Native grassland and forest

Rangeland Health Assessment

Field Workbook


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Rangeland Health Assessment
Native Grassland and Forest

by Saskatchewan PCAP Greencover Committee

Regina, Saskatchewan

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TABLE OF CONTENTS

ABOUT THIS WORKBOOK

INTRODUCTION

GETTING STARTED

NATIVE GRASSLAND HEALTH ASSESSMENT

NATIVE FOREST HEALTH ASSESSMENT

APPENDIX 1

APPENDIX 2

APPENDIX 3

ABOUT THIS WORKBOOK

Why Use This Workbook?

Rangelands are complex and diverse, but with practical field training, it is possible to consistently evaluate the state or health of a range site. Traditional range condition assessment can seem complex and cumbersome. The new range health methodology provides a visual system that allows users to readily see changes in range health and to provide information useful when planning management strategies. Range health assessment is intended to help users "tune" their eyes to some key indicators of range health.

Who is This Workbook For?

This workbook is for livestock producers, resource managers, agency staff, energy companies, protected area managers and anyone with an interest in the conservation and maintenance of rangeland plant communities.

What Will the Workbook Do For Me?

The workbook can be used as a field reference for on-the-ground range health assessments as well as an aid for field training.

Where Does It Apply?

The field workbook is designed for application on a full spectrum of range landscapes, including native grassland and native forest.

INTRODUCTION

What are Rangelands?

Rangeland (syn. Range) is land supporting indigenous or introduced vegetation that is either grazed or has the potential to be grazed and is managed as a natural ecosystem. Rangeland includes grassland, grazeable forestland, shrubland, pastureland and riparian areas.

Rangeland ecosystems have traditionally been valued as an important source of forage for the livestock industry. However, awareness of the important functions and values that rangelands provide to society is increasing. Rangeland health must be maintained to retain these functions and values. This field workbook is intended as a tool to measure rangeland health and help producers, resource managers and all users to manage rangelands in a sustainable manner.

What is Range Health?

The term "range health" means the ability of rangeland to perform certain key functions. The term health conveys the meaning that all parts that make up the whole ecosystem are present and work together. Range health is analogous to the health of the human body. When ill or under stress, important functions in the body, such as circulation, immunity, and growth, may be impaired.

For rangelands, the functions of healthy range (Table 1) include: net primary production, maintenance of soil/site stability, capture and slow release of water, nutrient and energy cycling and functional diversity of plant species. Healthy rangelands provide sustainable grazing for domestic livestock and also sustain a long list of other products and values. Declines in range health alert the range manager to develop alternate management strategies.

Table 1: Functions of healthy rangelands and why they are important.

Rangeland Functions	Why is the function important?
Productivity	• Healthy range plant communities are very efficient in utilizing available energy and water resources in the production of maximum biomass • Forage production for livestock and wildlife • Consumable products for all life forms (e.g. insects, decomposers etc.)
Site Stability	• Maintain the potential productivity of rangelands • Protect soils that have taken centuries to develop • Supports stable long-term biomass production
Capture and Slow Release of Water	• Storage, retention and slow release of water • More moisture available for plant growth and other organisms • Less runoff and potential for soil erosion • More stable ecosystem during drought
Nutrient Cycling	• Conservation and recycling of nutrients available for plant growth • Rangelands are thrifty systems not requiring the input of fertilizer
Plant Species Diversity	• Maintains a diversity of grasses, forbs, shrubs and trees • Supports high quality forage plants for livestock and wildlife • Maintains biodiversity, the complex web of life

Why Do We Need a New Methodology?

The range condition concept evolved in response to grazing management-caused deterioration of western rangelands dating back to the early 1900's. Alberta's first stocking guide for prairie grasslands was published in 1966 (Johnston et al. 1966). The concept was extended to Saskatchewan rangelands by Abouguendia (1990). Range condition measures the alteration of plant species composition due to grazing or other disturbances, relative to the climax plant community - the potential vegetation for the site. The range condition approach has worked well in semi-arid grasslands and has been well accepted by land managers. It relies on descriptions of relatively undisturbed range sites and their plant communities. However, the evolution of scientific thought in North America has highlighted a number of shortcomings of the range condition concept. One of the key assumptions is that all declines in range condition are reversible. Experience shows that this may not be the case. Therefore, more data needs to be collected to understand these plant community shifts. Plant succession may establish stable states that are relatively resistant to change, even with decades of rest.

A very significant shortcoming relates to communities that are invaded by non-native species and show no apparent trend back towards climax with any management treatment. Furthermore, the concept of a single climax or reference plant community under a forest community does not address the dynamic character of the forest understory as stand succession proceeds.

The traditional range condition approach does not consider requirements for soil protection and defoliation management impacts on soil. Range managers should be concerned if management practices are leading to accelerated erosion. A more comprehensive range health assessment tool must include soil indicators like site stability, soil protection, and extent of erosion features.

How is Range Health Measured?

Range health expands on the traditional range condition approach that considers plant community type in relation to site potential, by adding new and important indicators of natural processes and functions. Range health is measured by comparing the functioning of ecological processes on an area of rangeland to a standard known as an ecological site description. An **ecological site** is similar to the concept of **range site**, but a broader list of characteristics is described.

An ecological site, as defined by the Task Group on Unity in Concept and Terminology (1995), "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".

With some background knowledge about the local soils and vegetation, range health is rated for a site by scoring a series of questions that reflect key indicators of healthy range.

Why Does Range Health Matter?

Ask anyone what they would prefer, sickness or health. Anyone can describe what it is like to be ill and how much better we can work and play when we are healthy. The same contrast can be demonstrated for rangelands. Healthy rangelands can sustain a broad range of values and benefits (Table 2). When range health declines, so does the flow of values and benefits that might otherwise occur.

Table 2: Values and benefits of healthy rangeland.

Rangeland Users	Values and Benefits of Healthy Range
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 applicable) • Lower maintenance costs like weed control • Does not require the input of inorganic fertilizers and other soil amendments and additives. • Reduced concern for noxious weeds
Resource Managers	• Quality wildlife habitat • Maintain fisheries habitat • Maintain grazing opportunities • Preventing soil erosion • Timber production • Increased total net benefits
The Public	• Esthetic landscape values • Watershed protection • Water quality • Large soil carbon sinks • Bio-diversity • Opportunities for passive and consumptive recreation like hunting and tourism
Socio-Economics and Governance	• Healthy rangelands provide increased cooperation, increased total benefits to society with fewer conflicts to resolve, less regulation and enforcement. This means lower costs!

What Are the Indicators of Range Health?

Range health questions are indirect measures of the following indicators. An evaluation allows the manager to see whether important ecological functions are being performed.

1. *Species composition*

Plant species composition is a fundamental consideration in range health assessment. Plant species composition influences a site's ability to perform functions and provide products and services. 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, prolonged 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 are also the most sensitive to disturbance, and decline with increased disturbance such as a continuous and heavy grazing regime.
- With heavy grazing, species with greater adaptation to disturbance pressure will increase in abundance because they are provided opportunities to compete successfully. These may include disturbance-caused species such as dandelion or invasive species such a leafy spurge or Canada thistle.

Range management objectives should favour the later stages of plant succession (late-seral to reference plant community or good to excellent range condition). Late seral plant communities are superior in the efficient capture of solar energy, in cycling of organic matter and nutrients, in retaining moisture, in supporting wildlife habitat, and in providing the highest potential productivity

for the site. In contrast, early seral stages represent plant communities with diminished ecological processes, which are less stable and more vulnerable to invasion by non-native species. They also have diminished resource values for livestock forage production, wildlife habitat and watershed protection.

While range management goals on native rangeland generally favour late seral stages of plant succession, it is important when formulating range health goals to remember that ecological health and function must also consider the needs of other flora and fauna. Integrated range resource planning may identify several seral stages that are required to accommodate the needs of a diversity of species. For example, certain breeding birds like horned larks and burrowing owls prefer heavily grazed range in early seral stages, while Sprague's pipit favour lightly grazed range with late seral plant communities. To this end, range health assessment may serve as a useful coarse filter tool to assess habitat quality and to gauge desired outcomes. A deliberate decision to manage for lower seral stages (and lower range health scores) must be guided by informed resource management objectives and not merely as a pretext to accommodate reduced range health scores, much like the outdated range management concept of "sacrifice areas".

Managing for lower health scores poses a number of risks, including the potential for invasion by invasive species. Screening of sites that might be vulnerable to invasive species is an important consideration. What plant communities are the most suitable, and what areas are least vulnerable to invasion by non-native species, need to be carefully evaluated. The goal of creating sites on the landscape that retain early seral stage components will not be met if invasive species expand onto the management area.

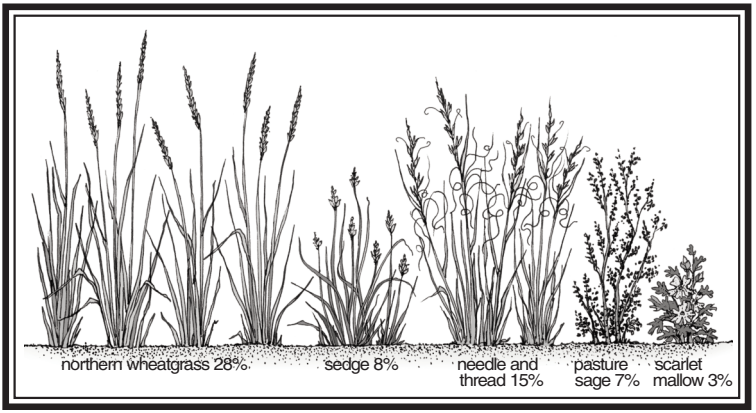
When disturbance impacts are reduced or removed, the present plant community may react in a number of ways:

- it may remain static,
- it may move toward a number of native plant communities including the reference plant community, or
- it may become invaded by invasive species.

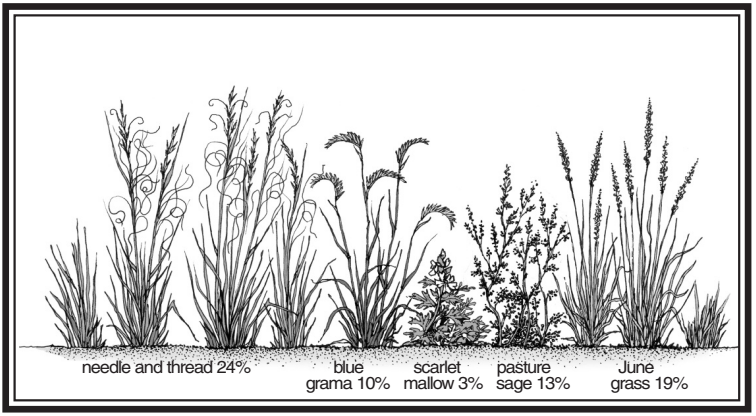
Figure 1 on page 13 provides a simplified example of how ecological status can be recognized on the landscape through a successional pathway commonly found in Saskatchewan rangelands. The plant communities (Figure 1) are primarily native with minor amounts of non-native plants. Range managers normally strive to maintain the reference plant community (Figure 1, top) and later seral communities (Figure 1, middle), which are dominated by northern wheatgrass and needle-and-thread 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 (Figure 1, bottom). In this example grazing resistant grasses and forbs are dominant at successional stages termed mid to early seral. The presence and abundance of disturbance resistant species, like blue grama, June grass and pasture sage, will help the manager to recognize these lower stages of ecological status.

These mid or early seral plant communities can be further degraded with sustained heavy disturbance pressure. Heavy disturbance levels may result in communities dominated by undesirable and invasive non-native species, a condition which may not be reversible. Improved range management may encourage a shift to more desirable species.

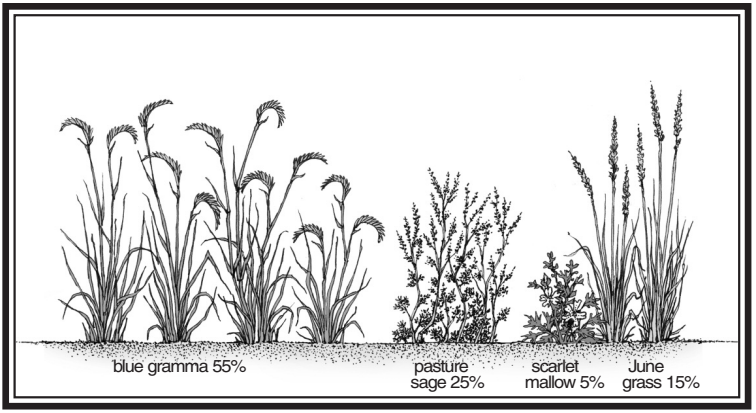


Example of reference plant community



Example of late seral plant community

Illustrations by Chris Jordison



Example of mid to early seral plant community

Figure 1: Successional pathway from healthy range to healthy with problems.

The model in Figure 1 is a simplified presentation of ecological successional pathways in native plant communities. Other ecological thresholds often exist along successional pathways. For more detail on these pathways and thresholds please refer to the Saskatchewan Rangeland Ecosystems publications (available in pdf format from www.pcap-sk.org or in binders from Saskatchewan Ministry of Agriculture, see contact list in Appendix 6).

Some Important Ecological Concepts

- Plant communities are mixtures of plant species that interact with one another.
- Succession is the gradual replacement of one plant community by another over time.
- Successional pathways describe the predictable pathway of change in the plant community as it is subjected to different types and levels of disturbance over time.
- Seral stages are the steps along a successional pathway.
- 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.
- An ecological site 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 status is the degree of similarity between the present plant community and the reference plant community.

2. *Community structure*

Nutrient cycling and energy flow is more efficient in diverse plant communities with varied canopy structures and rooting depths that can use sunlight, water and nutrients from different zones in the canopy and soil.

Plant community structure is particularly important in maintaining net primary production in forested rangelands, and in maintenance of habitat for a spectrum of wildlife species. Greatest forage yield in grasslands is associated with high community structure and the lowest yield with uniformly low community structure. Integrated range resource management objectives may require that management objectives for community structure be altered to create more diversity in the landscape. The presence of both over-and under-grazed patches may be an important source of plant canopy structure in prairie grassland environments, providing valuable habitat diversity for both wildlife and plants.

