequency, and timing.

- Intensity is how much biomass is removed or how much disturbance is done to the soil surface. The more leaf surface that remains after disturbance, the easier it is for the plant to recover. Severity of soil damage can grade from simple foot pressure, to bare soil, to penetration of soil, to mixing of soil surface layers, to complete turnover of soil as in some industrial disturbances.
- Frequency is how often the disturbance occurs. In grazing scenarios this generally means how often a plant is defoliated. Consecutively repeated damage to plants without time in between for recovery mines a plant's resources.

- Timing is at what time of year the disturbance occurs. Spring in Manitoba is generally the most sensitive time of year because plants are mining their roots and crowns to produce their first shoots and flowers, and soils are wettest and most susceptible to compaction.

Principles of Rangeland and Pasture Management Practices

Rangeland and pasture management practices have four principles at their core which are also applicable to other kinds of disturbance:

1) Control the amount of biomass removed. Balance forage supply with forage demand and leave enough behind to sustain ecological processes. In native rangelands the take-half-leave-half rule-of-thumb can be applied. Tame pastures tolerate a higher proportion of forage to be taken. Planned grazing systems can control the intensity of vegetation impact in various areas of a rangeland or pasture system, and allow for manipulation of heterogeneity at the whole-pasture or range scale.
2) Manage distribution of disturbances. This principle allows for the land manager to address heterogeneity targets by burning or grazing patches while leaving other patches intact or undergrazed. By habit, cattle in a large field will be selective, grazing some patches more than others. It also means that livestock overgrazing can be reduced or discouraged from certain areas by fencing, trail development, alternative water sources, and strategic salt and mineral placement. Using these same strategies, livestock can be encouraged to make heavier use of certain areas to achieve brush management, weed suppression, or enhancement of habitat.
3) Allow time for effective rest and recovery. Effective rest from any kind of disturbance happens in spring and summer when plants are growing, photosynthesizing, and retrieving nutrients and water. For example, a planned rotational grazing system allows you to rest certain areas while grazing others with desired intensity. Recovery can take several weeks to a full growing season, depending on the type of plant and favorability of growing conditions (e.g.dry periods, inundation with water and grasshoppers.)
4) Avoid use during sensitive periods. This applies to when soils are wet or when plants are mining their roots and crowns for growth and reproduction. A rotational grazing system is a great way of preventing livestock access to certain areas during these sensitive times, while grazing other areas with desired intensity.

Example Scenarios of Health Assessments

Scenario 1 – Healthy

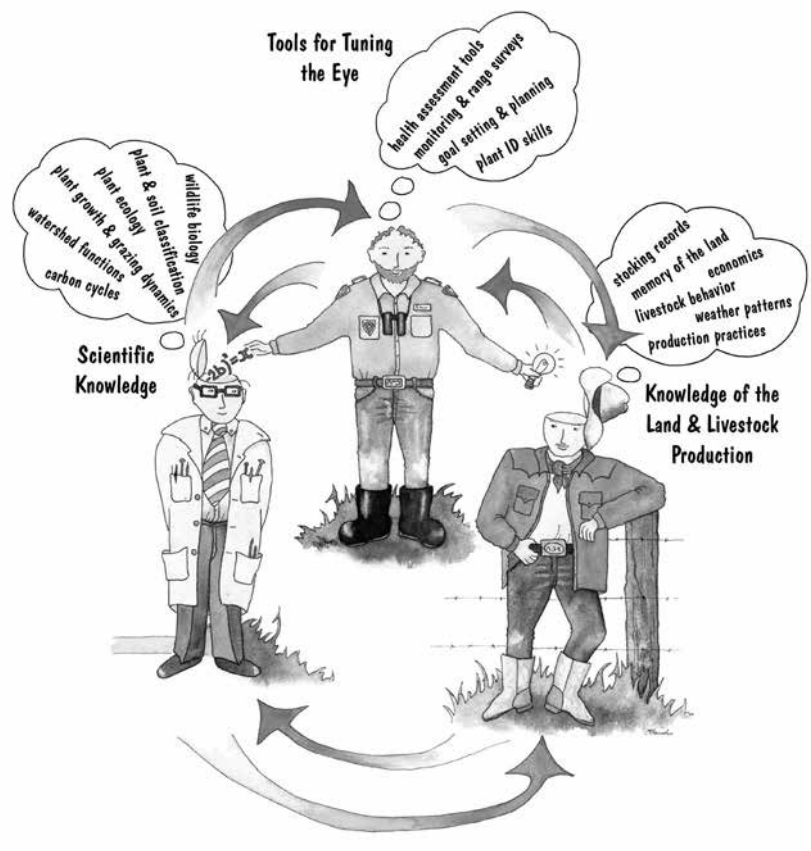
A native grassland site rates as healthy but the score of 76% is close to the low end of the range. The reduced health score is due to low litter values. A review of management practices suggests that stocking rates may not have been reduced sufficiently during recent dry years, resulting in an overbalance of forage demand with forage supply, and therefore less plant residue left over at the end of each growing season. A recent increase in average cow size has also contributed to increased forage demands on the pasture. Plans are made to reduce stocking rates slightly, thereby balancing the greater forage demand with forage supply, and coming into closer alignment with the long term average production potential. Deferring grazing in spring until the 3-leaf stage of preferred grasses would also sustain or improve the annual production of preferred forages.

