Alberta Biodiversity
Monitoring Institute

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Terrestrial Field Data Collection Protocols (Abridged Version)

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1. OVERVIEW OF ABMI DATA COLLECTION

Data Collected at Terrestrial Sites

ABMI surveys 1656 random sites across Alberta. This systematic sample of Alberta's biota and ecosystems has been labeled "terrestrial data collection" because many of these sites are in uplands, although some occur in lowlands. The ABMI terrestrial data collection is designed to be implemented by a field crew of two. At least one of the crew members must have a strong background in identifying vascular plants. Both crew members must be able to identify common mammals and birds. Many of the non-vertebrate and non-vascular plant species can only be accurately identified by taxonomic experts. As a result, bryophyte, lichen, and mite specimens are collected in the field and later identified by experts in a laboratory.

Data are collected for a wide variety of species and habitats at each ABMI terrestrial site (Table 1).

Table 1. Types of data collected at ABMI terrestrial sites.

General Habitat	*Taxa*
Physical characteristics (latitude, longitude, elevation, ecosite)	Vascular Plants
Photographs of the site	Bryophytes
% cover of water, bare soil, and low vegetation, shrubs, trees	Lichens
Area and type of natural and human created disturbance	Birds
Detailed Habitat	Mammals
Trees (live, dead, down logs)	Mites
Standing dead vegetation	
Soil (LFH, organic, mineral)	

Data Collected at Wetland Sites

Near every terrestrial site, ABMI also surveys an open-water wetland site. ABMI wetland data collection is designed to be implemented by a crew of two. At least one of the crew members must have a strong background in identifying vascular plants. Both crew members must be able to identify common mammals and birds. Many of the aquatic invertebrates can only be accurately identified by taxonomic experts; these specimens are collected at the wetland and later identified by experts in a laboratory.

Data are collected for a variety of species and habitats at each ABMI wetland site (Table 2). These wetland data collection protocols are described in a companion document.

Table 2. Types of data collected at ABMI wetland sites.

General Habitat	*Taxa*
Physical characteristics (latitude, longitude, elevation, ecosite)	Vascular Plants
Photographs of the site	Aquatic Invertebrates
Chemistry and nutrient content of water in the wetland	Birds
Area covered by open water, emergent vegetation, fen, and moist meadow	
% cover of water, bare soil, low vegetation, shrubs and trees around the wetland	
Area and type of natural and human created disturbance in an around the wetland	
Detailed Habitat	
Trees (live, dead, down logs)	

Landscape Information

To complement field data collection, information about the vegetation, physical features, climate, and human land uses around each ABMI terrestrial and wetland site are determined. Detailed landscape information is collected at two spatial scales: i) the area in which field data are collected (this area varies among protocols, Section 3), and ii) within a 5% sample of the landscape (i.e. within a 3 x 7 km rectangle) that encompasses the terrestrial site. This detailed information is collected based on manual interpretation of air photos. To complement the detailed landscape information, coarse landscape information is mapped throughout Alberta using satellite images.

Quality Control for Data Collection

All ABMI field staff receive classroom and field based training prior to beginning data collection. This training covers all protocols and prepares staff for the variety of habitats and field conditions they may encounter. To ensure that data collection remains consistent and accurate among crews, field supervisors visit each crew during data collection.

Field data are entered into electronic tablets to reflect exactly what is found / measured at the ABMI site. Electronic verification is built into the database to ensure that data are consistent with allowable codes. If the options for a data field do not include an appropriate response, crews record the most appropriate option and make notes in the comments. Completed data forms are checked in the evening for completeness, and copied to a computer for backup.

Differences in Data Collection Among Natural Regions

Trees and down logs are absent, or at very low densities, in sites located in the Grassland and Parkland natural regions, especially when agriculture activities are present. This results in crews having time available to survey additional elements. To better quantify low vegetation in agricultural areas, supplemental sampling is done for shrubs, grasses and herbs.

Specimen and Sample Processing

A variety of samples and specimens are collected during field sampling. These are shipped from the field to the lab for processing and storage. To ensure nothing gets lost, shipments are accompanied by a document describing what was sent.

Tree cores/cookies are processed at the lab to determine tree age, and organic soils are processed to extract mites. Organic and mineral soils are then shipped to analytical laboratories to determine soil chemistry and carbon content. Vascular plants that were not identified in the field during terrestrial and wetland surveys, are identified by experts. Bryophyte, lichen, mite, and aquatic invertebrate specimens are sorted by technicians and then sent to experts for identification. A sample of specimens identified by one expert are re-identified by a second expert to ensure accuracy.

Data Analyses & Interpretation

To facilitate interpretation of ABMI data, a group of researchers have developed scientifically robust analyses. As data become available, status and trend for species, habitats, human disturbance and biodiversity are determined using these analyses. Results are presented for the province as a whole, and for selected regions. In addition, analyses have been developed to assess ecological condition at specific sites. ABMI analyses methods are published in ABMI reports and the peer-reviewed literature.

Information Dissemination

All data collected by the ABMI are stored and managed on the ABMI web-site (www.abmi.ca). To the degree possible, data are uploaded to the web-site within 12 months of being collected. To facilitate use of the data, it can be down-loaded freely by everyone. As data summaries and analyses are completed, these are posted on the web-site.

2. SITE SELECTION & ESTABLISHMENT

2.1 Choosing Sites

- Terrestrial sites are spaced throughout Alberta using the 20 km National Forest Inventory (NFI) grid. This results in ABMI having 1656 terrestrial sites (Figure 1).
- To ensure the site locations remain confidential, the ABMI sites are offset a random direction and distance from the NFI sites.
- Exact ABMI site locations are not shared. ABMI has created approximate locations (randomly located within 5 km of the actual site), and these are available from the ABMI web-site.

