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What is agrobiodiversity

Biodiversity (biological diversity) refers to the variety and variability of all living organisms (animals, plants, and micro-organisms) on Earth. Agricultural biodiversity or agrobiodiversity refers to the variety and variability of living organisms important to food and fibre production. It includes organisms that are harvested as well as the unharvested organisms that support agricultural production. Agrobiodiversity includes a mix of naturally occurring organisms and organisms introduced by farmers. Naturally occurring or wild organisms might include trees, grasses, and insects. Introduced or domesticated organisms might include cattle, pigs, alfalfa and canola.

There are three kinds of biodiversity: genetic, species and ecosystem. In an agricultural setting, an example of:
- genetic biodiversity would be cattle breeds – Hereford, Angus, Charolais;
- species diversity would be crop types – cereals, corn, alfalfa; and
- ecosystem diversity would be production systems – pasture, continuous cropping.

Agroecosystems are ecosystems used for agriculture in similar ways, with similar components, interactions and functions. Agroecosystems differ from natural ecosystems because they are managed to be more productive for human purposes, and they depend on human activities for their survival. How agroecosystems are developed and managed can affect the natural ecosystems around them.

Agroecosystems can be viewed on a number of levels:
1. farm level: all the activities individual farmers do on their farms - the types of plants grown and animals raised; how the crops are grown and animals are raised;
2. local level: all the activities done by neighboring farmers; and
3. regional level: all the activities done on farms in a part of the province or country.

There can be several agroecosytems at any one of the levels.

Biodiversity can differ within each agroecosystem level and between levels. One farmer may choose to produce only annual crops like wheat and canola, while another farmer raises beef cattle, plants barley and canola each year, grows tame forage for hay and uses native pasture. The second farmer would have a more biodiverse farm than the first. A local farming area may be biodiverse, even if individual farms aren't, if within the local area some farmers choose to raise livestock while others grow crops. Similarly, one region can be more or less biodiverse than another depending on what farmers choose to produce and how they manage the natural areas on their farms.

Remember, farmers must make a living from their land. They make decisions about what they will produce based on the climate where they farm; their soil and land type; and the markets – in other words, what they'll get for the crops and livestock they have to sell.

Activity 1: Identifying agrobiodiversity

a. Divide your page into three columns. At the top of each column, write genetic, species and ecosystems. List under the proper heading all the examples of agrobiodiversity that you can think of. Don't forget the natural organisms. What role would natural organisms play in agrobiodiversity? Why would a farmer plant different crop species, or why would two farmers choose different varieties of the same species? (Hint: Do a web search for seed companies + Canada.)
b. On a map of the Province of Manitoba, identify the different agroecosystems you would expect to find in the different regions of Manitoba.

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The importance of agrobiodiversity

For much of the last half of the last century, biodiversity declined on farms as farmers specialized in one type of agricultural production.

They specialized because:
- their land was better suited to certain crops or livestock; or
- they liked working with either crops or livestock; or
- technology made it more efficient to concentrate on one type of production.

Biodiversity also declined as farmers cleared bush, ploughed up native grassland, and cleared marshes and potholes to increase the amount of land they could farm. There is a trend now to increase diversity because recent research has been able to show the value of biodiversity to farmers' incomes and the environment.

Agrobiodiversity helps sustain natural functions that are important to agricultural production such as decomposition of organic matter, rehabilitation of degraded soil, pollination, maintenance of water quality, and control of pests and diseases.

For example, raising livestock and growing crops in the same area benefits the soil because the manure from the livestock is a fertilizer that provides crops with some of the nutrients they need. Manure improves the structure of the soil making it easier for plant roots to grow. It also provides nutrients for micro-organisms in the soil. Raising livestock lets farmers grow crops that aren't eaten by people, such as forage, or aren't preferred by most people, such as barley. Growing a variety of different crop species reduces the potential for disease or insects to build up to a point where they significantly reduce crop yields.

Natural ecosystems play a key role in supporting agricultural production. The natural areas near farmed land and the headlands that surround fields are home to beneficial insects that pollinate crops or feed on insects that harm crops. Natural areas are home to wild plants that may have genes that are useful to plant breeders. By selecting genes from wild plants, scientists can develop crops that are resistant to diseases or insects or that can adapt to specific environments. Wild plants can be thought of as a reservoir of genetic material to solve problems in crop production that we may encounter in the future.