3. *Invasive species*

Invasive species tend to be rapid-growing plants that are non-native to the rangeland plant community (see Appendix 3 for more information about invasive species and Appendix 4 for a list of invasive species to consider when assessing rangelands in Saskatchewan). These species are seldom a problem in vigorous, well managed rangelands, but may occasionally occur in healthy stands. Invasive species may invade relatively healthy stands, but their presence often indicates a degrading plant community where management-caused disturbance such as overgrazing or other land use, have resulted in available niche space such as bare soil. Some invasive species, such as leafy spurge, may diminish the productivity of a site, threaten biological diversity, and reduce the structure, function, and sustainability of ecosystems. They also reduce the multiple uses and values that rangelands are normally capable of providing. Sustainable grazing management strives to maintain plant vigour and vegetation cover so that space is filled by plant communities that minimize invasion by non-native species.

4. *Site stability*

Rangelands show varying degrees of natural soil stability depending on climate, site, topography and plant cover. The amount of sediment produced by water and wind erosion from a particular ecological site type is termed geologic erosion. Managers strive to prevent accelerated erosion due to land management practices by maintaining adequate vegetation cover and minimizing exposed soil. Adequate vegetation cover protects the soil surface from the impact of raindrops, prevents overland flow, maintains infiltration and permeability, and protects the soil surface from erosion. Soil loss is a serious concern since erosion tends to remove finer particles like clays, silts and organic matter, which are most important to soil fertility and moisture holding capacity. 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. Excess sediment production has a negative impact on water quality since the fine particles that are eroded have a greater potential to absorb and carry nutrients and chemicals.

Some range sites are normally unstable, and erosion and sediment production on these sites can be viewed as a natural process. Unstable sites tend to exhibit significant exposed soil and have shallow soil profiles (e.g. seepage and slumping areas, badlands, thin breaks, saline lowlands, solonetzic soils, some sandy soils).

5. *Hydrologic function and soil protection*

This indicator deals with abundance and distribution of dead plant material (litter) on an ecological site. Plant residue enhances moisture retention and nutrient cycling and is linked to another indicator, site stability (soil exposure and erosion). When functioning properly, a watershed captures, stores and slowly releases moisture associated with normal precipitation events. Uplands make up the largest part of the watershed and are where most of

the moisture is captured and stored during precipitation events. Live plant material and litter (either standing, freshly fallen or slightly decomposed on the soil surface) is important for infiltration (slowing runoff and creating a path into the soil), reducing soil erosion from wind and water, reducing evaporative losses and reducing raindrop impact on the soil surface.

Litter also acts as a physical barrier to heat and water flow at the soil surface. Litter conserves moisture by reducing evaporation, making scarce moisture more effective. Litter removal will reduce forage yields by about 50% in mixed grass prairie. Litter, or organic residue, acts as a nutrient pool on forested sites, is an important rooting medium for many understory plants, protects the soil surface, and provides a home for decomposers.

Photo courtesy of Jim Romo

Figure 2: Litter includes ungrazed residue from previous year's growth including standing stems, fallen stems and leaf material, and partially decomposed material.

GETTING STARTED

How to Use the Field Workbook

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

The field workbook can be used at three levels:

Level 1: Awareness. Basic training will better "tune your eye" to the elements of range health, so that you can recognize general health of the land.

Level 2: Rapid Assessment. With study and repeated field training, the rapid assessment method provided in this field workbook can be used.

Level 3: Range Inventory. With expert training, vegetation inventory methods, and field forms, detailed range vegetation surveys can be completed including range health assessment.

The focus of this workbook is on the Awareness and Rapid Assessment levels. Regarding the Range Inventory level, a future task for Saskatchewan range managers is the development of quantitative range inventory protocols that incorporate the range health concept.

Before Going to the Field

Range health assessment requires basic understanding about the plant communities and soils being assessed. The Saskatchewan Rangeland Ecosystems publications contain descriptions of plant communities for different ecosites

across the province and is an important tool in the interpretation of ecological status. These rangeland ecosite descriptions provide a standard to compare to the plant communities on the ground. A complete list of these documents is provided in the reference material in Appendix 5.

How an area of rangeland is sampled will have a large impact on the quality of the data obtained from a health assessment. The areas to be sampled must provide an accurate representation of the area. Vegetation types and their proportions must be represented in the sampled area to provide an accurate summary of the resources present on a management unit. The scale of assessment can be at the plant community, field or pasture or other management unit (or polygon) size. Topographic maps, aerial photos, and maps outlining fences and other infrastructure on the area to be assessed are of great value in defining management units, vegetation types, and appropriate sampling locations.

Make use of all reference materials available, including:

- Saskatchewan Rangeland Ecosystems publications.
- Forest ecosite guides.
- Soil maps and soil survey reports.
- Lists of native as well as invasive plant species.
- Past range inventory data and reports.

Selecting the Site for Range Health Assessment

- Map and stratify the pasture unit being monitored. This will facilitate the selection of sites on the basis of different soil and vegetation types, so that more uniform areas can be selected. Avoid sampling across different vegetation types (e.g. native grassland to tame pasture). Assessment areas should be representative of the dominant plant communities in the pasture. Keep the assessment reflective of one management regime or grazing unit.

- Determine the purpose of the assessment. Is it to give a comprehensive overview of the management unit in terms of site stability, vegetation, and invasive species, or is it focusing on specific factors, such as invasive species infestations? Sampling areas will need to be adjusted for specific assessment requirements.
- If the area to be evaluated is a riparian area, use the riparian health assessment guide.
- The assessment area should be representative of the dominant plant communities in the pasture.
- Variability is normal on rangelands, even in areas that appear to be of similar vegetation or appearance. What is important is that the assessment captures and be representative of this variation.
- If the pasture has a significant, uneven distribution of invasive species or woody regrowth, consider dividing the pasture into smaller sample areas.

Estimating Vegetation Composition and Soil Exposure

Vegetation sampling can be done at several levels (see page 18), depending on the purpose of the survey and the resources available.

Rapid Assessment level

At the Rapid Assessment level, vegetation can be assessed by walking through the survey area and making "eyeball estimates" of the major species and other features such as bare soil exposure.

Range Inventory level

At the Range Inventory level, for more accurate results, quadrat sampling is necessary. A number of small sample plots called quadrats are distributed over the survey area.

Quadrats should be located by an objective method (e.g. place a quadrat every 20 paces along a transect). For sampling grassland and other herbaceous vegetation, commonly used quadrat sizes are 50 cm by 50 cm squares, or 20 cm by 50 cm rectangles (the "Daubenmire frame"). For sampling shrub vegetation, larger quadrats (e.g. 100 cm by 100 cm) are used. Standard quadrat frames can be made from welded steel rod or plastic pipe.

The larger the number of quadrats, the better the results, but the more time required for the survey. For most rangelands, at least 10 quadrats should be sampled. Numbers from the quadrats (e.g. abundance) are averaged to estimate the value for the survey area.

In pastures, one approach is to relate sampling to water sources. At each water source, a number of quadrats are placed along a transect radiating out from the source, and located within 1 km of the source. Measurements along the transect determine variability due to increased animal impact adjacent to water sources. Indicate the direction of sampling when sampling near water sources.

Estimating abundance

Several different measures are available for estimating the abundance of a plant species. For grassland vegetation, the method used in this workbook is **percent dry weight**. This is the percentage of the species in relation to the total weight of plants inside the quadrat, on a dry weight basis. Percent dry weight can be measured either by clipping and weighing the various plant species, or by visual estimates. Most surveys for range health assessment are done by visual estimates. However, clipping and weighing is valuable for training. Observers can do visual estimates on a quadrat, then clip and weigh to see how accurate the estimates were. With repetition, the observer develops a better eye for the percentages of the various species.

For forest vegetation, the method used in this workbook is **percent cover**. Cover is defined as the vertical projection of

Photo courtesy of Etienne Soulodre

Figure 3: Estimating vegetation composition and soil exposure.

the crown or shoot area of a plant species to the ground surface, expressed as a percent of the area of reference (e.g. a quadrat frame). Percent cover is estimated by looking vertically down on the quadrat and estimating the percent of the area covered by the species. Gaps between the leaves or branches should be subtracted – only the actual plant material contributes to the cover estimate. Cover can be estimated for an individual plant species, groups of plants, dead vegetation (i.e. litter) or for bare soil. When the cover values of all individual plant species are added up, the total cover may exceed 100% because of overlapping foliage from multiple species.

Bare soil is the percent of the area of reference where mineral soil is not covered by live or dead vegetation or rocks (greater than 6 in.) and would be vulnerable to erosion from wind, mechanical movement (e.g. as in hoof shear), raindrop impact or overland flow of water.

Space is provided on the worksheets to estimate percent dry weight or percent cover of four grasses and grass-likes, forbs, shrubs and trees to help establish the major components of the plant community under evaluation. Procedures for conducting detailed quantitative assessment of range vegetation cover can be obtained from various PCAP Partners (see contact list in Appendix 6).

When Should I Rate Range Health?

Range health should be assessed during a season when plants can be readily identified. Common health assessment windows include:

- In the Prairie Ecozone - mid-June to late July.
- In the Boreal Forest - July and August.

T`he window of assessment needs to be modified in years that are wetter or drier than normal. Also, if you intend to measure the total current annual forage production, it is best assessed towards the end of the growing season and before weathering and/or frosts, commonly late July or early August. Furthermore, remember that repeated assessments over a series of years should be done at similar seasons and grazing conditions.

How Much Time Does an Assessment Take?

- In the training phase, it may take 45 min to one hour to complete a range health assessment at a single site.
- With experience and the necessary reference materials, health assessments can be completed in 15 to 20 minutes.

Using the Range Health Worksheets

Examples of range health worksheets to be used in the field when conducting assessments are found in the Appendix of this workbook (see Appendix 1 for **Native Grassland** and Appendix 2 for **Native Forest**). Additional worksheets can be downloaded from: www.pcap-sk.org and www.swa.ca

Worksheets allow for the recording of the date and location of assessment including GPS coordinates. Range health can be estimated around a single point, over a fixed distance between two points (termed a transect), or can be averaged over a polygon (a unit of landscape like a soil or vegetation type). Carefully document and describe the area to be

sampled for future reference. Space is provided to list major grasses, forbs, shrubs and trees and estimate percentages of the dominant species. Plant species abundance will help to identify the plant community. Other methods and tools for detailed vegetation inventories are available from various PCAP Partners (see contact list in Appendix 6).

Photographs and Record Keeping

Photos of the sample area can provide a useful visual record of changes occurring over time. Reference photographs can provide visual support for written observations. The date, direction of view, and time of the photograph should be recorded, so that subsequent photographs can be as similar as possible. Include a card in the picture that indicates the name or number of the plot being photographed. The first photograph should be taken looking directly down on to the plot. The second photo is taken at a low angle from the side of the plot, in order to record plant community structure, approximately 4 meters away. The horizon should be positioned close to the top of the picture.

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 the study area be subdivided into smaller units. Written comments to further support data collected should be recorded and retained. In some cases, a particular question may not fit the observation area. You can contact various PCAP Partners (see contact list in Appendix 6) for clarification or suggestions to improve the methodology.

What is the Next Step?

Determine what kind of pasture being observed. Is it native grassland or forest? Go to the appropriate chapter and work through health assessment questions.

NATIVE GRASSLAND HEALTH ASSESSMENT

Introduction

Before proceeding with a grassland health assessment, review the previous sections on Range Health Indicators and Getting Started. It is also recommended that you familiarize yourself with the reference plant community description in the ecological site description publications. Bring enough worksheets (see Appendix 1) with you out in the field so that you can record the health assessment information and comments. There are five questions in the native grassland health assessment. The first three questions deal with vegetation status and question four and five pertain to hydrologic function and soil protection.

Question 1: Vegetation Status: What is the plant community?

Plant species composition is a key indicator of grassland health. It strongly influences the ability of a site to perform important ecological functions and to provide products and services. In grassland communities, a few key grass species normally provide most of the plant material, and they indicate ecological status. Key stages of plant succession are based on the dominant plant species. These stages are called "seral stages" and they reflect the amount of past disturbance to the plant community.

Traverse the map unit or polygon of interest and estimate plant species composition based on percent dry weight for herbaceous species and percent cover for woody species. Refer to the ecological site descriptions to determine the reference plant community. Additional reference material such as other plant community guides, benchmark data and undisturbed native plant communities can also be helpful in determining the reference plant community.

Scoring:

40 = Plant community composition closely resembles the reference plant community for the site and alteration of the plant community by disturbances is minimal. *Example:* Dry Mixed Grassland, Loam Ecosite: northern wheatgrass – needle-and-thread (reference plant community).

30 = Compared to the reference plant community, the plant community shows minor alteration in plant species composition because of disturbances. Disturbance impact is light to moderate. *Example:* Dry Mixed Grassland, Loam Ecosite: needle-and-thread – wheatgrass - June grass - blue grama

15 = Compared to the reference plant community, the plant community shows moderate alteration, because of disturbances, compared to the reference plant community for the site. The impact of disturbance on plant community composition is moderate to heavy. *Example:* Dry Mixed Grassland, Loam Ecosite: blue grama -needle-and-thread – June grass - western wheatgrass.

7 = Compared to the reference plant community, the plant community shows significant alterations due to disturbances. Disturbance impacts are heavy to very heavy. Plants are mostly native. Some tall-growing, non-native plants may be present. *Example 1*: Dry Mixed Grassland, Loam Ecosite: blue grama – pasture sage – June grass. *Example 2*: Kentucky bluegrass

0 = Compared to the reference plant community, the plant community shows severe to extreme alterations due to disturbances. Disturbance impacts are severe to very severe. Production is mostly from low-growing, non-native, disturbance induced plants. Example 1: dandelion – plantain

Scoring notes for question 1:

- For the Awareness and Rapid Assessment levels (see page 20) estimates should be made over the entire polygon.
- For the Range Inventory level estimates will be based on results from quadrats (see page 20-21).
- For grassland plant communities, the reference plant community is the reference plant community for the site under light disturbance.
- The reference plant community in grasslands is not assumed to be those grassland plant communities that develop under prolonged periods of rest, since the natural system evolved under periodic disturbances especially fire and grazing.
- In many grassland plant communities, long term rest allows a few competitive grass species to become dominant over the grasses and forbs that are normally important in the plant community.