Scenario 2 - Healthy with Problems

A health assessment of a forested field has scored 56%, with deductions for plant community composition and reduced structure. A review of management practices suggests that the cattle are using the pasture in early spring, and again in mid-summer. The pasture biologist has suggested deferring entry of cattle until late June and only one grazing period per year. The amount of time spent in this forested field is further reduced by recognizing that unpalatable shrubs should not be included as part of the forage supply.

Scenario 3 - Unhealthy

A modified native grassland has a health score of 28% with deductions for shifts towards unproductive disturbance-induced plant species, inadequate litter accumulation, soil erosion, invasive weeds, and woody regrowth problems. Years of season-long grazing has reduced forage production potential and removed most palatable plants from the site. It has limited the ability of the pasture to withstand the past two years of dry growing conditions. The forage and pasture specialist suggests that the original number of cattle allocated to the pasture can no longer be supported and that this number should be reduced until there is improved forage production. Installing a 4-paddock rotational grazing system will allow for the extended rest periods needed increase growth of favourable plants, cover bare soil and rebuild litter levels. Weed control is required, whether it be with chemical application, mowing or targeted grazing approaches.



A wise person once said, "*No one is as smart as all of us*". That's the philosophy we like to foster with range and pasture health assessment tools. Livestock producers possess tremendous wisdom, knowledge and experience on the land. Science can provide valuable insight into how ecosystems function. Range and pasture health assessment tools help to link science and wisdom to improve rangeland management and to make land management more sustainable.

Contacts for Further Information

Manitoba Range and Pasture Health Assessment Workbook

Visit the Manitoba Forage and Grassland Association website: http://mfga.net/

Grazing Management

Visit the Manitoba Agriculture website for up-to-date information on services and office locations in your area: http://www.gov.mb.ca/agriculture/contact/index.html

Call Agriculture and Agri-Food Canada – Brandon Research and Development Centre at 204-578-6700 with inquiries relating to grazing management practices.

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Appendix A – Lists of Decreasers, Increasers and Exotic Plants, Invasive Weeds, and Species at Risk

Table 3 – List of Decreasers, Increasers and Exotic Invaders

Scientific Name	Common Name(s)	Grazing Response[1]
GRASSES AND GRASSLIKE PLANTS		
Agropyron cristatum	Crested wheatgrass	Exotic/Invader
Agrostis scabra	(Rough) hair grass	Exotic/Invader
Agrostis stolonifera	Redtop, Creeping bentgrass	Exotic/Invader
Andropogon gerardii	Big bluestem	Decreaser
Andropogon hallii	Sand bluestem	Decreaser
Anthoxanthum nitens	Sweet grass	Increaser
Aristida purpurea	Red threeawn	Increaser
Avenula hookeri	Hooker's oatgrass	Decreaser
Beckmannia syzigachne	Slough grass	Increaser
Bouteloua curtipendula	Sideoats grama	Decreaser
Bouteloua gracilis	Blue grama	Increaser
Bromus ciliatus	Fringed brome	Decreaser
Bromus inermis	Smooth brome	Exotic/Invader
Bromus pumpellianus	Northern awnless brome	Decreaser
Calamagrostis canadensis	Canada reed grass	Increaser
Calamagrostis montanensis	Plains reed grass	Increaser/Decreaser [2]
Calamagrostis stricta ssp. *stricta*	Narrow reed grass	Decreaser
Calamagrostis stricta ssp. *inexpansa*	Northern reed grass	Decreaser
Calamovilfa longifolia	Sand grass, Prairie sandreed	Increaser/Decreaser [2]
Carex atherodes	Awned sedge	Decreaser
Carex duriuscula	Low sedge	Increaser
Carex filifolia	Thread-leaved sedge	Increaser
Carex pensylvanica	Pen or sun-loving sedge	Increaser
Carex praegracilis	Graceful sedge	Decreaser
Carex rostrata	Beaked sedge	Decreaser
Danthonia intermedia	Timber oatgrass, Intermediate oat grass	Increaser
Danthonia spicata	Poverty oatgrass	Increaser
Deschampsia cespitosa ssp. *Pparviflora*	Tufted hair grass	Decreaser
Dichanthelium spp.	Panic grass	Increaser/Decreaser [2]
Dichanthelium wilcoxianum	Wilcox panic grass	Decreaser
Distichlis spicata	Saltgrass	Increaser
Elymus canadensis	Canada wild rye	Decreaser
Elymus lanceolatus	Northern wheatgrass	Increaser
Elymus trachycaulus	Slender wheatgrass	Increaser/Decreaser [2]
Elymus trachycaulus ssp. *subecundus*	Bearded wheatgrass, Awned wheatgrass	Decreaser
Festuca hallii	Plains rough fescue	Decreaser