To help preserve both domesticated and wild species of plants, Canada has a network of gene banks. However, not all wild plants can be reproduced from the material in gene banks. Some plants require a community of plants or specific micro-organisms in their natural environment to reproduce. This is why it is important to retain some wild or natural areas.

Ecosystems do not stand still. They evolve and change. Shifts in the number and types of species are normal and unavoidable. However, it is wise to try to avoid creating conditions that speed up this process or result in loss of native species. There is a lot we don't yet know about the value or role of many species in ecosystems. Broad genetic diversity within a species gives it the best chance to adapt to future stresses.

While we have lost or reduced some native species in Canada, we have also gained biodiversity. Most of our domesticated plants and animals have been brought from other parts of the world.

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Not all additions to biodiversity are useful or beneficial. The introduction of invasive alien species, whether intended or by accident, can cause problems in existing ecosystems. Invasive alien species are those that have come from other parts of a country or the world, quickly invade the new area where they have been introduced, and are difficult to control. Leafy spurge, originally from Europe and Asia, came to the Eastern United States in the 1800's. It has now become a problem in many native pasture and range areas in Western Canada and the Western United States.

Leafy spurge competes by:

- shading out native vegetation;
- aggressively using available water and nutrients;
- producing toxins that prevent the growth of other plants underneath it.

Once present, it can completely overtake large areas of open land. It grows extremely well in dry conditions. Cattle will not eat it as it produces a chemical that irritates them.

Gene banks

Gene banks accept "deposits" of germplasm to ensure that genes of a wide variety of species are available in the event there is a natural disaster that eliminates or severely reduces a particular species. Gene banks are also a source of genetic material for researchers who are working to improve species.

In the case of plants, germplasm is usually seed, but it can be a plant part (stem, leaf, pollen) or just a few cells that can be grown into a whole plant. Plant germplasm contains the genetic information for a plant's hereditary makeup.

Canada has a Plant Germplasm System (PGS) which is a network of centres and people across the country dedicated to preserving the genetic diversity of crop plants, their wild and weedy relatives, and plants unique to Canada.

The PGS's main seed gene bank, in Saskatoon, Saskatchewan, has over 110,000 seed samples. The PGS gene bank for clones of small fruit and fruit tree crops, in Harrow, Ontario, has 3,000 samples. Approximately two-thirds of that collection consists of native wild relatives of Canadian fruit crops and the remaining one-third is of varieties developed in Canada or of interest to Canadian scientists.

The Plant Germplasm System is part of Canada's response to the United Nations Convention on Biological Diversity (CBD). It is an international agreement established in 1992 to conserve biodiversity and ensure its sustainable use. Offices for the CBD are based in Montreal, Quebec.

For more information on Canada's plant gene banks, see http://pgrc3.agr.gc.ca/about-propos_e.html

Activity 2: A closer look at agrobiodiversity – biotic and abiotic parts of agroecosystems

a. Select a farm field. (Check with the farmer first to see that it is okay to go into the field.) Look at the whole field. List all the abiotic (non-living) and biotic (living) things in the field. Now look more closely at one part of the field. Compare and contrast what you see in the cropped area with that in the uncropped or headland area around the field. What is the habitat like; what is the growth pattern of the plants like; what plants do you see? Do you see any signs of animal life? What are those signs?

b. Now look at a larger area – a section of land (1 mile x 1 mile or 1.6 km x 1.6 km) with different field and farming activities. How do the abiotic and biotic components differ from the single field? Describe/list the agrobiodiversity you see. Describe the ecosystems.

Ages 11-13 **Activity 3: The benefits and cost of biodiversity**

Based on what you have learned to this point about agrobiodiversity and what you know about crops and livestock:

a. List all the things that could be introduced to, or included, on a farm to increase its biodiversity.

b. Consider yourself a farmer. For each thing that that you are thinking about adding to, or including on your farm, identify what changes you would have to make to the farm operation. (Think about the cost of equipment or buildings, how you would sell the product, how you would manage your time, and what information you would need.) Identify the costs (costs aren't always money) and the benefits to each addition. What are the benefits and costs to too much or too little diversity?

Don't forget there is a role for natural areas in a farm operation.