Question 2: Vegetation Status: Are the Expected Plant Layers Present?

Native grasslands normally have a diversity of plant species that vary in size, height and rooting depth. 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. This provides for efficient nutrient cycling and energy flow, supporting forage production and important habitats for wildlife. Structural layers in grasslands include: 1) low shrubs, 2) tall graminoids and forbs, 3) medium graminoids and forbs, and 4) ground cover (graminoids, forbs, moss, and lichen) (Figure 4).

Always rate life form layers relative to the reference plant community. If a plant community loses one layer but gains another layer the assessment is still compared to the reference plant community. Deductions should be made

for losing the expected layer. Ensure that the entire polygon is assessed to determine if life form layers are present.

Scoring:

10 = The life-form layers closely resemble the reference plant community.

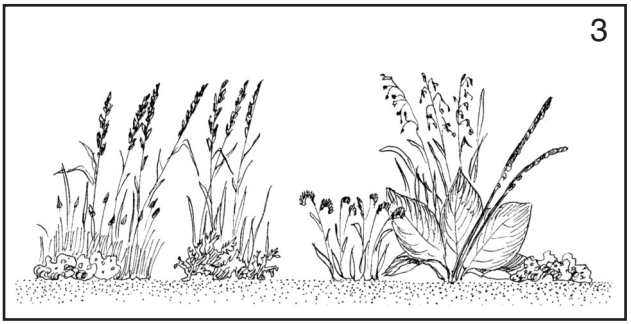
7 = Compared to the reference plant community, one life form layer is absent or considerably reduced.

3 = Compared to the reference plant community, two life form layers are absent or considerably reduced.

0 = Compared to the reference plant community, three life form layers are absent or considerably reduced.

Scoring Notes for Question 2:

- Estimates are made over the entire polygon at the time of assessment. For example, reduce the score if the assessment is conducted early in the season before plants have reached peak height. Estimates should be made based on the current conditions and not on future expected growth.
- Use canopy cover of major life form layers from ecological site description publications to answer this question. Review benchmark data, the Saskatchewan Rangeland Ecosystems publications, photographs or adjoining lightly or undisturbed areas to gain an understanding of expected plant layers. Where possible, compare the unit to a benchmark on a similar ecosite in the area. Keep notes of the variety of species, life forms and age classes across the unit and compare to the available information.
- Determine the normal life form layers expressed in the reference plant community and look for these layers, not the species (e.g. where the reference plant community was Rough Fescue and is now dominated by a vigorous stand of Smooth Brome; this plant community still has a tall graminoid layer and would get full marks for this layer).
- "Considerably reduced" implies that the structural layer is reduced by more than 50% compared to the reference plant community.



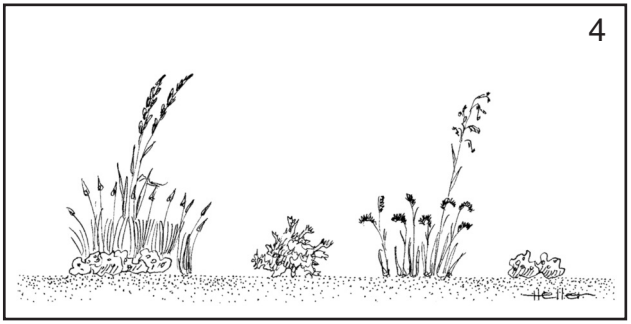


Figure 4: Changes in grassland plant community structure as disturbance levels increase.

1. All expected layers present.

2. Tall grasses and forbs are reduced.

3. Tall layer absent and midlayer reduced.

4. Low grasses and forbs; ground cover reduced.

- If two structural layers show moderate reduction (25 to 50%), then reduce the score by one category.
- If you think a structural layer is reduced, look to see if it is under stress (e.g. low shrubs with heavy browsing use of the 2nd year and older wood).
- If you are unsure how many structural layers should be present, check for disturbance impact on the plants, especially shrubs. Browsing of generally unpalatable shrubs such as snowberry and sagebrush usually indicates more desirable shrubs have been reduced or eliminated by grazing or browsing.
- 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 life form layer, note the missing layer in the comments section and the likely cause (e.g. insect damage, drought, fire, decadence).

Question 3: Vegetation Status: Are Invasive Species Present?

This question considers the degree of invasive species infestation of the site. Infestation is a function of plant density and patchiness or evenness over the monitoring area. All invasive species are considered collectively, not individually. Use the list of invasive species in Appendix 4. Record presence and density distribution of all invasive species that you observe as you examine the site.

The cover (Figure 5) and density distribution (Figure 7) of invasive species in native grassland can provide clues as to the health and function of the grassland. Invasive species commonly establish where disturbance has reduced the vigour of plants and has increased exposed ground.

Question 3.1: Cover of invasive species

Scoring:

5 = No invasive species present.

3 = Invasive species present with a total cover less than or equal to 1%.

0 = Invasive species present with a total cover over 1%.

Question 3.2: Density distribution of invasive species

Scoring:

5 = No invasive species on the site (see the below scoring notes).

3 = Invasive species are present at a low level of infestation (density distribution 1).

0 = Invasive species are present at a moderate to high level of infestation (density distribution 2 to 12).

Scoring notes for question 3:

- Estimates should be made over the entire polygon.
- Variations in species invasions can be averaged across the site. Observations are a cumulative evaluation of all the invasive species present. Record specific canopy cover and density distribution of specific invasive species in the comment section in the field worksheet.
- The density and distribution of dots in Figure 7 relates to the density and distribution of invasive species in the sampling area (polygon). Point ratings decline as infestation increases and rating values are on the right margin of Figure 7.
- Include invasive species listed in Appendix 4.
- If the grassland has a considerable, uneven distribution of invasive species, divide the native grassland into smaller sampling areas.

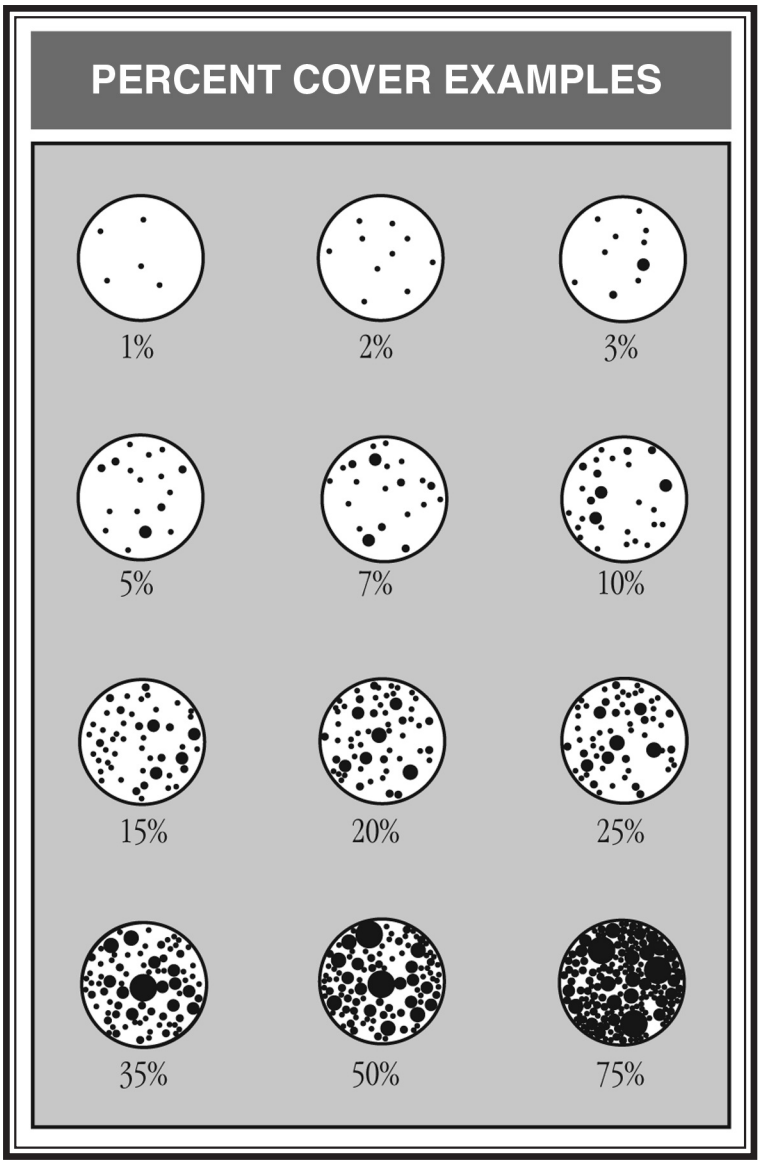


Figure 5: This graphic helps to develop a mental picture of the percent cover of bare soil or vegetation.

Table 3 Examples of invasive species (see Appendix 4 for a complete list).

Common name	Latin name
crested wheatgrass	*Agropyron cristatum*
nodding thistle	*Carduus nutans*
Canada thistle	*Cirsium arvense*
quack grass	*Elytrigia repens*
leafy spurge	*Euphorbia esula*
scentless chamomile	*Matricaria perforata*

Photo courtesy of Don Fontaine

Scentless chamomile

Photo courtesy of Don Fontaine

Leafy spurge

Photo courtesy of Steve Dewey, Utah State University, Bugwood.org

Canada thistle

Photo courtesy of Malin Hansen

Crested wheatgrass

Figure 6: Examples of invasive species.

DENSITY DISTRIBUTION			
Class	Description of abundance polygon	Distribution	Score
0	None		5
1	Rare		3
2	A few sporadically occurring individual plants		0
3	A single patch		
4	A single patch plus a few sporadically occurring plants		
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		
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 7: Density distribution guide for rating invasive species infestation. The density and distribution of dots in relation to the density and distribution of invasive species in the sampling area (polygon). Point ratings decline as infestation increases and rating values are on the right margin.

Question 4: Hydrologic Function and Soil Protection: Site Stability

Is the site subject to accelerated erosion? Is there management-caused bare ground?

To estimate "management-caused" bare ground and recognize accelerated erosion, determine the normal soil exposure and erosion processes for the site. Most sites in Saskatchewan have continuous ground cover. If the ecological site is normally unstable, look for management-caused erosion over and above normal or geologic rates. Early or initial erosion may require close observation by getting down close to the ground and looking under plant cover to see if there is any movement of light surface material (litter or soil). Look for evidence of erosion on any slope as deposition of soil particles at the bottom of the slope.

Refer to the ecological site description for the site to determine if it is naturally unstable or if the extent of bare ground is within the normal range for the site. Reduced live plant and litter cover from excessive disturbance can lead to erosion. Indicators of severe disturbance include abundant rutting, manure, hoof tracks and plant pedastalling (Figure 8). Slopes may show signs of rutting, hoof shearing and soil exposure.

Question 4.1: Is there more soil erosion than expected for this site?

Scoring:

10 = No sign of soil movement, deposition of soil/litter, plant pedastalling, coarse sand or aggregate remnants, flow patterns and/or scouring, rutting or hoof sheering beyond the natural extent for the site.

7 = Some evidence of slight soil movement or deposition of soil/litter, plant pedastalling, coarse sand or aggregate remnants, flow patterns and/or scouring, that is management-caused and beyond the natural extent for the site. Old erosion features may be stable and vegetated. Flow patterns may be short and shallow. Extent of exposed soil is only slightly greater than expected for the site.

3 = Moderate amounts of soil movement or deposition of soil/litter, plant pedastalling, flow patterns and/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. The extent of exposed soil is greater than expected for the site but vegetation (live plants and litter) still protects most of the site. Signs of hoof sheering 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. Pedastalled plants with exposed roots and rocks exposed or sitting on the surface. Hoof sheering may be common across the site, beyond localized patches. There is evidence of instability.

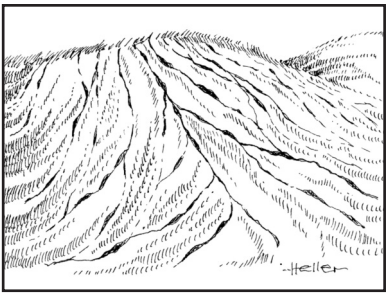
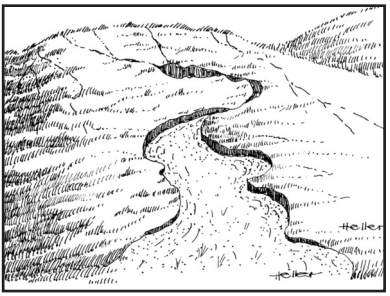
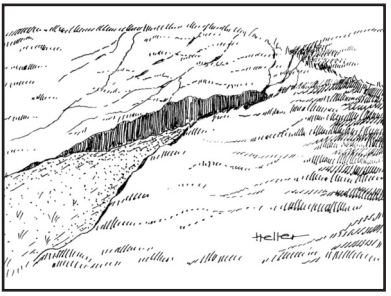


Figure 8: Examples of soil erosion, compaction, hoof shearing, and trailing.

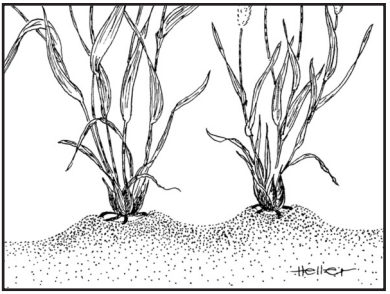
a. Rill erosion



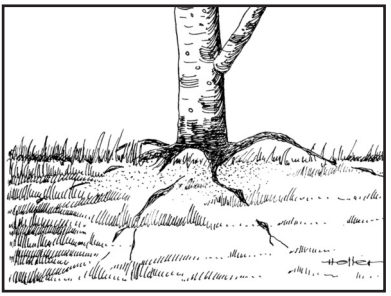
b. Gully erosion (macro)



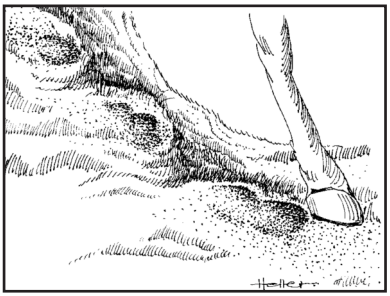
c. Gully erosion (macro)



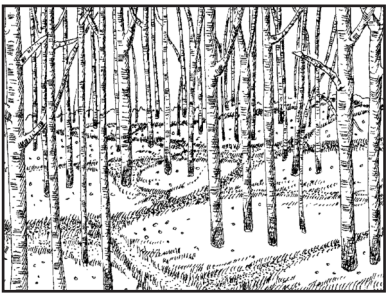
d. Pedastalling



e. Compaction (macro)



f. Hoof shearing (micro)



g. Trailing (macro)

Question 4.2: Is there more bare soil than expected for this site?