Scientific Name	Common Name(s)	Grazing Response[1]
Festuca ovina	Sheep fescue	Increaser
Glyceria grandis	Tall manna grass	Decreaser
Glyceria striata	Fowl manna grass	Increaser/Decreaser [2]
Hesperostipa comata	Needle and thread	Increaser/Decreaser [2]
Hesperostipa curtiseta	Western porcupine grass	Increaser/Decreaser [2]
Hesperostipa spartea	Porcupine grass	Decreaser
Hordeum jubatum	Foxtail barley	Increaser
Juncus balticus	Baltic rush	Increaser
Koeleria macrantha	Prairie junegrass	Decreaser
Leymus innovatus	Hairy wildrye	Increaser
Maianthemum stellatum	Solomon's seal, Star-flowered false Solomon's seal	Increaser/Decreaser [2]
Muhlenbergia cuspidata	Plains muhly	Increaser/Decreaser [2]
Muhlenbergia richardsonis	Mat muhly	Increaser
Nassella viridula	Green needlegrass	Decreaser
Opuntia, Escobaria spp.	Cactus	Increaser
Oryzopsis asperifolia	Aspen rice grass, White-grained rice grass	Decreaser
Panicum virgatum	Switch grass	Decreaser
Pascopyrum smithii	Western wheatgrass	Decreaser
Piptatherum pungens	Northern ricegrass	Decreaser
Poa palustris	Fowl blue grass	Decreaser
Poa pratensis	Kentucky bluegrass	Exotic/Invader
Puccinellia nuttalliana	Nuttall alkali grass	Decreaser
Schizachne purpurascens	Purple oat grass	Decreaser
Schizachyium scoparium	Little bluestem	Increaser/Decreaser [2]
Scholochloa festucacea	Rivergrass, Spangletop	Decreaser
Spartina gracilis	Alkali cordgrass	Increaser
Spartina pectinata	Prairie cordgrass	Decreaser
Sporobolus cryptandrus	Sand dropseed	Increaser/Decreaser [2]
Sporobolus heterolepis	Prairie dropseed	Decreaser
FORBS		
Achillea millefolium	Woolly yarrow, Western yarrow	Increaser
Anemone patens	Crocus	Increaser
Antennaria spp.	Everlasting	Increaser
Apocynum androsaemifolium	Spreading dogbane	Decreaser
Aralia nudicaulis	Wild sarsaparilla	Decreaser
Artemisia frigida	Fringed sage	Increaser
Artemisia ludoviciana	Prairie sage	Increaser
Astragalus spp.	Milkvetches	Increaser
Chenopodium album	Lamb's quarters	Exotic/Invader
Dalea purpurea	Purple prairie clover	Decreaser
Gaillardia aristata	Gaillardia, Blanketflower	Increaser

Scientific Name	Common Name(s)	Grazing Response[1]
Galium boreale	Northern bedstraw	Increaser
Geum aleppicum	Yellow avens	Increaser
Geum triflorum	Three-flowered avens	Increaser
Glycyrrhiza lepidota	Wild licorice	Increaser
Grindelia squarrosa	Gumweed	Increaser
Gutierrezia sarothrae	Broomweed	Increaser
Hedysarum spp.	Sweet-broom	Increaser
Heterotheca villosa	Golden aster	Increaser
Lathyrus ochroleucus	Cream-colored vetchling	Decreaser
Lathyrus venosus	Wild peavine, Purple peavine	Decreaser
Lepidium densiflorum	Common peppergrass	Exotic/Invader
Liatris punctata	Dotted blazing star	Decreaser
Lupinus argenteus	Silky or silvery lupine	Increaser
Lygodesmia juncea	Skeleton weed	Increaser
Mertensia paniculata	Tall lungwort	Decreaser
Oxytropis spp.	Locoweeds	Increaser
Penstemon spp.	Beard tongue	Increaser
Petasites spp.	Coltsfoot	Decreaser
Phlox hoodii	Moss phlox	Increaser
Ratibida columnifera	Long-headed coneflower	Increaser
Selaginella densa	Club moss	Increaser
Solidago canadensis	Graceful goldenrod	Increaser
Solidago missouriensis	Low goldenrod	Increaser
Sphaeralcea coccinea	Scarlet mallow	Increaser
Symphyotrichum falcatum	White prairie aster	Increaser
Symphyotrichum laeve	Smooth aster	Increaser
Taraxacum officinale	Dandelion	Exotic/Invader
Thalictrum venulosum	Meadow rue	Increaser
Thermopsis rhombifolia	Golden bean	Increaser
Tragopogon dubius	Goatbeard	Exotic/Invader
Trifolium spp.	Clover	Exotic/Invader
Vicia Americana	Wild Vetch	Decreaser
Vicia spp.	Vetches	Decreaser
Zigadenus venenosus	Death camas	Increaser
SHRUBS AND TREES		
Alnus viridis	Green alder	Increaser
Amelanchier alnifolia	Saskatoon	Decreaser
Artemisia cana	Silver sage	Increaser
Artemisia frigida	Fringed sage	Increaser
Atriplex gardneri	Nuttall's saltbush	Decreaser
Betula papyrifera	Paper birch	Decreaser

Scientific Name	Common Name(s)	Grazing Response[1]
Cornus sericea ssp.sericea	Red-osier dogwood	Decreaser
Corylus cornuta	Beaked hazel	Increaser
Crataegus chrysocarpa var. *subrotundifolia*	Round-leaved hawthorn	Increaser
Dasiphora fruticose	Shrubby cinquefoil	Increaser
Elaeagnus commutata	Wolf willow	Increaser
Juniperus horizontalis	Creeping juniper	Increaser
Krascheninnikovia lanata	Winterfat	Decreaser
Lonicera dioica	Twining honeysuckle	Decreaser
Populus balsamifera	Balsam poplar	Increaser
Populus tremuloides	Trembling aspen, Aspen poplar	Increaser
Prunus pensylvanica	Pin cherry	Decreaser
Prunus pumila	Sand cherry	Decreaser
Prunus virginiana	Chokecherry	Decreaser
Quercus macrocarpa	Bur oak	Increaser
Ribes oxyacanthoides	Gooseberry	Increaser
Ribes spp.	Currant	Increaser
Rosa spp.	Rose	Increaser
Rubus idaeus	Raspberry	Increaser
Salix spp.	Willow	Increaser/Decreaser [2]
Shepherdia canadensis	Canada buffaloberry	Decreaser
Spiraea alba	Meadowsweet	Decreaser
Symphoricarpos albus	Snowberry	Increaser
Symphoricarpos occidentalis	Western snowberry	Increaser
Vaccinium oxycoccos	Low bush-cranberry	Decreaser
Viburnum lentago	Nannyberry	Decreaser
Viburnum opulus	High-bush cranberry	Decreaser