Forages in agroecosytems

Forages are grasses and forbs (broadleaved) plants used for animal feed. The plants are grown for their leaves and stems rather than for their seeds. Forages can be tame (domesticated) and planted as part of a cropping system to be used for pasture or cut for hay. They can also be native (natural) and found in areas where it is difficult to crop the land or the land shouldn't be cropped for environmental reasons. These native areas can be used for pasture and are sometimes cut for hay. In addition to being a feed source for livestock, forages provide feed and year-round cover for wildlife.

Forages are then part of two different agroecosystems – the cropped agroecosystem and the native pasture or rangeland agroecosystem.

Examples of forages

Tame species		Native species	
Grasses	Forbs	Grasses	Forbs
smooth brome	alfalfa	blue grama	American hedysarum
Timothy	birdsfoot trefoil	switchgrass	purple prairie clover
tall fescue	sweetclover	green needlegrass	Depending on the time of year, livestock will eat a variety of forbs that are not generally considered to be a true forage, such as asters, wild vetch fleabanes, and violets
Russian wild ryegrass	alsike clover	western wheatgrass	
orchardgrass	sainfoin	June grass	
tall wheatgrass	red clover	little bluestem	
crested wheatgrass		big bluestem	

For help in identifying some native and tame grasses, check out this Agriculture and Agri-Food Canada website: http://www.agr.gc.ca/cal/epub/762e/762_toc_e.html

For more information on forages, go to this Agriculture and Agri-Food Canada website: www.agr.gc.ca/misb/spcrops/ and select the link for forages.

Ages 11-13 **Tame forage as part of a cropped agroecosystem**

Introducing forages into a cropped ecosystem increases biodiversity by adding plant species that are different from the cereal, oilseed or pulse crops that farmers may grow each year. In addition to adding biodiversity, forages provide a number of benefits to a cropped ecosystem that ensures the continued success of agroecosystems.

1. Legume forages increase the amount of nitrogen in the soil through nitrogen fixation. Nitrogen (N) is one of the three main nutrients plants need to grow. The other two are Phosphorus (P) and Potassium (K). When legumes are planted alone or together with grass forage, farmers can apply less commercial nitrogen fertilizer to the pasture or hayland and in the first year of an annual crop after the forage has been removed. Commercial nitrogen fertilizers are made from natural gas. Introducing legumes to an agricultural ecosystem reduces the use of non-renewable resources and saves farmers money.

Legumes do require some Nitrogen in the year they are planted because the Nitrogen fixing bacteria in the root nodules need some time to start producing Nitrogen. The Nitrogen can be added to the field in the form of manure or commercial fertilizer.

2. Forages "break" the disease cycle. Plant diseases in annual crops can seriously reduce yields. Chemical control methods can be expensive and are often not available.

Forage plants are different from many plants used as annual crops, so they don't have the same diseases. If they do have the same diseases, forages are usually harvested before the disease can become serious. By planting forages for several years between annual crops, the amount of some disease organisms in a field can be reduced.

3. Forages help with weed control. Once forages are well established, their leaves and roots thickly cover a field. They "choke out" or out-compete annual weed seedlings because they are better able to take up soil water. They also prevent the seedlings from getting the sun they need for photosynthesis by shading them with their leaves. However, forage seedlings do not compete well with weeds. It is important that forages be planted into a field where weeds have been well controlled. They also must receive the proper amount of nutrients so they will grow vigorously.

Forages allow farmers to make different choices when using herbicide. If, for example, a broadleaf forage is planted, such as alfalfa, a farmer can use an herbicide that kills grassy weeds without hurting the alfalfa.

The combination of careful herbicide use and competition from the forage can reduce the overall number of weed seeds in a field. This, then, requires less overall use of herbicide during the life of the forage crop and in the annual crops following the forage.

4. Forages improve soil quality. The plant material produced by a forage stand over its life, both above ground as leaves and stems and below ground as roots, results in a large amount of organic matter being left in the soil after the forage stand is removed. Plant roots grow more easily through soils with good levels of organic matter. Rain enters the soil more easily, and water is better distributed through the crop's root zone. There is less erosion in soils with good organic matter levels.

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As you can see, the use of forages in a crop rotation provides several benefits to a cropped agroecosystem. However, farmers can't just make planting decisions for environmental reasons. They must consider when, where, and for how much they can sell what they produce if their families are to continue to live on their farms. A forage stand lasts for about five years. That means a farmer must have a market or use for the forage if it is to be part of a crop rotation.