Scoring:

5 = 10% or less of area is exposed soil that is management-caused.

3 = greater than 10 and up to 20% of the area is exposed soil that is management-caused.

2 = greater than 20 and up to 50% of the area is exposed soil that is management-caused.

0 = greater than 50% of the area is exposed soil that is management-caused.

Observed bare soil ____ *minus* Expected bare soil ____ *equal* Management-caused bare soil

Scoring notes for question 4.2:

General scoring comments

- Estimates should be made over the entire polygon.
- To estimate management-caused bare soil, first estimate total bare soil, then subtract the amount considered to be expected or naturally occurring. The difference will be considered management-caused bare soil. Report this amount on the field sheet. Take time to record moss and lichen cover as well, because this layer helps to stabilize the site. Example: if total bare soil is 10% and expected bare soil is 2%, then management-caused bare soil equals 8%. This site would receive full marks of "5" (Figure 9).
- The Saskatchewan Rangeland Ecosystem publications provide soil exposure standards for judging the "management-caused" portion. The publications are available in pdf format from www.pcap-sk.org or in binders from Saskatchewan Ministry of Agriculture (see contact list in Appendix 6).
- This question focuses on increased soil exposure and the increased potential for soil erosion on range sites that are normally stable, and is 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 disturbed sites.
- Ground squirrel and pocket gopher activity increases in response to foraging opportunities associated with invasive species.
- On heavily disturbed sites, a considerable amount of bare soil from rodent burrows should be considered management-caused.

People, livestock and wildlife impacts on bare soil

- Large numbers of people, livestock, elk and deer may increase bare soil.
- Wildlife winter ranges may be especially prone to hoof shearing, resulting in increased bare soil.
- When wildlife impacts increase soil exposure, treat it as management-caused and note the source of the impact in the comment section.

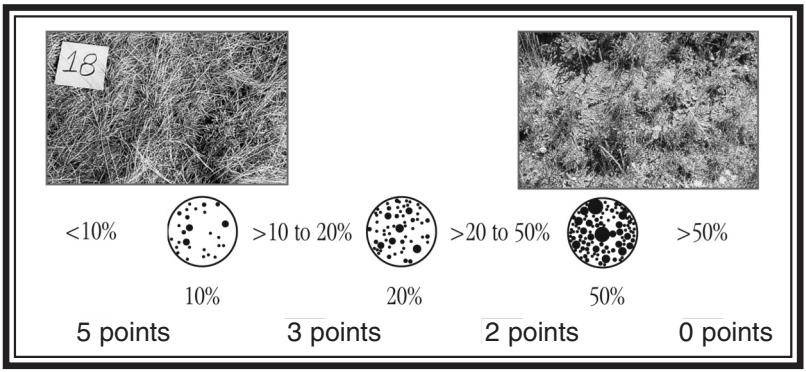


Figure 9. Increase in management-caused bare soil as disturbance levels increase.

Question 5: Hydrologic Function and Soil Protection: Is the Expected Amount of Litter Present?

In grasslands, litter acts as a physical barrier to heat and water flow at the soil surface (Figure 10). Litter conserves scarce soil water by reducing evaporation, improving infiltration and cooling the soil surface. This question

evaluates the ability of a site to retain soil water based on amounts of organic residue. Litter weight (lb/acre) estimates are made in representative areas and compared to "litter normals" that are appropriate to the site being evaluated. Litter is sampled from a number of representative areas by hand raking from a 0.25m^2 area or plot frame. Figure 11 provides litter normals for a broad range of ecoregions and ecosites. Litter normals were developed from long-term benchmark monitoring of healthy and productive sites under minimal disturbance from the Rangeland Health Assessment workbook developed in Alberta (Adams et al. 2005). These litter normals have been reviewed and compared with Saskatchewan data, and the recommended litter normals for Saskatchewan ecological sites are presented in Figure 11. Litter includes ungrazed residue from previous year's growth including standing stems, fallen stems and leaf material, and partially decomposed material (Figure 10). Estimate litter across the entire polygon. The reference should be minimally disturbed range with enough litter to retain soil water. Look at the distribution, evenness and patchiness of litter across the site.

Scoring:

25 = Litter amounts are more or less uniform across site and include standing dead plant material, fallen dead plant material and variably decomposed material on the soil surface. Litter standing crop (lb/acre) is in the range of 65 to 100% of expected amounts under moderate disturbance.

13 = Litter amounts appear slightly to moderately reduced and are somewhat patchy across the site. The litter is less frequent in distribution with fallen dead plant material and variably decomposed material on the soil surface being the dominant litter types. Litter standing crop (lb/acre) is in the range of 35 to 65% of expected amounts under moderate disturbance.

0 = Litter amounts appear greatly reduced or absent. The extent and distribution of exposed soil has increased. There is little or no standing or fallen litter. Decomposing material on the soil surface is the main type of litter. The distribution of litter is not uniform across the site. Litter standing crop (lb/acre) is less than 35% of amounts expected under moderate disturbance.

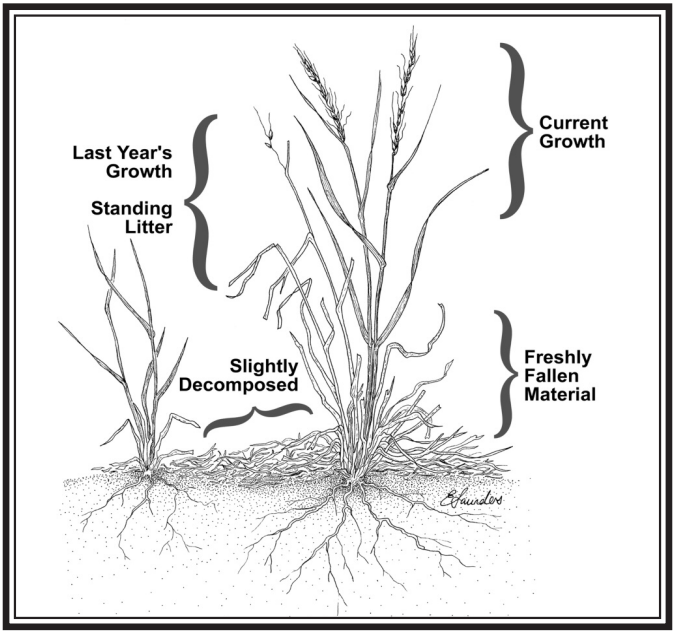


Figure 10. Various types of litter associated with native grasslands.

Scoring notes for question 5:

- In the Prairie Ecozone, litter amounts are closely linked to plant growth. The extra effort it takes to estimate litter levels provides a strong prediction of the ability of the site to retain soil water.
- Another option for learning to measure litter amounts is by collecting litter and making litter bags with known litter weights. Compare these bags to the area being scored for litter. Hand rake litter from a 0.25m^2 frame, oven dry it and weigh it. To convert the dry weight into kg/ha, multiply the weight in grams by 40. To convert the dry weight into lbs/acre, multiply the weight in grams by 35.6. To facilitate future assessments, it is a good idea to keep bags of litter samples that represent different reference plant communities.
- When rating range health, practise hand raking litter from representative areas (from 0.25m^2 frames; 50 cm x 50 cm or 18 inches by 18 inches) and then make comparisons to the standards found in the litter samples or the pictures in Figure 11.

- When raking litter don't include in the sample any herbage that grew in the current year. Include all litter from previous years' growth, including previous years' standing litter.

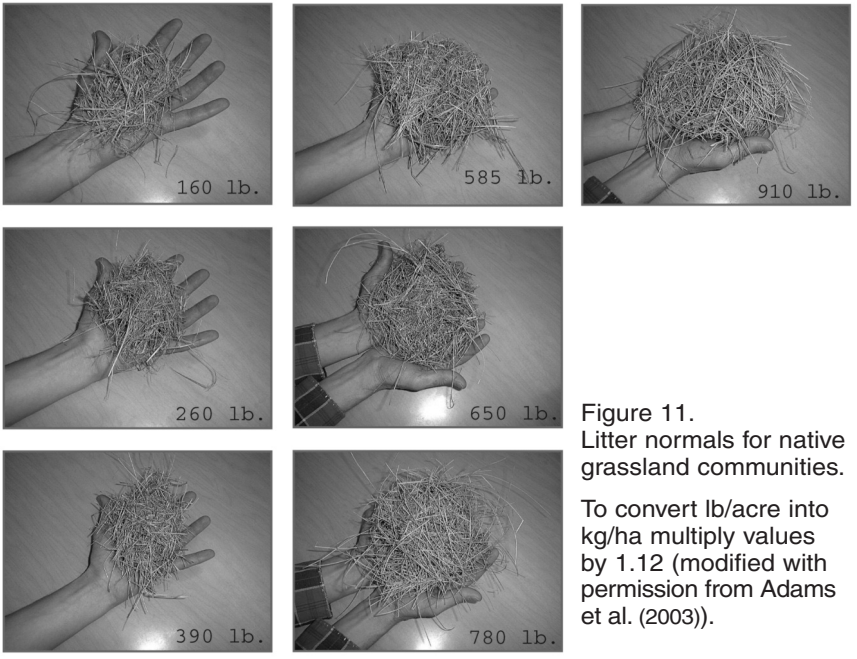


Figure 11.
Litter normals for native grassland communities.

To convert lb/acre into kg/ha multiply values by 1.12 (modified with permission from Adams et al. (2003)).

Rangeland Health Assessment Litter Normals (lb/ac)

Ecoregion	Ecosite	Healthy		Healthy with problems	Unhealthy
		Average	>65%	65%-35%	<35%
Dry Mixed Grassland	Loam	400	>260	260-140	<140
	Solonetzic	250	>160	160-85	<85
	Thin	150	>95	95-50	<50
Mixed Grassland	Loam	600	>390	390-210	<210
	Thin	300	>195	195-105	<105
Aspen Parkland	Loam	1500	>975	975-525	<525
	Sandy Loam	1100	>715	715-385	<385
	Sand	800	>520	520-280	<280
	Dunes	400	>260	260-140	<140
Cypress Upland	Loam	900	>585	585-315	<315

Notes:

NATIVE FOREST HEALTH ASSESSMENT

Introduction

This native forest health assessment method is intended to be used for poplar forests (i.e. trembling aspen or balsam poplar), which account for most of the forest used for grazing in Saskatchewan. The method is applicable to pure hardwood stands and to mixedwood stands where poplars are mixed with spruce or other conifers. Pure softwood forests (spruce or pine) have very different vegetation, and methods have not yet been developed for assessing them. The method applies best to mature stands. In very young stands, the dense poplar foliage close to the ground prevents the development of typical understory vegetation, avoid sampling these stands if possible.

The method can be used both in the Boreal Transition Ecoregion (the "forest fringe") and in the Aspen Parkland Ecoregion, with some differences between the two detailed in the method. In the Aspen Parkland, many land parcels are a patchwork of poplar forest and grassland. While ideally both types should be assessed, time constraints often limit assessment to one or the other. The grassland assessment method is recommended if there is enough grassland for meaningful assessment, because small bluffs of trees are highly variable, and because changes due to grazing are better understood in grassland. As a rule-of-thumb, if more than 20% of the upland is native grassland, use the grassland method; if more than 80% is forest, use the forest method.

Heavy livestock grazing in poplar forests causes a number of changes. Natural forests have several layers of understory vegetation, including tall and short shrubs, tall and short herbs, and mosses and lichens. Under heavy grazing, shrub and herb layers become shorter and more open. Some plant species are preferred by grazers, so they gradually decrease in abundance (decreaser species), while other species that are less preferred gradually increase (increaser species).

Livestock trampling and other disturbances (e.g. ATV traffic) can compact or remove the protective layer of surface organic matter, exposing bare soil and promoting erosion. Both the loss of plant cover and the exposure of bare soil can encourage non-native species to move into the site. These plants are not part of the natural forest, and some of them are highly invasive, aggressively crowding out the native species.

To assess a parcel of land (e.g. a fenced grazing field), pick a location that represents the main area used for grazing. Avoid concentration areas at water sources, at gates, or along fences, but also avoid remote parts of the parcel that are rarely grazed. Assessment should be done on the main range site in the area. For example, if the area is mostly aspen forests on loamy uplands, with a few small wetlands, assess the loamy uplands. Record the location where the assessment was done, either by marking it on a map or aerial photograph, or by taking a GPS reading.

For comparison purposes, also look at an area of forest that is ungrazed or only lightly grazed. It is important that this be in the same general type of vegetation and on the same range site as the area being assessed. For example when assessing a pasture in mature aspen forest on sandy soils, also locate an ungrazed area in mature aspen forest on sandy soils. This area is called a **reference plant community**, and it represents the potential plant community for that type of land. The Saskatchewan Rangeland publications describe the potential vegetation and soil characteristics for various site types. The publications are available in pdf format from www.pcap-sk.org or in binders from Saskatchewan Ministry of Agriculture (see contact list in Appendix 6). If there is an ecological site description for the type of land being assessed, use it for reference community information.

Two alternative approaches have been developed for assessing forest health:

- An indicator method, in which questions are answered about the area being assessed. Indicators are provided for both vegetation status and soil protection. This method is most suitable for one-time assessments and for communicating with producers and land managers.
- A quantitative method, in which sampling and measurements are used to determine vegetation status. Soil protection is still assessed by indicators. This method is more suitable for monitoring.

For each method, there are two sets of questions, which produce two components of the range health score. The first set addresses **vegetation status**, and includes questions on species composition, vegetation structure, and invasive species. The second set addresses **hydrologic function and soil protection**, and includes questions on the surface organic layer, signs of soil erosion, and exposure of bare soil. These two components are added together to give the overall range health score.