1- From Abouguendia. 1990.; USDA Natural Resource Conservation Service (NRCS). 1984., Prairie Farm Rehabilitation Administration (PFRA). 2000-2013.
2- Different sources suggest different grazing responses

Invasive Weeds

The invasive weed species list below is based on expert recommendations to include regulated noxious weeds (Tier 1, Tier 2 and selected Tier 3 noxious weeds as set out in Manitoba's *Noxious Weeds Act* regulation 2017), and to add other invasive species that threaten the functioning of rangelands and pastures including riparian areas.

The far-right column in Table 4 refers to the designation that is given to these 4 groups of weeds. Each Tier refers to the degree of severity of the weed and response required by legislation. Additional invasive species of concern are represented by the letter "C" in the far-right column and are not currently subject to regulation in Manitoba.

In Table 4:

All Tier 1 and 2 weeds are listed:

- Tier 1 noxious weeds must be destroyed by the landowner or occupier of the land.
- Tier 2 noxious weeds must be destroyed if the area colonized by the weeds is less than five acres; and controlled if over five acres. According to the Act, "control" means to "curtail its growth and prevent its spread beyond its current location".

For the purpose of assessing range and pasture health, only selected Tier 3 weeds are presented while native species and nuisance weeds that are less problematic on rangelands and pastures are absent:

- Tier 3 noxious weeds must be controlled if uncontrolled growth or spread is likely to negatively affect Manitoba's economy or environment or the well-being of residents in proximity.
- The complete list of Tier 3 weeds is available in the *Noxious Weeds Act* regulation.

Additional invasive species of concern are listed but not currently subject to regulation in Manitoba.

Table 4
List of Invasive Weeds

Family	Common Name	Scientific Name	Tier
Amaranthaceae/Amaranth	Palmer amaranth	*Amaranthus palmeri*	1
Amaranthaceae/Amaranth	Russian thistle	*Salsola kali*	3
Amaranthaceae/Amaranth	Russian thistle	*Salsola pestifer*	3
Amaranthaceae/Amaranth	Smooth pigweed	*Amaranthus hybridus*	1
Amaranthaceae/Amaranth	Tall waterhemp	*Amaranthus tuberculatus*	1
Apiaceae/Carrot	Giant hogweed	*Heracleum mantegazzianum*	1
Asteraceae/Aster	Annual sow-thistle	*Sonchus oleraceus*	3
Asteraceae/Aster	Bull Thistle	*Cirsium vulgare*	3
Asteraceae/Aster	Canada thistle	*Cirsium arvense*	3
Asteraceae/Aster	Common burdock	*Arctium minus*	3
Asteraceae/Aster	Common crupina	*Crupina vulgaris*	1
Asteraceae/Aster	Common tansy	*Tanacetum vulgare*	2
Asteraceae/Aster	Diffuse knapweed	*Centaurea diffusa*	1
Asteraceae/Aster	Greater burdock	*Arctium lappa*	3
Asteraceae/Aster	Nodding thistle	*Carduus nutans*	2
Asteraceae/Aster	Orange hawkweed	*Hieracium aurantiacum*	1
Asteraceae/Aster	Ox-eye daisy	*Leucanthemum vulgare*	2
Asteraceae/Aster	Perennial sow-thistle	*Sonchus arvensis*	3
Asteraceae/Aster	Russian knapweed	*Acroptilon repens*	1
Asteraceae/Aster	Scentless chamomile	*Matricaria perforata*	2
Asteraceae/Aster	Spiny annual sow-thistle	*Sonchus asper*	3
Asteraceae/Aster	Spotted knapweed	*Centaurea stoebe*	1
Asteraceae/Aster	Squarrose knapweed	*Centaurea virgata*	1
Asteraceae/Aster	Woolly burdock	*Arctium tomentosum*	3
Asteraceae/Aster	Yellow star-thistle	*Centaurea solstitialis*	1
Balsaminaceae/Touch-me-not	Himalayan balsam	*Impatiens glandulifera*	C
Boraginaceae/Borage	Blue weed	*Echium vulgare*	C
Boraginaceae/Borage	Hound's-tongue	*Cynoglossum officinale*	1
Boraginaceae/Borage	Paterson's curse	*Echium plantagineum*	1
Brassicaceae/Mustard	Garlic mustard	*Alliaria petiolata*	1
Brassicaceae/Mustard	Hoary alyssum	*Berteroa incana*	2
Butomaceae/Flowering Rush	Flowering rush	*Butomus umbellatus*	C
Caprifoliaceae/Honeysuckle	Field scabious	*Knautia arvensis*	2