Farmers can use the forage for their own livestock or sell it locally or regionally to other livestock producers. Because hay is bulky, it can be expensive to ship long distances. To make transportation more economical, facilities have been built in some areas to compact Timothy hay or dehydrate alfalfa (remove the moisture) to process it into pellets or meal. Major markets have been developed in the United States for baled alfalfa or mixed alfalfa/grass hay and in Japan for processed alfalfa.

Forage in a native pasture or rangeland

Native pasture or rangeland is land that has not been cultivated or seeded. In actual fact, much of what we now consider native is really naturalized. This means that at some time during the settlement of agricultural Manitoba, this land was seeded either to crops or tame forages. For a variety of reasons, it has been allowed to go back to a natural state.

Today 93 percent of the Canadian Prairies is used for agricultural land. All that remains of the original native vegetation is an estimated:

- one percent of tall grass prairie
- 13 percent of short grass prairie
- 19 percent of mixed grass prairie and
- 16 percent of aspen parkland.

In Manitoba, there are just under four million acres (1.62 million hectares) of native or naturalized pasture and hayland.

In this section, we will refer to both naturalized and native pasture or rangeland as native. Native pastures can be areas of considerable biodiversity. There are usually many more species of grasses and broadleaved plants than in a tame pasture. In some cases, there may be species that are unique to native areas. As a result, there is a need to protect these areas.

However protection does not necessarily mean leaving native areas completely untouched. Before the prairies were settled, the grasslands and wooded areas were affected by grazing bison and fire. These natural harvesters affected plant growth by removing older leaves and stems. Without some form of trimming, some species can actually become threatened. Untrimmed or unharvested grasslands develop a heavy litter (dead leaves and stems) that creates a mat that can smother plants. Untrimmed or unharvested grasslands become dominated by one or two aggressive species. These take over and choke out other plants. Smooth brome is an aggressive non-native plant that can spread into a native pasture from roadsides or road allowances and replace native species.

Today cattle or other domesticated grazing animals take the place of natural harvesters. They are an important part of the ecosystem if native pastures and rangeland are to maintain biodiversity. The key is to watch where and how livestock graze and move the animals to new areas as indicated by the health of the plant stand. Pastures in "good" range condition have 50 to 75 percent of their original vegetation. Taller, more productive plant species dominate "good" condition rangelands. The key to keeping biodiversity in a native pasture is to manage for a balance between the use of, and rest for, plants.

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Livestock have preferences about where they graze. They prefer to graze close to where they get their water. They also tend to graze in "clumps". In a large pasture, the areas they first graze in the spring can be where they naturally want to stay for the whole season. This is because the plants they first eat are trimmed and regrow. This regrowth is more appetizing than older plants that have drier leaves and stems. If areas are overgrazed and too much of each plant is eaten, the plants are weakened. Other plants can then move into the area.

In overgrazed areas, stronger plant species will grow into these areas and out compete the plants that were originally there. This is called succession. In some cases, those stronger plants can be shrubs and small bushes. This is how a pasture (both native and tame) can change into a wooded area. Trampling by livestock hooves can be as much of a problem as overgrazing. At low to moderate levels, trampling creates small basins in the soil for water and grass seeds to catch. If there is too much trampling, the soil becomes compacted making it harder for seedlings to germinate and grow. Soil erosion due to wind and water can result.

Grassland plants can be classified according to whether they become more or less abundant where there is disturbance or rest.

- **decreasers:** These are desirable forage plants that livestock prefer to eat. Repeated, and excessive disturbance (overgrazing or trampling) causes them to decrease in abundance and vigor; examples are little bluegrass and June grass.
- **increasers:** These are plants that livestock don't eat as readily or that aren't as readily affected by disturbances. At first they increase in abundance after disturbance has occurred. If a lot of disturbance continues, they will decline; examples are big bluestem and porcupine grass.
- **invaders:** These are weeds or invasive alien species that appear and increase when disturbance weakens and kills the increaser/decreaser species. Invaders are very resistant to disturbance and are usually less productive; examples are Kentucky bluegrass and dandelion.

At times, in certain areas, over or undergrazing may be necessary to encourage particular animal or plant species and maintain the most biodiversity possible. The burrowing owl prefers shorter vegetation so that it can see predators. Waterfowl, sage grouse and sharp-tailed grouse prefer areas that have been lightly grazed so they have protection.