Showing the two component scores gives insight into problem areas. For example, in many cases the score for vegetation status is low, but the score for hydrologic function and soil protection is still high. This indicates that even though the plant community has been disrupted, at least the site is still being protected. However, the impact that has changed the plant community could eventually lead to degradation of the soil, indicating the need for changes in management.

To use either method, be familiar with the main plant species making up the vegetation. Those with little training in plant identification are advised to spend some time in the field with someone who knows plants, before doing an assessment.

For help with plant identification, the following publications are recommended:

• Saskatchewan Forage Council. 2007. *Field guide: identification of common range plants of northern Saskatchewan.* (www.saskforage.ca).

• D. Johnson, L. Kershaw, A. MacKinnon, and J. Pojar. 1995. *Plants of the western boreal forest and aspen parkland.* Lone Pine Publishing, Edmonton, AB.

The worksheets for the indicator and quantitative method (Appendix 2) can be used in the field to record scores for each of the range health questions, and to write down comments.

INDICATOR METHOD

Question 1: Vegetation Status: What is the Plant Community?

This question examines the species composition of the plant community.

• Plant species composition is a key indicator of forest health.

• Plant species influence a site's ability to provide forage.

• Shrubs, forbs and grasses provide a diversity of forage and nutrient values.

• Changes to plant species composition can reduce forage production and management flexibility.

• Management goal is to maintain the production potential of the plant community at the level produced under a light to moderate grazing regime. The plant community should resemble its potential or the reference plant community for the site and forest successional stage.

• As grazing pressure increases from light to moderate to heavy and very heavy, there is a change in the understory species composition.

Examine the area being assessed and identify the main plant species present. Look particularly for decreaser species and non-native species (see the worksheets in Appendix 2 for lists of species in these categories). Compare the vegetation on the assessment area with a reference community (an ungrazed or lightly grazed area on the same type of land), or check the ecological site description if there is one.

Scoring:

40 = Plant community resembles the reference community for the site. The full range of native species found in the reference community is present. Decreaser species (both shrubs and herbs) are abundant and vigorous. *Example:* aspen/low-bush cranberry/ rose/ tall forb.

30 = Minor changes from the reference community. Decreaser species are less abundant or less vigorous than in the reference community, and there has been some increase in shorter or less palatable species. *Example:* aspen/rose/low-bush cranberry/low forb.

15 = Moderate changes from the reference community. Decreaser species have been substantially reduced or eliminated, and replaced by shorter or less palatable species. Non-native species have increased in abundance. *Example:* aspen/rose/clover.

0 = Significant changes from the reference community. Non-native species have become dominant, accompanied by unpalatable native species. *Example:* aspen/Kentucky blue grass/dandelion

Question 2: Vegetation Status: Are the Expected Plant Layers Present?

Examine the structure of the vegetation. Natural forests show several layers (see Figure 12):

- Tree layer (e.g. aspen, balsam poplar).
- Tall shrub layer (e.g. alder, willow).

- Mid shrub layer (e.g. saskatoon, chokecherry, hazelnut, dogwood).
- Short shrub layer (e.g. rose, snowberry).
- Tall herb layer (e.g. sarsaparilla, peavine, tall grasses).
- Short herb layer (e.g. strawberry, wintergreen).
- Moss and lichen layer.

When plants occupy different layers, they are able to use sunlight, water and nutrients from different zones in the vegetation canopy and soil. This diversity supports optimum grazing for livestock, provides diverse habitats for many wildlife species, and benefits other uses and values. Heavy grazing impact tends to thin out and eventually eliminate the taller vegetation layers, leaving a simpler structure with fewer layers (Figure 12). As structure declines, so do the values and benefits from the site.

The density of each of the vegetation layers depends on the type of land (for example, the shrub layers are denser on loamy sites than on sandy sites), so the structure should be compared with a reference community on the same type of land.

Scoring:

20 = All vegetation layers are present. The structure of the forest resembles the reference community.

10 = One vegetation layer is absent or significantly reduced (less than half of the cover in the reference community).

5 = Two vegetation layers are absent or significantly reduced (less than half of the cover in the reference community).

0 = Three vegetation layers are absent or significantly reduced (less than half of the cover in the reference community).

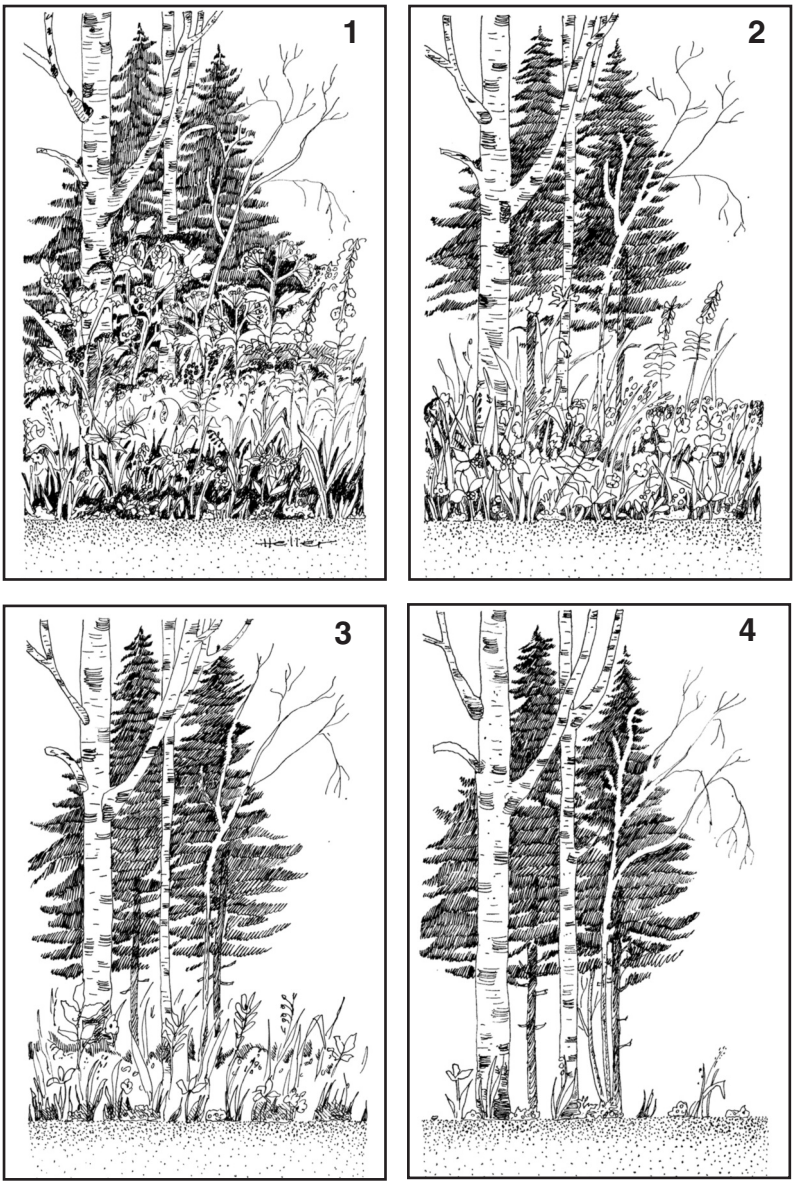


Figure 12. Changes in forest plant community structure as disturbance increases. 1. All expected layers present. 2. Tall shrubs reduced. 3. Tall and medium shrubs eliminated. 4. Two shrub layers missing, as well as grass and tall forb layers.

Question 3: Vegetation Status: Are Invasive Species Present?

While exploring the area, look particularly for those non-native species considered to be invasive (see Appendix 4 for a list of invasive species). Invasive species are those that show a strong tendency to invade areas of natural vegetation, often aggressively crowding out the native plant species. Some invasive species are considered noxious and will significantly decrease the quality of the range. Other species, however, may be found as forage plants in tame pastures (e.g. smooth brome). Estimate the percent cover of invasive species (i.e. the percentage of the land area in the parcel covered by these plants).

Scoring:

10 = No invasive species present.

5 = Invasive species present but cover less than 1%.

0 = Cover of invasive species more than 1%.

Question 4: Hydrologic Function and Soil Protection

This question deals with the ability of the area to store water and to prevent soil erosion. Live plant material and the LFH layer made up of decomposing plant material allows infiltration (slow runoff), reduce soil erosion from wind and water, reduce evaporation losses and reduce raindrop impact on the soil surface, while areas with a lot of bare soil are subject to erosion.

Question 4.1: Is there more soil erosion than expected for this site?

Accelerated erosion due to management activities is a serious issue, leading to long-term negative impacts on the site potential. If the early signs of accelerated erosion are recognized early, management changes can be made before the situation becomes serious.

To recognize accelerated erosion, knowledge of normal soil erosion processes in forest plant communities is required. Sandy forest sites or steep river breaks may be naturally unstable and erosion prone. However, most forest range sites are stable and have no visible signs of erosion.

Signs of erosion include: hoof-shearing, excessive livestock trails, rills and gullies, pedastalled plants, and deposition of soil or litter in low areas or against obstacles (Figure 13).

Scoring:

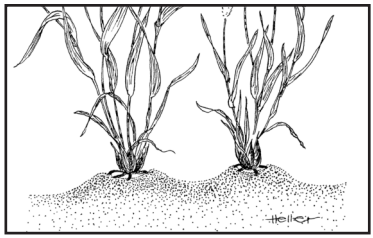
5 = No signs of soil erosion.

3 = Some signs of soil erosion at a small scale (e.g. small rills or occasional hoof-shearing).

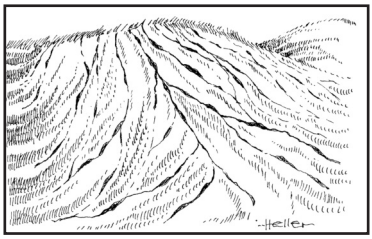
1 = Signs of soil erosion at a large scale (e.g. well-defined flow patterns or frequent trailing and hoof- shearing).

0 = Obvious signs of soil erosion at a large scale, with movement of soil off the site.

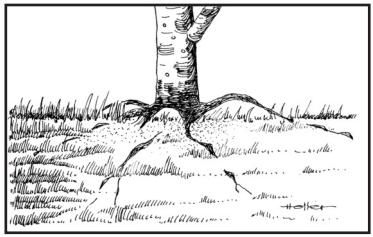
Figure 13: Examples of soil erosion, compaction, hoof shearing, and trailing.



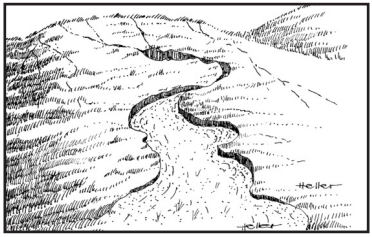
d. Pedastalling



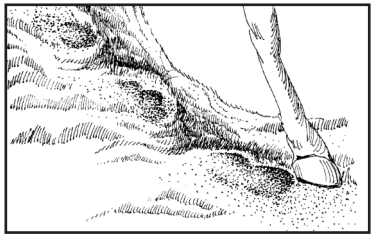
a. Rill erosion



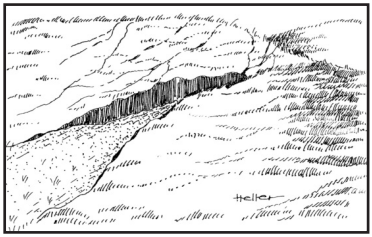
e. Compaction (macro)



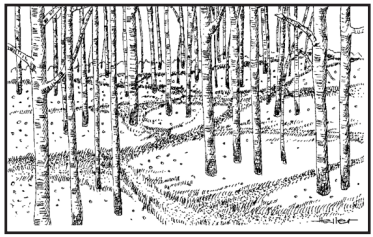
b. Gully erosion (macro)



f. Hoof shearing (micro)



c. Gully erosion (macro)



g. Trailing (macro)

Question 4.2: Is there more bare soil than expected for this site?

Exposure of bare soil as a result of management activities (e.g. livestock grazing, vehicle traffic, timber harvesting) is an indicator of reduced range health. In healthy forests, the soil is covered by plants (including mosses and lichens) and surface organic matter (LFH). If the soil is bare, it means that plant cover has been reduced and the LFH layer has been disturbed, reducing their role in hydrology and nutrient cycling. Exposure of bare soil is the main factor leading to soil erosion.

In most undisturbed forests, the percent of bare soil is zero. However, sandy sites, especially in the Aspen Parkland, may have some bare soil even in ungrazed reference areas. Estimate the percent of the area that is exposed bare soil (Figure 14). If there is a measurable amount of bare soil in reference areas, only the amount that is beyond this natural level should be considered as a sign of reduced range health. For example, if reference areas have 10% bare soil, and the grazed area being assessed has 30% bare soil, then 20% can be attributed to management impacts.

Include the bare soil found along livestock trails in the portion attributable to management impacts. Also, rodent activity increases when there is an increase of invasive, tap rooted species. On heavily grazed sites, most of the bare soil from rodent burrows should be attributed to management impacts.

Scoring:

10 = less than 1% of area is bare soil that can be attributed to management impacts.

7 = 1% to 5% of area is bare soil that can be attributed to management impacts.

3 = 5% to 15% of area is bare soil that can be attributed to management impacts.

0 = More than 15% of area is bare soil that can be attributed to management impacts.