Family	Common Name	Scientific Name	Tier
Caryophyllaceae/Pink	Baby's breath	*Gysophila paniculata*	2
Caryophyllaceae/Pink	Bladder campion	*Silene vulgaris*	2
Caryophyllaceae/Pink	Bouncingbet	*Saponaria officinalis*	2
Cuscutaceae/Dodder	Dodder	*Cuscuta* spp.	3
Cyperaceae/Sedge	Yellow nutsedge	*Cyperus esculentus*	2
Euphorbiaceae/Spurge	Cypress spurge	*Euphorbia cyparissias*	2
Euphorbiaceae/Spurge	Leafy spurge	*Euphorbia esula*	2
Fabaceae/Legume	Birdsfoot trefoil	*Lotus corniculatus*	C
Hypericaceae/St. John's Wort	St. John's wort	*Hypericum perforatum*	2
Lythraceae/Loosestrife	Purple loosestrife	*Lythrum salicaria*	C
Orobanchaceae/Broom-rape	Red bartsia	*Odontites vernus*	1
Plantaginaceae/Plaintain	Butter and eggs	*Linaria vulgaris*	C
Plantaginaceae/Plaintain	Dalmatian toadflax	*Linaria dalmatica*	2
Poaceae/Grass	Common reed (invasive variety)	*Phragmites australis* spp. *australis*	2
Poaceae/Grass	Common reed (native/tame variety)	*Phragmites australis*	C
Poaceae/Grass	Downy brome	*Bromus tectorum*	2
Poaceae/Grass	Japanese brome	*Bromus japonicus*	2
Poaceae/Grass	Jointed goatgrass	*Aegilops cylindrica*	1
Poaceae/Grass	Serrated tussock	*Nassella trichotoma*	1
Poaceae/Grass	Woolly cupgrass	*Eriochloa villosa*	1
Polygonaceae/Buckwheat	Japanese knotweed	*Fallopia japonica*	1
Polygonaceae/Buckwheat	Mile-a-minute weed	*Persicaria perfoliata*	1
Rhamnaceae/Buckthorn	European buckthorn	*Rhamnus cathartica*	3
Tamaricaceae/Tamarix	Saltcedar	*Tamarix ramosissima*	1

Rare, Endangered, and Threatened Species in Manitoba

Rare, endangered and threatened plant and animal species have various levels of legal protection accorded by the Government of Canada through the *Species at Risk Act* and *The Migratory Birds Convention Act* and the Government of Manitoba through the *Endangered Species and Ecosystems Act.*

Canada's *Species at Risk Act* (*SARA*) seeks to prevent the extinction of wildlife species or to provide for the recovery of extirpated, endangered or threatened species; and to manage species of special concern so that these do not become endangered or threatened. The regulations and protections outlined in SARA are only in place for those species listed on Schedule 1 of SARA. *SARA* regulations apply only to federal lands – except for fish and other aquatic species listed in Schedule 1 of *SARA* – and all bird species listed under the *Migratory Birds Convention Act. The MBCA* prohibitions apply to all private and public lands in Canada, making it illegal to be in possession of a migratory bird or nest, or buy, sell exchange or gift a bird or nest, or make it a commercial transaction.

Manitoba's *Endangered Species and Ecosystems Act* (*ESEA*) seeks to protect and enhance the survival of plant and animal species listed under the *Act;* reintroduce extirpated species into the province; and conserve and promote recovery of species indigenous to Manitoba. Once a species is assigned to the *ESEA* list, it is unlawful to kill, injure, possess, disturb or interfere with the species or its habitat – on both public or private property.

Manitoba's legislation also provides for ecosystems to be listed as Endangered or Threatened under the *ESEA*. Protections for listed ecosystems only apply to those provincial Crown lands that have been designated as Ecosystem Preservation Zones. As of 2017, alvars and the tallgrass prairie are listed as 'Endangered'.

Table 5 provides the complete list of all species listed under *SARA* and/or the *ESEA* as of 2017 that are found in Manitoba. There are differences in the species found on these lists due to variances in where the species is in the federal review process and/or they may reflect species status specific to Manitoba. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is the federal advisory body that assesses wildlife species in Canada; these assessments then inform species designations under SARA.

Important Categories (*COSEWIC, SARA* and *ESEA)*:

Endangered: Extinction or extirpation imminent throughout all or large portion of their Manitoba range.

Threatened: Likely to become endangered or at risk if nothing to reverse factors contributing to vulnerability

Of Special Concern: At risk of becoming threatened or endangered.

Table 5
List of Rare, Threatened and Endangered Species in Manitoba

Amphibians				
Common name	**Scientific name**	**COSEWIC status**	***SARA* (Canada)**	***ESEA* (Manitoba)**
Eastern Tiger Salamander	*Ambystoma tigrinum*	Endangered		
Great Plains Toad	*Anaxyrus cognatus*	Special Concern	Special Concern (Schedule 1)	Threatened
Northern Leopard Frog	*Lithobates pipiens*	Special Concern	Special Concern (Schedule 1)	
Western Tiger Salamander	*Ambystoma mavortium*	Special Concern		