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Farmers and ranchers who have access to native grassland have a variety of reasons for keeping the area in native species rather than seeding it to tame forages. Native plants are well adapted to the areas in which they grow. Because there is greater biodiversity, there will usually be some plants in the pasture that will produce in years when growing conditions are abnormal (too dry or too wet). The mix of plants in a native pasture means there are plants maturing at different times during the year. Some grasses are cool season, growing better in the spring and fall; others are warm season, growing best in the summer. This means cattle can adjust their diets over the grazing season, selecting the plants that are the most appetizing and nutritious. The grazing season can also be longer on native pasture because of the mix of plants.

For more information on prairie grasslands, visit Environment Canada's Conservation of Canadian prairie grasslands:
http://www.pnr-rpn.ec.gc.ca/nature/whp/prgrass/df03s00.en.html

Disturbance species

Plant species that move into areas that are overgrazed or trampled are called disturbance species. They are plants that can establish themselves and grow quickly in disturbed areas. Disturbance species can grow in either tame or native pastures. They are plants which are absent or present only in small amounts in undisturbed areas.

While they do introduce biodiversity, most disturbance species are not the preferred species because:

- they are not good feed for either domestic animals or wildlife;
- they grow aggressively and choke out preferred plants, eventually reducing biodiversity and the feed value of the pasture;
- they are shallow-rooted and less productive; or
- they are not good at providing cover for wildlife.

The number and type of disturbance species present can determine the health of a pasture or rangeland. A large amount of disturbance plants indicates an alteration of the normal plant community that would be expected on the site. Following are some disturbance plants.

Plants that appear first

annual sowthistle
dandelion
foxtail barley
green foxtail
hempnettle
Russian thistle
shepherd's purse
stinkweed
wild buckwheat
wild mustard
wild oats

Plants that arrive later

clovers
*Kentucky bluegrass
*quackgrass
Timothy
strawberries

*These plants will persist in a pasture once established.

Ages 11-13 **Activity 4: Ecological succession in a pasture**

Remember we said that forage competes well with weeds if it is healthy and well maintained. Think about what happens if a tame or native pasture is overgrazed. Think about what happens when livestock graze in one area or on one or two plant types more heavily because that's what they like.

a. Comparing/contrasting tame and native forage ecosystems. (Remember to ask permission before entering a farmer's field.)

i. In a tame pasture that has been established for a number of years, make an inventory of all the different type of plants in the pasture. Are disturbance plants present? Identify which plants are weeds and which are the original forage species. Map the field by showing where large groupings of the same plants exist. Is there any pattern to where the plants are growing? Why might this pattern have developed? What environmental factors might have affected this pattern? Based on the number of plants of each type that you see, can you determine a succession pattern? In other words, list the plants that have been there the shortest to the longest time.

ii. In a native pasture, make an inventory of all the different type of plants in the pasture. Is the pasture naturalized or truly native? Identify which plants are native and which ones are domesticated. How would you classify the health of the pasture: is it overgrazed, undergrazed, or grazed in the right amount? Map the field by showing where large groupings of the same plants exist. Is there any pattern to where the plants are growing? Why might this pattern have developed? What environmental factors might have affected this pattern? Based on the number of plants of each type that you see, can you determine a succession pattern? In other words, list the plants that have been there the shortest to the longest time.

b. If you do not have access to a pasture, research what types of forage plants might be planted in a tame mixed forage pasture and their growth characteristics. Research what types of native plants might be expected in a native pasture in your area and their growth characteristics. Develop a succession plan for a pasture that has been established for six or seven years. What environmental factors will affect the rate of succession and how?

c. Suggest how a farmer can prevent or reduce succession from occurring in a pasture.

Note: The Living Prairie Museum in Winnipeg and Fort Whyte Centre are urban places that can be used to observe native forage ecosystems. The Oak Hammock Marsh Interpretive Centre near Stonewall also has native forage ecosystems.

Activity 5: Plant competition in a biodiverse environment

a. Collect a sample of quack grass with a good amount of roots attached. Collect a sample of a forage grass and alfalfa plant with roots attached. Compare the three root systems. Describe the differences and similarities. Take several pieces of quack grass root at least 12 cm long and plant them in soil in a small tray. Do the same for the alfalfa and forage grass roots. Keep the soil moist but not wet, and keep the plants in a warm place. Observe what develops after several weeks. What are the characteristics of the quack grass plant that make it so competitive and a weed that farmers very much want to keep out of their fields.