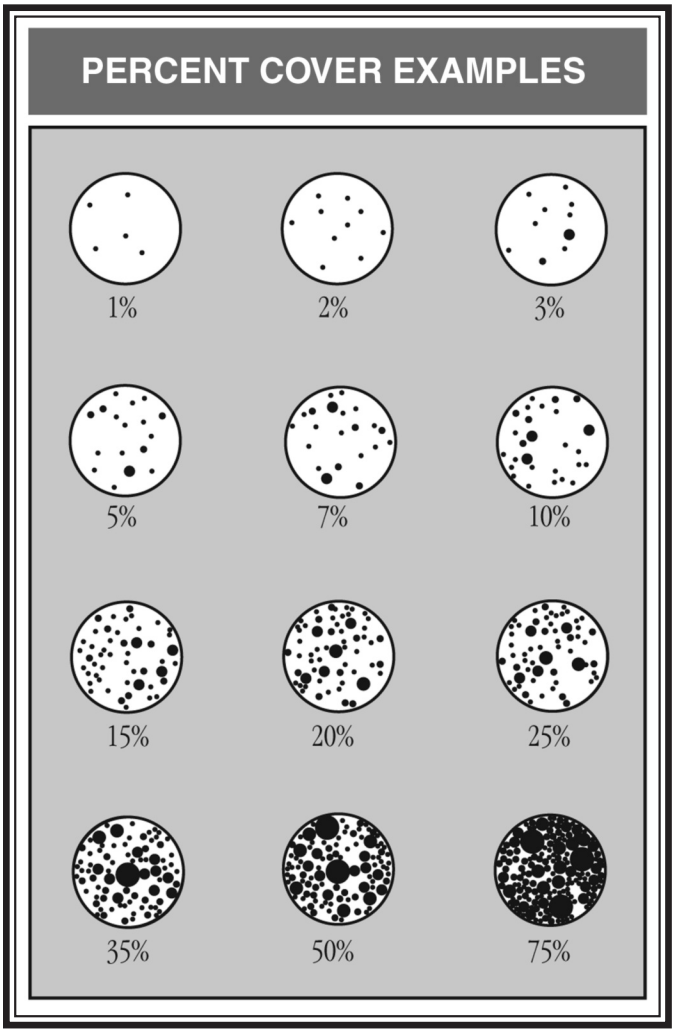


Figure 14: This graphic helps to develop a mental picture of the percent cover of bare soil or vegetation.

Question 5: Hydrologic Function and Soil Protection: How Thick is the Surface Organic Layer (LFH)?

Examine the surface organic layer, made up of decomposing leaves and other plant parts, that covers the mineral soil. This includes **litter**, **fermenting** and **humified** layers, and so is referred to as the "LFH". In undisturbed

forests, the LFH layer will be spongy and relatively thick. The actual thickness varies between dry and moist sites, so some field sampling is required to determine normal thickness for the site being assessed. A healthy LFH layer performs important functions, including storing and releasing energy and water, buffering erosive forces, reducing evaporation, and providing nutrients for forest plants. By measuring the thickness and sponginess (compressibility and resistance) of the LFH, an indirect measurement of the health of the nutrient and water cycling processes on the site can be obtained. Impacts such as livestock grazing or vehicle traffic can break down and compact the LFH layer, making it thinner and less porous.

Check the LFH layer in the grazed area, and in a reference area (ungrazed or lightly grazed) on the same type of soil (Figure 15). Measure the thickness of the LFH layer by digging a small pit to expose a vertical cross-section of the soil. This should be done in at least three places to get an average thickness. Another method is the "**LFH Pencil Test**", which also gives an indication of whether the layer has been compacted. To do this, place the eraser end of a sharp pencil (or similar object) in the middle of the palm of the hand and then, with a straight arm, push the pencil into the LFH. Gauge the resistance felt as the pencil moves through the LFH. Compare the resistance in the grazed area to that in the reference community – generally more resistance is found where there has been compaction because of grazing impact. Thickness of the LFH can be estimated by the distance the pencil penetrates before it hits mineral soil. If sampling after leaf fall, carefully brush away the leaves from the current year to ensure an accurate measure of LFH thickness. Calculate the percent reduction in thickness compared to the reference community. For example, if the LFH is 10 cm thick in the reference community and 6 cm thick in the grazed community, it has been reduced by 40%.

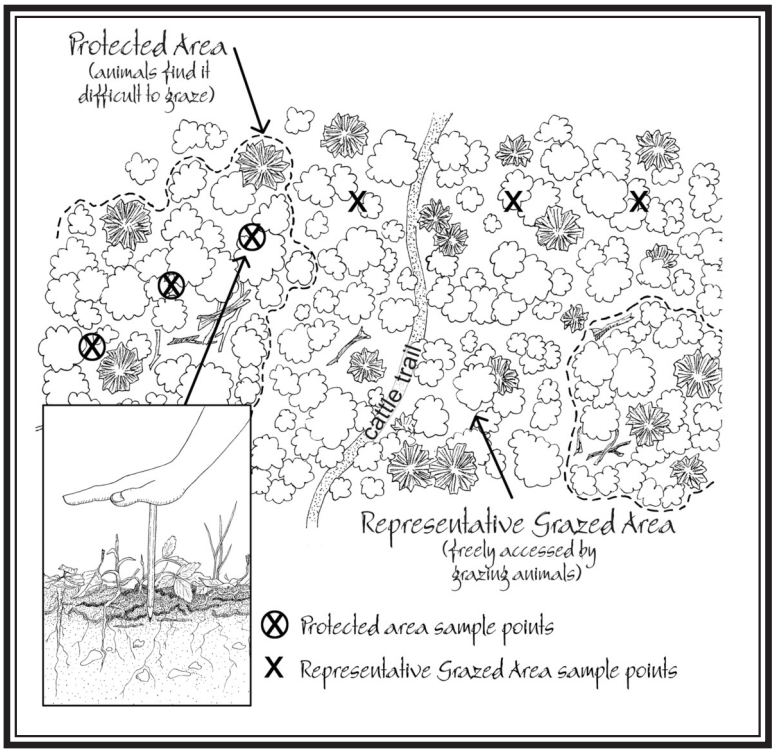


Figure 15. Example of sample site selection in reference areas versus grazed areas for the "LFH Pencil Test".

Answering the question requires the area to be classed as either a dry site or a moist site. Dry sites tend to have coarse-textured soils (sands and gravels), or are on steep south-facing slopes. Stands appear open, and the shrub and herb layers are relatively low. Examples of plant community types include aspen/buffaloberry, aspen/green alder-hairy wild-rye, aspen/blueberry-bearberry. Average to moist sites have fine-textured soils (i.e. loam or clay) and are mainly on gentler slopes, or on easterly or northerly aspects. Plant diversity is greater and plant cover is thicker, with denser layering. Examples of plant communities include: aspen/saskatoon, aspen/low-bush cranberry, aspen/rose, aspen/beaked willow, aspen/forb, aspen/beaked hazelnut, and balsam poplar communities.

Scoring:

15 = Thickness similar to reference areas on the same site. Not compacted.

10 = Thickness reduced by 20-30% on moist sites, 30-40% on dry sites, compared to reference areas on the same site. Somewhat compacted.

5 = Thickness reduced by 30-40% on moist sites, 40-50% on dry sites, compared to reference areas on the same site. Compacted.

0 = Thickness reduced by > 40% on moist sites, > 50% on dry sites, compared to reference areas on the same site. Very compacted.

QUANTITATIVE METHOD

This is a "quick quantitative" approach that uses a standard method to collect data related to vegetation status, but which is not as time-consuming as complete quadrat sampling for range condition. The vegetation status assessment has two components: a cover-pole survey and a frequency survey. The cover-pole survey is a quick way of measuring the vertical structure of the vegetation, by standing a fixed distance away from a vertical pole and recording how much of it can be seen. The frequency survey is used to measure the species changes, by recording the number of plots containing decreaser shrubs, decreaser herbs, or invasive species.

A standard cover-pole is required (2.5 cm in diameter and 2 metres long, painted in 20 alternating black and white bands 10 cm long) to help with estimates. To reduce the amount of equipment needed, the cover-pole is laid on the ground to create the plot used for the frequency survey.

Plot a transect which is as long as possible (at least 200 metres, but preferably up to 1000 metres). Follow the line by aiming at a distant landmark (e.g. a distinctive tree), to ensure that the transect remains straight. Walking through

the forest without following a straight line usually results in patches of dense vegetation being avoided, and results will be biased. Locate 30 sample points by dividing up the line equally (e.g. if the line is 300 metres long, place a sample point every 10 metres). Locate the points by pacing out the distance, but try to pace evenly. Keep your eyes on the target and don't look at the vegetation underfoot. If the measured point is on a range site other than the one being sampled (usually a wetland), then pace out another fixed distance. If this measured point puts you back on the range site being sampled, then use it.

At the sample point, do the frequency survey first. Lay the cover-pole on the ground at right angles to the line of travel and with the one-metre mark (i.e. the middle of the pole) at your toe. Do not look at the plants when laying down the pole, just try to lay it down exactly at right angles, but disturbing the vegetation as little as possible. The pole lying on the ground forms a sample area 2 metres long and 2.5 cm wide. Record the presence or absence in this area (i.e. directly over or under the pole) of decreaser shrubs, decreaser herbs, and invasive species. Check Appendix 2 for a list of decreaser species and Appendix 4 for a list of invasive species. Use the first page of the score-sheet for recording presence/absence data.

For example, suppose the main decreaser shrubs in an area are chokecherry, pincherry, and saskatoon. Look for these species along the length of the pole. If you find a twig of chokecherry or a leaf of saskatoon extending over the pole, then record a "1" for decreaser shrubs, indicating "present". If there are no chokecherry, pincherry, or saskatoon plants over the pole, record a "0" for decreaser shrubs, indicating "absent". If the saskatoon leaf is beside the pole, but not directly over it as you look down vertically, then it is absent. Note that there is no need to record how many leaves or twigs cross over the pole, or how many different kinds of decreaser shrubs are there. Once a decreaser shrub has been found over the pole, then stop looking for that

category of plants. Do the same for decreaser herbs and invasive species. Record your data on the first page of the worksheet in Appendix 2.

Next do the cover-pole survey. Stand the pole vertically at the sample point by sticking the pointed end into the ground. Pace out 5 metres from the pole, in a direction **exactly at right angles** to the original line of travel. At 5 metres, **before looking at the pole**, take a sideways step to the right (to avoid looking down your path through the vegetation), turn to face the pole, put your feet together, and stand up straight. Then look at the pole **without** any further movement of your body or head. There are 20 segments on the pole. Record on the first page of the score-sheet how many of the segments are visible. A segment is considered visible if at least three-quarters of it can be seen.

It sometimes happens that a tree is completely blocking the pole from sight. Because understory vegetation is being measured and not tree trunks, do not use this view. Instead, take another sideways step (again stepping, putting feet together, and standing up straight **before** you look at the pole) and measure from this position.

These instructions are necessary to get an objective measurement. Field trials show that beginners tend to overestimate the amount of the pole visible (that is, underestimate the amount of cover). One reason is that unless a precise method for walking out and choosing the place to stand is used, observers can unconsciously take an easier route, which will tend to have less cover between the observer and the pole. The other reason is that if you allow yourself to move your body or head, you will naturally tend to move so you can see the pole better, bringing more segments into view. Either way, the measurement is biased. The cover-pole method has a lot of advantages (simple, fast, no specialized knowledge required), but it will only give useful results if observers do it properly.

The cover-pole survey records the number of segments visible at 30 points. The worksheet tells you to add up the 30 values and divide the total by 6 to get the **average percent of the pole visible**. Dividing by 6 is the same as dividing by 30 sample points to get the average number of segments visible, then dividing this by 20 segments per pole and multiplying by 100 to get the average percent of the pole visible. Subtract the percent visible from 100 to get the **average percent of the pole hidden**, which represents the amount of vertical structure.

The frequency survey records 1 for "present" or 0 for "absent" at 30 points for each of decreaser shrubs, decreaser herbs, and invasive species. The score-sheet instructs you to add up the 1s, then divide the total by 30 and multiply by 100 to get the **percent frequency** for each group of plants. This is the percentage of sample points at which the category of plants was present.

Now turn to the second page of the worksheet. Use the results of the frequency survey and the cover-pole survey to answer the questions related to vegetation status. Add up the scores for each question to get a total score (out of 70) for vegetation status.

Question 1: Vegetation Status: What is the Plant Community?

This question considers species composition of the plant community.

- Plant species composition is a key indicator of forest health.
- Plant species influence a site's ability to provide forage.
- Shrubs, forbs and grasses provide a diversity of forage and nutrient values.
- Changes to plant species composition can reduce forage production and management flexibility.
- One management goal is to maintain the production potential of the plant community at the level produced under a light to moderate grazing regime. The plant community should resemble its potential or the reference

plant community for the site and forest successional stage.

- As grazing pressure increases from light to moderate to heavy and very heavy, there is a change in the understory species composition.

In the Quantitative Method, this question is broken down into two parts. Percent frequency values for **decreaser shrubs** (Question 1.1) and **decreaser herbs** (Question 1.2) are expected to be higher in healthy stands and decrease with heavy grazing. The percent frequency of invasive species, which is used to answer Question 3 (see below), also helps to show the impact of grazing on the plant community.

Question 1.1: What kinds of shrubs are present?

Scoring:

15 = Frequency of decreaser shrubs more than 60% (more than 50% in Aspen Parkland).

10 = Frequency of decreaser shrubs 40% to 60% (30% to 50% in Aspen Parkland).

5 = Frequency of decreaser shrubs 20% to 40% (10% to 30% in Aspen Parkland).

0 = Frequency of decreaser shrubs less than 20% (less than 10% in Aspen Parkland).

Question 1.2: What kinds of herbs are present?

Scoring:

15 = Frequency of decreaser herbs more than 90% (more than 75% in Aspen Parkland).

10 = Frequency of decreaser herbs 65% to 90% (55% to 75% in Aspen Parkland).

5 = Frequency of decreaser herbs 40% to 65% (35% to 55% in Aspen Parkland).

0 = Frequency of decreaser herbs less than 40% (less than 35% in Aspen Parkland).

Question 2: Community Structure:
Are the expected vegetation layers present?

Natural forests show several layers (Figure 12):

- Tree layer (e.g. aspen)
- Tall shrub layer (e.g. alder, willow)
- Mid shrub layer (e.g. saskatoon, chokecherry, hazelnut, dogwood)
- Short shrub layer (e.g. rose, snowberry)
- Tall forb layer (e.g. fireweed, sarsaparilla, tall grasses)
- Short forb layer (e.g. strawberry, wintergreen)
- Moss and lichen layer

When plants occupy different layers, they are able to use sunlight, water and nutrients from different zones in the vegetation canopy and soil. This diversity supports optimum grazing for livestock, provides diverse habitats for many wildlife species, and benefits other uses and values. Heavy grazing impact tends to thin out and eventually eliminate the taller vegetation layers, leaving a forest with simpler structure consisting of fewer layers (Figure 12). As structure declines, so do the values and benefits from the site.