Arthropods				
Common name	**Scientific name**	**COSEWIC status**	***SARA* (Canada)**	***ESEA* (Manitoba)**
Dakota Skipper	*Hesperia dacotae*	Endangered	Threatened (Schedule 1)	Threatened
Dusky Dune Moth	*Copablepharon longipenne*	Endangered	Endangered (Schedule 1)	Endangered
Gold-edged Gem	*Schinia avemensis*	Endangered	Endangered (Schedule 1)	Endangered
Greenish-white Grasshopper	*Hypochlora alba*	Special Concern		
Gypsy Cuckoo Bumble Bee	*Bombus bohemicus*	Endangered		
Monarch	*Danaus plexippus*	Endangered	Special Concern (Schedule 1)	
Nine-spotted Lady Beetle	*Coccinella novemnotata*	Endangered		
Ottoe Skipper	*Hesperia ottoe*	Endangered	Endangered (Schedule 1)	Threatened
Pale Yellow Dune Moth	*Copablepharon grandis*	Special Concern	Special Concern (Schedule 1)	Endangered
Poweshiek Skipperling	*Oarisma poweshiek*	Endangered	Threatened (Schedule 1)	Endangered
Transverse Lady Beetle	*Coccinella transversoguttata*	Special Concern		

Uncas Skipper	*Hesperia uncas*			Endangered
Verna's Flower Moth	*Schinia verna*	Threatened	Threatened (Schedule 1)	Endangered
White Flower Moth	*Schinia bimatris*	Endangered	Endangered (Schedule 1)	Endangered
Yellow-banded Bumble Bee	*Bombus terricola*	Special Concern		
Birds				
Common name	**Scientific name**	**COSEWIC status**	***SARA* (Canada)**	***ESEA* (Manitoba)**
Baird's Sparrow	*Ammodramus bairdii*	Special Concern	Special Concern (Schedule 1)	Endangered
Bank Swallow	*Riparia riparia*	Threatened		
Barn Swallow	*Hirundo rustica*	Threatened		
Bobolink	*Dolichonyx oryzivorus*	Threatened		
Buff-breasted Sandpiper	*Tryngites subruficollis*	Special Concern	Special Concern (Schedule 1)	
Burrowing Owl	*Athene cunicularia*	Endangered	Endangered (Schedule 1)	Endangered
Canada Warbler	*Cardellina canadensis*	Threatened	Threatened (Schedule 1)	Threatened
Chestnut-collared Longspur	*Calcarius ornatus*	Threatened	Threatened (Schedule 1)	Endangered
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened (Schedule 1)	Threatened
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened (Schedule 1)	Threatened
Eastern Whip-poor-will	*Antrostomus vociferous*	Threatened	Threatened (Schedule 1)	
Eastern Wood-pewee	*Contopus virens*	Special Concern		
Eskimo Curlew	*Numenius borealis*	Endangered	Endangered (Schedule 1)	Endangered
Evening Grosbeak	*Coccothraustes vespertinus*	Special Concern		

Common name	Scientific name	COSEWIC status	*SARA* (Canada)	*ESEA* (Manitoba)
Ferruginous Hawk	*Buteo regalis*	Threatened	Threatened (Schedule 1)	Endangered
Golden-winged Warbler	*Vermivora chrysoptera*	Threatened	Threatened (Schedule 1)	Threatened
Harris's Sparrow	*Zonotrichia querula*	Special Concern		
Horned Grebe	*Podiceps auritus*	Special Concern	Special Concern (Schedule 1)	
Ivory Gull	*Pagophila eburnean*	Endangered	Endangered (Schedule 1)	Endangered
Lark Bunting	*Calamospiza melanocorys*	Threatened		
Least Bittern	*Ixobrychus exilis*	Threatened	Threatened (Schedule 1)	Endangered
Loggerhead Shrike *migrans* subspecies	*Lanius ludovicianus migrans*	Non-active	Endangered (Schedule 1)	
Loggerhead Shrike Prairie subspecies	*Lanius ludovicianus excubitorides*	Threatened	Threatened (Schedule 1)	Endangered
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened (Schedule 1)	Threatened
Peregrine Falcon *anatum & tundrius* subspecies	*Falco peregrinus anatum* *Falco peregrinus tundrius*	Special Concern	Special Concern (Schedule 1)	Endangered (Falco peregrinus)
Piping Plover *circumcinctus* subspecies	*Charadrius melodus circumcinctus*	Endangered	Endangered (Schedule 1)	Endangered (Charadrius melodus)
Red Knot *rufa* subspecies	*Calidris canutus rufa*	Endangered	Endangered (Schedule 1)	Endangered
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Threatened	Threatened (Schedule 1)	Threatened
Red-necked Phalarope	*Phalaropus lobatus*	Special Concern		
Ross's Gull	*Rhodostethia rosea*	Threatened	Threatened (Schedule 1)	Endangered
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Special Concern (Schedule 1)	
Short-eared Owl	*Asio flammeus*	Special Concern	Special Concern (Schedule 1)	Threatened
Sprague's Pipit	*Anthus spragueii*	Threatened	Threatened (Schedule 1)	Threatened