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b. In the fall (or at the appropriate time), collect weed seeds from red root pig weed, dandelion, shepard's purse, stinkweed and Canada thistle. In the spring, in separate containers plant some of the weed seeds. Also plant in separate containers, alfalfa, clover, timothy and bromegrass seeds. In another container plant a mix of equal amounts of each of the forage seeds and a mixture of weed seeds. Scatter the seeds evenly over the soil. Keep the soil moist and warm, and provide adequate light. Once the seeds sprout, measure the growth (average height and width of an equal number of plants) on a weekly basis and keep a growth chart of the progress of each type of plant. Compare the rate at which each type of plant grows. Also observe, compare and describe the growth habit – how many leaves each plant type has each week, which plant type has the biggest leaves? Observe if the plants in the mixed forage and weed container behave any differently than the same type of plant when they are growing in a container of all the same plants. What does this tell you about competition among plants and which are best suited to survive?

Activity 6: A soil quality study

Gather soil samples from four different land management systems. If possible, collect the samples from an area where the soil type is as much the same as possible – example: samples are all sandy clay, or all sandy loam or all clay. Take soil samples from:

a. an established forage field of four to five years;
b. a field that has been cultivated and cropped continuously;
c. a field that has been zero or minimum tilled for a number of years; and
d. a field that has had manure applied to it for several years.

Observe and describe the amount of organic matter in each of the samples. Take a handful of each of the soil samples and make a fist. How does each of the samples respond? Do they clump and hold together?
Take four large juice cans from which the bottom has been cut out, and cover the bottom with cheesecloth or a lightly woven cloth. Use elastic bands to hold the cloth in place. Fill the cans half full of each soil. Add 200 ml of water. Hold each can over a separate container to catch the water. Time how long it takes for the water to stop dripping from each soil type. Measure the amount of water that passed through each soil type. What conclusions do you reach?

Send the extra soil that was not used in the water experiment for soil nutrient analysis for organic matter, nitrogen and phosphorus.

Activity 7: Seasonal diary, how farming activities affect ecosystems and biodiversity.

Select a land area large enough to contain a number of different cropping/ livestock activities. Check with the farmer first to see that it is all right to use the farm for your study. Follow the activities from September to the end of May. In your journal note and describe how the activities that take place affect agricultural ecosystems and the natural, unfarmed ecosystem that is part of the agricultural area. In a final report that summarizes your observations, indicate where there are places that farming practices could be changed to benefit the ecosystems of the area. For what reasons might the farmer(s) not make the changes? Are there ways a group of farmers could work together to improve biodiversity?

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Throughout the year, look for:

- evidence of wind/water erosion
- cereal and row crops
- methods of applying manure, timing of application
- irrigated/non-irrigated fields
- draining/retaining potholes
- impact of shelterbelts/hedgerows
- pattern of snow distribution in a field – is there a way a farmer can improve spring moisture conditions in a field by redistributing snow?
- tillage methods: conventional, minimum tillage, zero-till – make note of timing of seeding
- livestock grazing – how are cattle distributed in a pasture at different times of the year? Are areas overgrazed? Why might this be? What happens in over grazed or undergrazed areas? Is there evidence of disturbance species?
- use of unfarmed areas (sloughs, potholes, riverbeds) - are there changes that need to be made?

Vocabulary

carbon sequestration: carbon is part of two greenhouse gases, carbon dioxide and methane. In order to reduce the amount of greenhouse gas, it is important to reduce the amount of carbon released into the atmosphere. One way is to "store" the carbon in soil. This is called carbon sequestration.

continuous cropping: Annual crops, such as canola, wheat, barley, are planted year after year without a break for forages.

crop rotation: a planned sequence of growing crops, often in a two to four year cycle.

forage crop: a crop that is used to feed mainly cattle, bison, sheep and horses either by grazing or making hay; a forage can be a grass such as timothy or fescue or a broad leaf legume such as alfalfa or clover. A grain crop, such as oats, can also be forage if it is cut or pastured while the crop is still green. In a native pasture, forbs other than legumes will be more common.

forage stand: a forage crop that is growing in a field.

forb: any plant that is not a grass or grass-like; a broadleaved plant.

grass: a forage plant that looks like a grass; it has long slender leaves mostly coming from the base of the plant.

hay: a dried forage crop used for animal feed. It is not the same as straw which is what is left after the seed has been removed from a ripened cereal crop.

headland: the area that runs around the outside of a field where the crop does not grow; it can be cultivated, but is usually left to native species or tame forages that have "escaped" from a field. This can be an area of considerable biodiversity in a continuous cropping area.