In the Quantitative Method, structure is assessed using the results of the cover-pole survey, which showed the average percent of the cover-pole that is hidden. This will be higher in communities with taller and denser vegetation layers, and will decrease as structure is reduced because of grazing impact.

Scoring:

20 = More than 50% of cover-pole is hidden (more than 40% in Aspen Parkland).

15 = 40% to 50% of cover-pole is hidden (30% to 40% in Aspen Parkland)

10 = 30% to 40% of cover-pole is hidden (20% to 30% in Aspen Parkland)

5 = 20% to 30% of cover-pole is hidden (10% to 20% in Aspen Parkland)

0 = Less than 20% of cover-pole is hidden (less than 10% in Aspen Parkland)

Question 3: Vegetation Status: Are Invasive Species Present?

Invasive species are those that show a strong tendency to invade areas of natural vegetation, often aggressively crowding out the native plant species. Some of these species are considered noxious, but some are forage plants that are considered desirable in tame pastures (e.g. smooth brome). The increase of invasive species such as Kentucky bluegrass is one of the major shifts in species composition caused by heavy grazing in forests. Therefore, the results of Question 3 also relate to the changes in community composition addressed by Question 1 (see above).

In the Quantitative Method, Question 3 is answered using the results of the frequency survey. In healthy stands, the frequency of invasive species will be 0%, while the frequency will increase as invasion by these species increases in unhealthy stands.

Scoring:

20 = No invasive species present.

15 = Invasive species present but frequency less than 20%.

10 = Frequency of invasive species 20% to 40%.

5 = Frequency of invasive species 40% to 60%.

0 = Frequency of invasive species more than 60%.

Questions 4 and 5: Hydrologic Function and Soil Protection

The assessment of hydrologic function and soil protection in the Quantitative Method is the same as in the Indicator Method. While doing the survey for vegetation status, watch for signs of erosion and exposure of bare soil, and make occasional measurements of the thickness of the surface organic layer. After the survey is complete, answer the questions on the field worksheet in Appendix 3 and calculate a score (out of 30) for hydrologic soil protection. Add this to the vegetation status score to get the overall range health score (out of 100).

APPENDIX 1

Field Worksheet: Grassland Range Health Assessment

Plot _____ **Observer** _____ **Date** _____ **Photo #** _____

Legal Location _____

GPS Coordinates (NAD 83)

Latitude _____ **Longitude** _____ **Easting** _____ **Northing** _____

Ecoregion _____ **Ecosite** _____ **Soil Map Unit** _____

DOMINANT PLANT COMMUNITY SPECIES

Grasses & Grasslikes	Dry Weight (%)	Forbs	Dry Weight (%)	Shrubs	Cover (%)	Trees	Cover (%)

VEGETATION STATUS

Question 1. What is the **plant community?**

Plant community composition closely resembles the reference plant community for the site and alteration of the plant community by disturbances is minimal. *Example: Dry Mixed Prairie, Loam Ecosite,* northern wheatgrass – needle-and-thread (Reference plant community).	40	
Compared to the reference plant community, the plant community shows minor alteration in plant species composition due to disturbances. Disturbance impact is light to moderate. *Example: Dry Mixed Prairie, Loam Ecosite,* Needle-and-thread - June Grass - Pasture Sage - blue grama.	30	
Compared to the reference plant community, the plant community shows moderate alteration due to disturbances. Disturbance impact on plant community composition is moderate to heavy. *Example: Dry Mixed Prairie, Loam Ecosite,* blue grama -needle-and-thread – sedge- western wheatgrass.	15	
Compared to the reference plant community, the plant community shows significant alterations due to disturbances. Disturbance impact is heavy to very heavy. Plants are mostly native. Some tall-growing, non-native plants may be present. *Example 1: Dry Mixed Prairie, Loam Ecosite, Blue grama – pasture sage – June grass Example 2: Kentucky bluegrass*	7	
Compared to the reference plant community, the plant community shows extreme to severe alterations due to disturbances. Disturbance impact is severe to very severe. Production is mostly from low-growing, non-native, disturbance induced plants. *Example: Dandelion – Plantain*	0	
	Score	

Question 2. Are the expected **vegetation layers** present**?**

The life form layers closely resemble the reference plant community.	10	
Compared to the reference, 1 life form layer is absent or considerably reduced.	7	
Compared to the reference, 2 life form layers are absent or considerably reduced.	3	
Compared to the reference, 3 life form layers are absent or considerably reduced.	0	
	Score	

Question 3. Are **Invasive/Noxious species** present**? Y** or **N**
Which species? _____

Question 3.1 What is the **cover** of **Invasive/Noxious species?**

No invasive/noxious species	5	
Invasive/noxious species present but less than 1% cover	3	
Invasive/noxious weeds present with a total canopy cover over 1%	0	
	Score	

Question 3.2 What is the **distribution** of **Invasive/Noxious species?**

No invasive/noxious species on the site	5	
Invasive/noxious species are present at a low level (density distribution class 1)	3	
Invasive/noxious species are present at a moderate to high level (density distribution classes 2 to 13)	0	
	Score	

(A) TOTAL SCORE FOR VEGETATION STATUS

Saskatchewan Grassland Range Health Assessment

HYDROLOGIC FUNCTION & SOIL PROTECTION

Question 4.1 Is there more **soil erosion** than expected for this site? Y or N		
No signs of soil erosion or not beyond the natural extent* for the site *Note: see workbook for information on erosion features	10	
Some evidence of soil erosion	7	
Moderate amounts of soil erosion	3	
Extreme amounts of soil erosion	0	
	Score	
Question 4.2. Is there more **bare soil** than expected for this site? Y or N		
10% or less of exposed soil is human-caused	5	
Greater than 10 and up to 20% of exposed soil is human-caused	3	
Greater than 20 and up to 50% of exposed soil is human-caused.	2	
Greater than 50% of exposed soil is human-caused.	0	
Actual ____ % less Expected ____% = _____% Human Caused **Club Moss _____ %**	**Score**	
Question 5. Is the expected amount of **litter** present?		
Litter amounts are more or less uniform across site litter standing crop (lb./ac.) is in the range of 65 to 100% of expected amounts under moderate disturbance.	25	
Litter amounts are somewhat patchy across the site and litter standing crop (lb./ac.) is in the range of 35 to 65% of expected amounts under moderate disturbance.	13	
The distribution of litter is not uniform across the site. Litter standing crop (lb./ac.) is in the range of less than 35% of amounts expected under moderate disturbance.	0	
	Score	
(B) TOTAL SCORE FOR HYDROLOGIC FUNCTION & SOIL PROTECTION		

Range Health Scores

(A) Vegetation status (out of 60)

(B) Hydrologic function & soil protection (out of 40)

Overall score (out of 100)

Healthy 75%-100% ---- Healthy with Problems 50%-74% --- Unhealthy < 50%

Class	Abundance of species in polygon	Distribution	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		
5	Several sporadically occurring plants		
6	A single patch plus several sporadically occurring plants		
7	Several well-spaced patches		0
8	A few patches plus several sporadically occurring plants		
9	Several well-spaced patches		
10	Continuous uniform occurrences of well-spaced plants		
11	Continuous occurrence of plants with a few gaps in distribution		
12	Continuous dense occurrence of plants		
13	Continuous occurence of plants		

NOTES:

APPENDIX 2

Field Worksheet: Forest Health Assessment - Indicator Method

Plot _____ Observer _____ Date _____ Photo # _____

Legal Location _____

GPS Coordinates (NAD 83)

Latitude _____ Longitude _____ Easting _____ Northing

Ecoregion _____ Ecosite _____ Soil Map Unit _____

Dom. Tree Species _____ Canopy Height _____ Crown Closure _____

DOMINANT PLANT SPECIES

Grasses & Grasslikes	Cover (%)	Forbs	Cover (%)	Shrubs	Cover (%)	Trees	Cover (%)

VEGETATION STATUS

Question 1. What is the plant community?		
Plant community resembles the reference community for the site. The full range of native species found in the reference community is present. Decreaser species (both shrubs and herbs) are abundant and vigorous. *Example*: aspen / low-bush cranberry / rose / tall forb	40	
Minor changes from the reference plant community. Decreaser species are less abundant or less vigorous than in the reference community, and there has been some increase in shorter or less palatable species. *Example*: aspen / rose / low-bush cranberry / low forb	30	
Moderate changes from the reference plant community. Decreaser species have been substantially reduced or eliminated, and replaced by shorter or less palatable species. Non-native species have increased in abundance. *Example*: aspen / rose / clover	15	
Significant changes from the reference plant community. Non-native species have become dominant, accompanied by unpalatable native species. *Example*: aspen / Kentucky blue grass / dandelion	0	
	Score	
Question 2. Are the expected vegetation layers present?		
All vegetation layers are present. The structure of the forest resembles the reference plant community.	20	
One vegetation layer is absent or significantly reduced (less than half of the cover in the reference community).	10	
Two vegetation layers are absent or significantly reduced (less than half of the cover in the reference community).	5	
Three vegetation layers are absent or significantly reduced (less than half of the cover in the reference community).	0	
	Score	
Question 3. Are invasive species present?		
No invasive species present.	10	
Invasive species present but cover less than 1%.	5	
Cover of invasive species more than 1%.	0	
	Score	
(A) TOTAL SCORE FOR VEGETATION STATUS		

HYDROLOGIC FUNCTION AND SOIL PROTECTION

Question 4.1. Is there more soil erosion than expected for this site?		
No signs of soil erosion	5	
Some signs of soil erosion at small scale (e.g. small rills or occasional hoof-shearing)	3	
Signs of soil erosion at large scale (e.g. well-defined flow patterns or frequent trailing and hoof-shearing)	1	
Obvious signs of soil erosion at large scale, with movement of soil off the site	0	
	Score	

Question 4.2. Is there more bare soil than expected for this site?		
Less than 1% of area is bare soil that can be attributed to management impacts	10	
1% to 5% of area is bare soil that can be attributed to management impacts	7	
5% to 15% of area is bare soil that can be attributed to management impacts	3	
More than 15% of area is bare soil that can be attributed to management impacts	0	
	Score	

Question 5. How thick is the surface organic layer (LFH)?		
Thickness similar to ungrazed areas on the same site. Not compacted.	15	
Thickness reduced by 20-30% on moist sites, 30-40% on dry sites, compared to ungrazed areas on the same site. Somewhat compacted.	10	
Thickness reduced by 30-40% on moist sites, 40-50% on dry sites, compared to ungrazed areas on the same site. Compacted.	5	
Thickness reduced by >40% on moist sites, >50% on dry sites, compared to ungrazed areas on the same site. Very compacted.	0	
	Score	

(B) TOTAL SCORE FOR HYDROLOGIC FUNCTION & SOIL PROTECTION

RANGE HEALTH SCORE

(A) Vegetation status (out of 70)	
(B) Hydrologic function and soil protection (out of 30)	
Overall score (out of 100)	

75 – 100%	Healthy
50 – 74%	Healthy with problems
< 50%	Unhealthy

Major Decreaser Species

Decreaser herbs - forbs		page*	**Decreaser herbs - grasses**		page*
wild sarsaparilla	*Aralia nudicaulis*	196	awned wheat grass	*Agropyron trachycaulum*	260
showy aster	*Aster conspicuus*	183	slender wheat grass	*Agropyron subsecundum*	260
hawk's-beard	*Crepis* spp.		fringed brome grass	*Bromus ciliatus*	272
fairybells	*Disporum trachycarpum*	83	northern awnless brome	*Bromus pumpellianus*	273
fireweed	*Epilobium angustifolium*	149	marsh reed grass	*Calamagrostis canadensis*	265
cow-parsnip	*Heracleum lanatum*	153	northern reed grass	*Calamagrostis inexpansa*	264
cream-coloured vetchling	*Lathyrus ochroleucus*	141	tall sedges	*Carex spp.*	
purple peavine	*Lathyrus venosus*	140	Canada wild rye	*Elymus canadensis*	261
tall lungwort	*Mertensia paniculata*	201	hairy wild rye	*Elymus innovatus*	
spreading sweet-cicely	*Osmorhiza depauperata*	153	rough-leaved rice grass	*Oryzopsis asperifolia*	267
American vetch	*Vicia americana*	140	northern rice grass	*Oryzopsis pungens*	
			fowl blue grass	*Poa palustris*	271
			purple oat grass	*Schizachne purpurascens*	273

Decreaser shrubs

saskatoon	*Amelanchier alnifolia*	56	choke cherry	*Prunus virginiana*	57
red-osier dogwood	*Cornus stolonifera*	54	low bush-cranberry	*Viburnum edule*	64
pin cherry	*Prunus pensylvanica*	57	high bush-cranberry	*Viburnum opulus*	65

*page number of photo and description in Johnson et al. (1995): *Plants of the Western Boreal Forest and Aspen Parkland*

Field Worksheet: Forest Health Assessment - Quantitative Method

Plot _____ **Observer** _____ **Date** _____ **Photo #** _____

Legal Location _____

GPS Coordinates (NAD 83)

Latitude _____ **Longitude** _____ **Easting** _____ **Northing**

Ecoregion _____ **Ecosite** _____ **Soil Map Unit** _____

Dom. Tree Species _____ **Canopy Height** _____ **Crown Closure** _____

	FREQUENCY SURVEY (record 1 for present, 0 for absent)			COVER-POLE
	decr. shrubs	decr. herbs	invasive	number of segments visible
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
total				
	divide by 30, multiply by 100			divide by 6
	PERCENT FREQUENCY			subtract from 100
				PERCENT HIDDEN

VEGETATION STATUS

Question 1a. What kind of shrubs are present?

Frequency of decreaser shrubs more than 60% in Boreal Forest (>50% in Aspen Parkland)	15
Frequency of decreaser shrubs 40 - 60% in Boreal Forest (30 - 50% in Aspen Parkland)	10
Frequency of decreaser shrubs 20 - 40% in Boreal Forest (10 - 30% in Aspen Parkland)	5
Frequency of decreaser shrubs less than 20% in Boreal Forest (<10% in Aspen Parkland)	0
Score	

Question 1b. What kind of herbs are present?