Common name	Scientific name	COSEWIC status	*SARA* (Canada)	*ESEA* (Manitoba)
Trumpeter Swan	*Cygnus buccinator*			Endangered
Western Grebe	*Aechmophorus occidentalis*	Special Concern		
Whip-poor-will	*Caprimulgus vociferous*			Threatened
Whooping Crane	*Grus americana*	Endangered	Endangered (Schedule 1)	Endangered
Yellow Rail	*Coturnicops noveboracensis*	Special Concern	Special Concern (Schedule 1)	
Fishes				
Common name	**Scientific name**	**COSEWIC status**	***SARA* (Canada)**	***ESEA* (Manitoba)**
Bigmouth Buffalo	*Ictiobus cyprinellus*	Special Concern	Special Concern (Schedule 1)	
Bigmouth Shiner	*Notropis dorsalis*	Not at Risk	Special Concern (Schedule 3)	
Carmine Shiner	*Notropis percobromus*	Threatened	Threatened (Schedule 1)	
Chestnut Lamprey	*Ichthyomyzon castaneus*	Non-active	Special Concern (Schedule 3)	
Lake Sturgeon	*Acipenser fulvescens*	Endangered		
Northern Brook Lamprey	*Ichthyomyzon fossor*	Non-active	Special Concern (Schedule 3)	
Shortjaw Cisco	*Coregonus zenithicus*	Threatened	Threatened (Schedule 2)	
Silver Chub	*Macrhybopsis storeriana*	Non-active	Special Concern (Schedule 1)	
Lichen				
Common name	**Scientific name**	**COSEWIC status**	***SARA* (Canada)**	***ESEA* (Manitoba)**
Flooded Jellyskin	*Leptogium rivulare*	Special Concern	Threatened (Schedule 1)	

Mammals				
Common name	**Scientific name**	**COSEWIC status**	***SARA* (Canada)**	***ESEA* (Manitoba)**
American Badger *taxus* subspecies	*Taxidea taxus taxus*	Special Concern		
Atlantic Walrus	*Odobenus rosmarus rosmarus*	Special Concern		
Beluga Whale	*Delphinapterus leucas*	Special Concern		
Boreal Woodland Caribou	*Rangifer tarandus*	Threatened	Threatened (Schedule 1)	Threatened
Little Brown Myotis (Little Brown Bat)	*Myotis lucifugus*	Endangered	Endangered (Schedule 1)	Endangered
Mule Deer	*Ogocoileus hemionus*			Threatened
Northern Myotis /Northern Long Eared Bat	*Myotis septentrionalis*	Endangered	Endangered (Schedule 1)	Endangered
Polar Bear	*Ursus maritimus*	Special Concern	Special Concern (Schedule 1)	Threatened
Wolverine	*Gulo gulo*	Special Concern		
Wood Bison	*Bison bison athabascae*	Special Concern	Threatened (Schedule 1)	
Molluscs				
Common name	**Scientific name**	**COSEWIC status**	***SARA* (Canada)**	***ESEA* (Manitoba)**
Mapleleaf	*Quadrula quadrula*	Threatened	Endangered (Schedule 1)	Endangered
Reptiles				
Common name	**Scientific name**	**COSEWIC status**	***SARA* (Canada)**	***ESEA* (Manitoba)**
Prairie Skink	*Plestiodon septentrionalis*	Endangered	Endangered (Schedule 1)	Endangered
Snapping Turtle	*Chelydra serpentina*	Special Concern	Special Concern (Schedule 1)	
Western Hognose Snake	*Heterodon nasicus*			Threatened

Vascular Plants				
Common name	**Scientific name**	**COSEWIC status**	***SARA* (Canada)**	***ESEA* (Manitoba)**
Buffalograss	*Bouteloua dactyloides*	Special Concern	Special Concern (Schedule 1)	Threatened
Culver's root	*Veronicastrum virginicum*			Threatened
Fascicled Ironweed(Can)/ Western Ironweed (MB)	*Vernonia fasciculata*	Endangered		Endangered
Gattinger's Agalinis	*Agalinis gattingeri*	Endangered	Endangered (Schedule 1)	Endangered
Gastony's Cliffbrake	*Pellaea gastonyi*			Endangered
Great Plains Ladies'-Tresses	*Spiranthes magnicamporum*			Endangered
Hackberry	*Celtis occidentalis*			Threatened
Hairy Prairie-clover	*Dalea villosa*	Special Concern	Special Concern (Schedule 1)	Threatened
Riddell's Goldenrod	*Solidago riddellii*	Special Concern	Special Concern (Schedule 1)	Threatened
Rough Agalinis	*Agalinis aspera*	Endangered	Endangered (Schedule 1)	Endangered
Small White Lady's-slipper	*Cypripedium candidum*	Threatened	Endangered (Schedule 1)	Endangered
Smooth Goosefoot	*Chenopodium subglabrum*	Threatened	Threatened (Schedule 1)	Endangered
Western Prairie Fringed Orchid	*Platanthera praeclara*	Endangered	Endangered (Schedule 1)	Endangered
Western Silvery Aster	*Symphyotrichum sericeum*	Threatened	Threatened (Schedule 1)	Threatened
Western Spiderwort	*Tradescantia occidentalis*	Threatened	Threatened (Schedule 1)	Threatened

Draft Manitoba Range and Pasture Health Assessment Workbook

Appendix B – Grassland Health Assessment Score Sheet and Invasive Plants Form

Manitoba Range Health Assessment Score Sheet for Grasslands

Date:	Observer:	Operation or Project:
Field/Management Subunit:		Plot/Transect/Polygon Name:
Latitude/Northing:	Longitude/Easting:	Legal Land Description (LSD/QS - SEC - TWP - RGE - MER):
Ecoregion & Ecosite:		Reference Plant Community (RPC) Name:
Long-term Grazing Intensity (circle one): Ungrazed Light Moderate Heavy		Estimated Current Forage Utilization (%)