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legume: a forage that fixes nitrogen; a legume is called a broadleaf crop because it has round or oval leaves spaced along a stem.

improved/tame hay/pasture: hay or pasture land that has been seeded by a farmer with a type (variety) of forage that best suits the growing conditions of the area.

marginal land: farmland that is not well suited to producing annual crops. This could be due to soil type, climate, or terrain. For example, field of sandy soil in a windy area may be considered marginal.

micro-organisms: any organism too small to be seen with the unaided eye; soil fungi and bacteria are micro-organisms that break down organic matter releasing nutrients that can be used by plants.

native hay/pasture: hay or pasture land that is in a natural or close to natural state. It has not been seeded by a farmer or it was seeded at one time and is in the process of moving to a naturalized state. The land may be this way because it is difficult to cultivate and seed because it is too stony, is marshy, or has too many pockets of trees. There is very little true native pasture left on the Prairies.

nitrogen-fixing bacteria: bacteria that take nitrogen from the air and change it into a form of nitrogen that can be used by plants.

nodules: growths on the roots of legume plants where nitrogen-fixing bacteria live.

organic matter: the remains of formerly living things such as plants, animals, insects and micro-organisms at various stages of decay. Well-decayed or decomposed organic matter in a layer just above the mineral soil is called humus.

potholes: small depressions in the ground formed when chunks of ice from retreating glaciers were buried. As the ice melted, the soil covering it collapsed forming the pothole. Potholes fill with water each spring and provide habitat for ducks and geese.

road allowance: an area of land that runs between sections, left to allow for the future building of a road. Because roads are not needed around every section, many road allowances are now farmed.

section: a measurement of agricultural land used in Western Canada. It measures one mile x one mile or a square mile (1.6 km x 1.6 km). It has 640 acres or 259 hectares. The British method of "square survey" was used in much of the Prairies to determine property lines. A half section of 320 acres or 130 hectares is one mile x one-half mile; a quarter-section is 160 acres or 64 hectares and one-half mile x one-half mile. Today roads follow the section lines in most cases.

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rotational grazing: cattle, sheep or horses are moved from one pasture to another after a set number of days well before all the forage is eaten. Usually three or four pastures are involved. Length of time in the pasture depends on the size of the herd and the type(s) and condition of the forage.

species: related individuals that resemble one another, or are able to breed among themselves but not with members of other species.

symbiotic: two organisms that live closely together and benefit each other as in the case of nitrogen fixing bacteria and legumes. These bacteria, called rhizobia, release the nitrogen they fix into the soil around the plant providing a needed nutrient to the plant; in return the plant gives the bacteria a home in the nodules on its roots.

Resources

For presentations on this topic, contact Manitoba Agriculture, Food and Rural Initiatives - local agricultural representative.

A list of agricultural representatives can be found at www.gov.mb.ca/agriculture/contact/agoffices.html

Information resources

Your Window on Biodiversity, Environment Canada: www.cbin.ec.gc.ca/ Check out the Issues section in particular.

Biological Diversity in Food and Agriculture, Food and Agriculture Organization: www.fao.org/biodiversity/

Agroecosystems, Dalhousie University: http://is.dal.ca/~dp/agroecosystems.html

Convention on Biological Diversity: www.biodiv.org/doc/publications/guide.asp

Biodiversity, Prairie Farm Rehabilitation Administration (PFRA): www.agr.gc.ca/pfra/biodiversity/intro_e.htm

Theory of Biodiversity, Quebec Biodiversity Website, The Redpath Museum of McGill University, www.redpath-museum.mcgill.ca

Map Resource:
For a map of grassland and parkland in Manitoba, visit Environment Canada's site: http://www.pnr-rpn.ec.gc.ca/nature/whp/prgrass/df03s59.en.html