Frequency of decreaser herbs more than 90% in Boreal Forest (>75% in Aspen Parkland)	15
Frequency of decreaser herbs 65 - 90% in Boreal Forest (55 - 75% in Aspen Parkland)	10
Frequency of decreaser herbs 40 - 65% in Boreal Forest (35 - 55% in Aspen Parkland)	5
Frequency of decreaser herbs less than 40% in Boreal Forest(<35% in Aspen Parkland)	0
Score	

Question 2. Are the expected plant layers present?

More than 50% of cover-pole hidden in Boreal Forest (>40% in Aspen Parkland)	20
40 - 50% of cover-pole hidden in Boreal Forest (30 - 40% in Aspen Parkland)	15
30 - 40% of cover-pole hidden in Boreal Forest (20 - 30% in Aspen Parkland)	10
20 - 30% of cover-pole hidden in Boreal Forest (10 - 20% in Aspen Parkland)	5
Less than 20% of cover-pole hidden in Boreal Forest (<10% in Aspen Parkland)	0
Score	

Question 3. Are invasive species present?

No invasive species present	20
Invasive species present but frequency less than 20%	15
Frequency of invasive species 20% to 40%	10
Frequency of invasive species 40% to 60%	5
Frequency of invasive species more than 60%	0
Score	

(A) TOTAL SCORE FOR VEGETATION STATUS

HYDROLOGIC FUNCTION AND SOIL PROTECTION

Question 4.1. Is there more soil erosion than expected for this site?		
No signs of soil erosion	5	
Some signs of soil erosion at small scale (e.g. small rills or occasional hoof-shearing)	3	
Signs of soil erosion at large scale (e.g. well-defined flow patterns or frequent trailing and hoof-shearing)	1	
Obvious signs of soil erosion at large scale, with movement of soil off the site	0	
	Score	

Question 4.2. Is there more bare soil than expected for this site?		
Less than 1% of area is bare soil that can be attributed to management impacts	10	
1% to 5% of area is bare soil that can be attributed to management impacts	7	
5% to 15% of area is bare soil that can be attributed to management impacts	3	
More than 15% of area is bare soil that can be attributed to management impacts	0	
	Score	

Question 5. How thick is the surface organic layer (LFH)?		
Thickness similar to ungrazed areas on the same site. Not compacted.	15	
Thickness reduced by 20-30% on moist sites, 30-40% on dry sites, compared to ungrazed areas on the same site. Somewhat compacted.	10	
Thickness reduced by 30-40% on moist sites, 40-50% on dry sites, compared to ungrazed areas on the same site. Compacted.	5	
Thickness reduced by >40% on moist sites, >50% on dry sites, compared to ungrazed areas on the same site. Very compacted.	0	
	Score	

(B) TOTAL SCORE FOR HYDROLOGIC FUNCTION & SOIL PROTECTION

RANGE HEALTH SCORE

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Major Decreaser Species

Decreaser herbs - forbs		page*	**Decreaser herbs - grasses**		page*
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fairybells	*Disporum trachycarpum*	83	northern awnless brome	*Bromus pumpellianus*	273
fireweed	*Epilobium angustifolium*	149	marsh reed grass	*Calamagrostis canadensis*	265
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purple peavine	*Lathyrus venosus*	140	Canada wild rye	*Elymus canadensis*	261
tall lungwort	*Mertensia paniculata*	201	hairy wild rye	*Elymus innovatus*	
spreading sweet-cicely	*Osmorhiza depauperata*	153	rough-leaved rice grass	*Oryzopsis asperifolia*	267
American vetch	*Vicia americana*	140	northern rice grass	*Oryzopsis pungens*	
			fowl blue grass	*Poa palustris*	271
			purple oat grass	*Schizachne purpurascens*	273
Decreaser shrubs					
saskatoon	*Amelanchier alnifolia*	56	choke cherry	*Prunus virginiana*	57
red-osier dogwood	*Cornus stolonifera*	54	low bush-cranberry	*Viburnum edule*	64
pin cherry	*Prunus pensylvanica*	57	high bush-cranberry	*Viburnum opulus*	65

*page number of photo and description in Johnson et al. (1995): *Plants of the Western Boreal Forest and Aspen Parkland*

APPENDIX 3

Invasive Species for Native Grassland and Forest Health Assessment

Why assess invasive species in native grassland and forest health assessments?

Invasion by non-native plants degrades biological communities and threatens the survival of many native species in North America and elsewhere around the world (Randall 1996). Invasive species have recently gained notoriety as major conservation and management concerns in natural ecosystems (Macdonald et al. 1989, Soule 1990, Westman 1990, Hobbs and Huenneke 1992). Pimm and Gilpin (1989) stated that when "viewed on a global scale invasions by non-native plants, animals, fungi, and microbes are believed to be responsible for greater losses of biological diversity than any other factor except habitat loss and direct exploitation of organisms by humans". The control of non-native plants has become one of the most expensive and urgent tasks of managers in several U.S. National Parks (Randall 1996).

How to read the invasive species list

This is a generic species list that is used for native grassland and forest health assessment. Refer to the riparian health assessment guide for species used in riparian health assessments. Each species is described by: scientific name, common name, family name, and growth form.

The Saskatchewan Range Health Committee proposed the following list of invasive species based on literature review and expert opinion. The following conditions were used to develop the list:

- it is qualitative
- it does not include species that increase with disturbance but do not persist, therefore there was more emphasis put on perennial species
- it only includes species that invade into native vegetation
- it is based on ecological principles

Courtesy of K. George Beck & James Sebastian, Department of BioAg Science and Pest Management, Bugwood.org

Absinth *Artemisia absinthium*

Photo courtesy of K. George Beck, Bugwood.org

Nodding thistle *Carduus nutans*

Photo courtesy of Dean Wm. Taylor

Kentucky bluegrass *Poa pratensis*

Photo courtesy of Don Fontaine

Russian knapweed *Acroptilon repens*

Photo courtesy of Malin Hansen

Smooth brome *Bromus inermis*

Photo courtesy of Jerry Asher, USDI Bureau of Land Management, Bugwood.org

Yellow starthistle *Centaurea solstitialis*

Figure 16: Examples of invasive species.

APPENDIX 4

Invasive Species in Forest and Grassland Areas of Saskatchewan

Scientific Name	Common Name	Family	Growth-Form
Acroptilon repens	Russian knapweed	Asteraceae	perennial forb
Agropyron cristatum	crested wheatgrass	Poaceae	perennial graminoid
Arctium lappula	great burdock	Asteraceae	biennial forb
Arctium minus	common burdock	Asteraceae	biennial forb
Artemisia absinthium	absinth	Asteraceae	perennial forb
Bromus inermis	smooth brome grass	Poaceae	perennial graminoid
Bromus japonicus	Japanese brome	Poaceae	annual graminoid
Bromus tectorum	downy brome	Poaceae	annual graminoid
Caragana arborescens	caragana	Fabaceae	shrub
Carduus nutans	nodding thistle	Asteraceae	biennial forb
Centaurea diffusa	diffuse knapweed	Asteraceae	biennial forb
Centaurea maculosa	spotted knapweed	Asteraceae	perennial forb
Centaurea solstitialis	yellow starthistle	Asteraceae	annual forb
Cirsium arvense	Canada thistle	Asteraceae	perennial forb
Convolvulus arvensis	field bindweed	Convolvulaceae	perennial forb
Cropina vulgaris	common cropina	Asteraceae	perennial forb
Elytrigia repens	quack grass	Poaceae	perennial graminoid
Euphorbia esula	leafy spurge	Euphorbiacae	perennial forb
Knautia arvensis	blue buttons	Dipsacaceae	perennial forb
Leucanthemum vulgare	oxeye daisy	Asteraceae	perennial forb
Linaria vulgaris	yellow toadflax	Scrophulariaceae	perennial forb
Lythrum salicaria	purple loosestrife	Lythraceae	perennial forb
Matricaria perforata	scentless chamomile	Asteraceae	annual/biennial forb
Poa pratensis	Kentucky bluegrass	Poaceae	perennial graminoid
Rhamnus cathartica	common buckthorn	Rhamnaceae	shrub
Tamarix chinensis	salt cedar	Tamaricaceae	shrub
Tanacetum vulgare	common tansy	Asteraceae	perennial forb

APPENDIX 5

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APPENDIX 6

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Fax: (306) 445-4016

Melfort Regional Office
Highway 3 W, P.O. Box 2139
MELFORT SK S0E 1A0
Phone: (306) 752-2791
Fax: (306) 752-9799

Wadena Regional Office
77 1st St. NE, P.O. Box 670
WADENA SK S0A 4J0
Phone: (306) 338-3677
Fax: (306) 338-2199

Meadow Lake Regional Office
201 2nd St W, P.O. Box 727
MEADOW LAKE SK S9X 1C7
Phone: (306) 236-6662
Fax: (306) 236-5153

Estevan Regional Office
77 - 1st St. NE, P.O. Box 670
ESTEVAN SK S0A 4J0
Phone: (306) 338-3677
Fax: (306) 338-2199

Native Plant Society of Saskatchewan (NPSS)
P.O. Box 21099
SASKATOON SK S7H 5N9
Phone: (306) 668-3940
Fax: (306) 258-2244
Email: info@npss.sk.ca
Web address: www.npss.sk.ca

Nature Conservancy of Canada

Saskatchewan Office
#100 - 1777 Victoria Ave.
REGINA SK S4P 4K5
Phone: (306) 347-0447
Toll Free: 1-866-662-7275
Fax: (306) 347-2345
Email: saskatchewan@natureconservancy.ca
Web address:
www.natureconservancy.ca

Nature Saskatchewan

#206, 1860 Lorne St.
REGINA SK S4P 2L7
Phone: (306) 780-9273
Toll Free in SK: 1-800-667-4668
Fax: (306) 780-9263
Email: info@naturesask.ca
Web address:
www.naturesask.ca

Prairie Conservation Action Plan (PCAP)

P.O. Box 4752
Main Floor, Canada Centre,
Ipsco Place
REGINA SK S4P 3Y4
Phone: (306) 352-0472
Fax: (306) 569-8799
Email: pcap@sasktel.net
Web address: www.pcap-sk.org

Saskatchewan Ministry of Agriculture

Head office

3085 Albert St.
REGINA SK S4S 0B1
Phone: (306) 787-5140
Web address:
www.agriculture.gov.sk.ca

Agriculture Knowledge Centre
Phone: (866) 457-2377
Fax: (306) 694-3938
Out-of-province: (306) 694-3727
Email: aginfo@gov.sk.ca
Web address:
www.agriculture.gov.sk.ca/AKC

Regional offices

Regina Regional Office
515 Henderson Dr.
REGINA SK S4P 3V7
Phone: (306) 787-9773

Saskatoon Regional Office
3830 Thatcher Ave,
SASKATOON SK S7K 2H6
Phone: (306) 933-7986

Swift Current Regional Office
P.O. Box 5000
350 Cheadle St. W
SWIFT CURRENT SK S9H 4G3
Phone: (306) 778-8218

Kindersley Regional Office
P.O. Box 1690, 409 Main St.
KINDERSLEY SK S0L 1S0
Phone: (306) 463-5513

Watrous Regional Office
P.O. Box 520, 403 Main St.
WATROUS SK S0K 4T0
Phone: (306) 946-3230

Prince Albert Regional Office
P.O. Box 3003
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PRINCE ALBERT SK S6V 6G1
Phone: (306) 953-2363

Yorkton Regional Office
38 - 5th Ave. N
YORKTON SK S3N 0Y8
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Weyburn Regional Office
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110 Souris Ave.
WEYBURN SK S4H 2Z9
Phone: (306) 848-2857

Outlook Regional Office
P.O. Box 9
420 Saskatchewan Ave. W
OUTLOOK SK S0L 2N0
Phone: (306) 867-5575

North Battleford Regional Office
1192 - 102nd St.
NORTH BATTLEFORD SK S9A 1E9
Phone: (306) 446-7964

Tisdale Regional Office
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1150 - 99th St.
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Saskatchewan Ministry of Environment

Regina Office
3211 Albert St.
REGINA SK S4S 5W6
Phone: (306) 787-2314
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www.environment.gov.sk.ca

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112 Research Dr.
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Saskatchewan Forage Council (SFC)

P.O. Box 1715
OUTLOOK SK S0L 2N0
Phone: (306) 966-2148
Fax: (306) 867-8120
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Saskatchewan Invasive Alien Species Project

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Fax: (306) 258-2244
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Web address: www.npss.sk.ca

Saskatchewan Sheep Development Board (SSDB)

2213C Hanselman Court
SASKATOON SK S7L 6A8
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Fax: (306) 933-7182
Email: sheepdb@sasktel.net
Web address: www.sksheep.com

Saskatchewan Soil Conservation Association

P.O. Box 1360
INDIAN HEAD SK S0G 2K0
Phone: (306) 695-4233
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Saskatchewan Stock Growers Association (SSGA)

PO Box 4752
Main Floor, Canada Centre,
Ipsco Place
REGINA SK S4P 3Y4
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Fax: (306) 569-8799
Web address:
www.skstockgrowers.com

Saskatchewan Watershed Authority (SWA)

Head Office
111 Fairford St. E
MOOSE JAW SK S6H 7X9
Phone: (306) 694-3900
Fax: (306) 694-3944
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Other Offices

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Park Plaza
#420 - 2365 Albert St.
REGINA SK S4P 4K1
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Fax: (306) 787-0780

Saskatoon Office
Innovation Place
101 - 108 Research Dr.
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Regional offices

Northeast (Nipawin)
Regional Office
P.O. Box 2133
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Fax: (306) 862-1771

East Central (Yorkton)
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2nd Floor, 120 Smith St. E
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WEYBURN SK S4H 2Z9
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Regional Office
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Saskatchewan Wildlife Federation (SWF)

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Saskatchewan
Prairie Conservation
Action Plan

PCAP Greencover Partners

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada
SRC smart science solutions
Saskatchewan Ministry of Agriculture
Saskatchewan Watershed Authority
Saskatchewan Ministry of Environment
Saskatchewan Stockgrowers Association
Nature Conservancy Canada
Conservation Nature Canada
Ducks Unlimited Canada Conserving Canada's Wetlands
Nature Saskatchewan
SAMA
University of Saskatchewan

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