Dominant Plant Species

Grass/Grasslikes	%Cover	Forbs	%Cover	Shrubs	%Cover	Trees	%Cover

Health Indicators (*Circle appropriate score for each question*)

1A How does the plant community composition compare to the reference plant community (RPC)?
(*Skip to **1B** if the plant community has more than 50% non-native species*)

The plant community closely resembles the reference plant community (RPC) for the ecosite. Alteration of the plant community composition by disturbance is minimal.	40
Compared to the RPC, alteration of the plant community composition from disturbance or exotic invasion is apparent but light. Decreaser plants are abundant.	30
Compared to the RPC, alteration of the plant community composition from disturbance or exotic invasion is moderate. Decreaser plants are common, but there is an elevated level of increaser or exotic plants.	20
Compared to the RPC, alteration of the plant community composition from disturbance or exotic invasion is significant. Increaser and/or exotic plants have become most abundant.	15
Compared to the RPC, alteration of the plant community composition from disturbance or exotic invasion is severe. Increaser and exotic plants dominate. Decreaser plants are very uncommon, if present.	0

1B Is the plant community dominated by productive and palatable decreaser plants?
(*Complete this question ONLY IF if the plant community has more than 50% non-native species*)

Site is dominated by palatable and productive species, that are vigorous.	15
Site is a mixture of palatable/productive and weedy/disturbance-induced non-native species, with the most palatable plants showing evidence of reduced vigour.	8
Site is dominated by weedy and disturbance-induced non-native species. Any remaining forage plants have reduced vigour.	0

2.1 Are the expected plant layers present?

The structural layers closely resemble the reference plant community (RPC).	10
Compared to the RPC, one life form layer is absent or significantly reduced.	7
Compared to the RPC, two life form layers are absent or significantly reduced.	3
Compared to the RPC, three or more life form layers are absent or significantly reduced.	0

2.2 Is the site subject to brush encroachment?

Woody vegetation is either absent, or present in expected cover amounts, compared to the reference plant community (RPC).	5
Woody vegetation is newly present or exceeds expected RPC levels by up to 15% cover.	3
Woody vegetation exceeds expected levels by over 15% cover.	0

3.1 Is there human-caused bare ground? Human caused bare soil (%)_____ Moss/lichen cover (%)_____
Comments _____

Less than 10% cover of exposed soil is human-caused.	5
Greater than 10% and up to 20% cover of exposed soil is human-caused.	3
Greater than 20% and up to 50% cover of exposed soil is human-caused.	1
Greater than 50% cover of exposed soil is human-caused.	0

3.2 Is the site subject to accelerated erosion?

No sign of soil movement or none beyond the natural extent for the site.	10
Some evidence of human-caused soil erosion.	7
Moderate amounts of human-caused soil erosion.	3
Extreme amounts of human-caused soil erosion.	0

4.0 Is the expected amount of plant litter present?

Litter is more or less uniform, and includes standing dead, fallen dead and variably decomposed plant materials. Average amount (lb/ac) is >75% of the expected amount, and not stifling plants.	20
Litter is reduced, and no longer uniform across the site. 5 to 25% of the area has little to no litter. Average amount (lb/ac) is 50 to 75% of the expected amount. Where litter is excessive (>100% of expected), impacts are beginning to show on the plants.	13
Litter is reduced, with acceptable amounts only in scattered patches. 25 to 67% of the area has little to no litter. Average amount (lb/ac) is 25 to 50% of the expected amount. Where litter is excessive (>100% of expected), impacts are very evident on the plants.	6
Litter is greatly reduced or absent over more than 67% of the area being assessed. Average litter amount (lb/ac) is <25% of the expected amount. Amount of exposed soil may have increased.	0

5.0 Are invasive weeds on the site? List the species: _____

5.1 What is the cover of invasive species?

No invasive weeds are present in the area sampled.	5
Invasive weeds cover <1% of the area.	3
Invasive weeds cover 1 to 15% of the area.	1
Invasive weeds cover greater than 15% of the area.	0

5.2 What is the density & distribution pattern of invasive species?

No invasive weeds are present in the area sampled.	5
Invasive weed infestation is light, with rare or a few sporadic individuals, or one single patch (class 1 to 3).	3
Invasive weed infestation is moderate, with a patch and a few individuals, or several sporadic plants, or several patches (class 4 to 7).	1
Invasive weed infestation is severe, with individuals spreading out from a few patches, or several patches, or continuous to uniform distribution (class 8 to 13).	0

Comments and Recommendations

Total Score:

Health Category (circle one)
Healthy (75-100%)
Healthy w/ Problems (50-74%)
Unhealthy (0-49%)

Apparent Trend (circle one)
Unknown
Upward
Stable
Downward

Photographs

Invasive Plants Form

Date	Observer
Activity #	Land Type

Comments

GPS Coordinates (NAD 83)	Lat.	Long.

LSD:	QS:	SEC:	TWP:	RGE:	M:

Invasive Plant	
Cover %	Distribution
Treatment	
Area (m^2, acres, or ha)	

Invasive Plant	
Cover %	Distribution
Treatment	
Area (m^2, acres, or ha)	

Invasive Plant	
Cover %	Distribution
Treatment	
Area (m^2, acres, or ha)	

Invasive Plant	
Cover %	Distribution
Treatment	
Area (m^2, acres, or ha)	