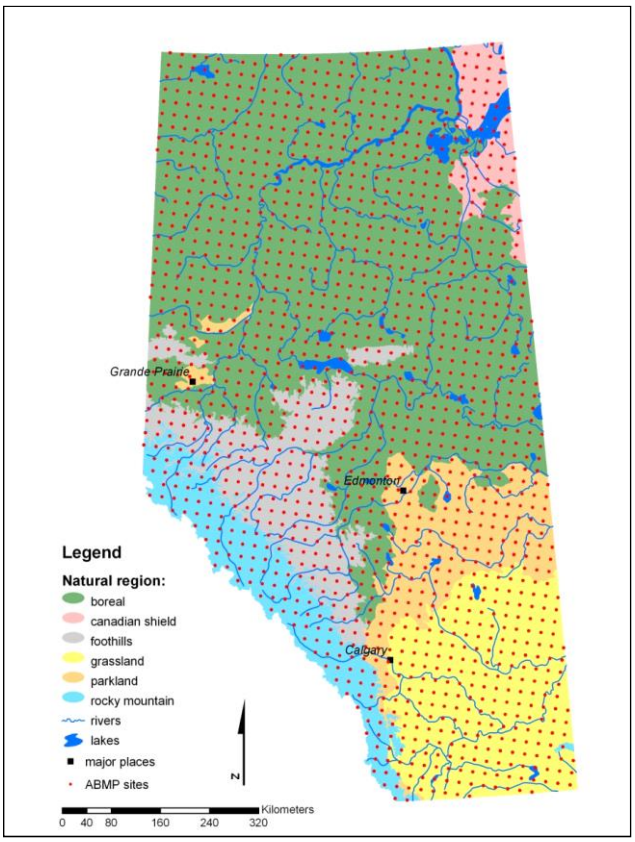

Figure 1

Public Land

- The public land manager is contacted to determine whether there are restrictions on activities at the site, and to organize access to the location.

Private Land, National Parks, Provincial Parks, and Reserve Lands

- The land owner is contacted to obtain permission to access the site and to collect information.
- If permission is granted by the land owner, the location becomes the permanent ABMI site.
- If permission to survey the site is not granted by the land owner, a new random location within 5 km of the NFI site is identified with the restriction that the new location must also be for the same ownership type and have similar vegetation as the original location.
    - The new land owner is contacted to request permission, and the process repeated if permission is not granted

2.2 Field Reconnaissance

- Prior to data collection, crews create maps and visit each site to determine the length of time required for travel, identify the best route to the site, and record potential hazards along the route.
- During field reconnaissance as many impediments to travel as possible are removed.
- Satellite images are used as base-maps, with GIS layers showing access features (roads, trails, rail lines, pipelines, cut lines, well sights, and water features) are overlaid.
- For sites located in open water, distance from vegetation to site center (and to all bird point counts) is determined on the maps.
    - If the site center and all bird point count stations are obviously >200 m from vegetation, the site is recorded as "Open Water" and is not visited to collect field data.
    - If either site center or the bird point count stations are <200 m from vegetation, then the site is visited. Note that it may be necessary to visit the site and/or the bird point count stations to confirm they >200 m from vegetation.
        - Normal data collection occurs at these sites <200 m from vegetation.
        - Note that at some sites, some bird point count stations (and/or site center) may be in open water >200 m from vegetation and therefore not surveyed, even though other bird point count stations are in upland areas or <200 m of vegetation and thus surveyed.
- If takes more than 2.5 hours to travel to a site then helicopter access is required so that field crews can access the site and complete the data collection in a single day.
    - If required, a clearing for the helicopter pad is created >200 m from site center but otherwise as close as possible.
    - The most unobtrusive pad possible is created (i.e., the fewest and smallest trees and shrubs are cut).

2.3 Establishing Plots, Transects and Stations

- Sites are visited early in the spring to establish plots and layout transects that will be sampled during subsequent visits.
- By doing this work prior to data collection, there is sufficient time to collect data during subsequent visits.

Layout on Public Land

Central 1 ha

- Site center is located as precisely as possible using a hand-held GPS.
- A 1.5 m steel bar is driven into the ground at site center so it protrudes 1 m.
- A 12" metal spike is driven 30 cm below the ground surface.
- The nested plots and transects (Figure 2) are laid out with the aid of a GPS, compass and measuring tape.
    - The boundary of the 1 ha area, and the lines dividing this into four 50x50 m vascular plant plots, are marked with flagging tape.
    - The four 5 x 5 m, 10 x 10 m, 25 x 25 m nested tree plots, and four 25 m DWM transects are marked with pin flags at the corners and end of the transects. The distance between the corners of the nested plots are measured diagonally to ensure they are within 20 cm of true locations.
    - To ensure the tree plots and DWM transects can be accurately relocated in future years, the GPS locations are recorded at 35.35 m along the sub-ordinal and four 1.5 m steel bars are driven into the ground so they protrude 1 m (these bars mark the inside corner of the tree plots along each of the sub-ordinal transects). Magnetic survey spikes are also driven into the ground at these four locations to ensure they can be located accurately if the steel bar is missing.
    - The two 30 m surface substrate (LFH) transects and four soil/arthropod sample locations are marked with pin flags.
    - Note that no extra marking are used for the 4 lichen and moss plots. When collecting data these are marked with a tape measure based on pin flags from the tree plots.

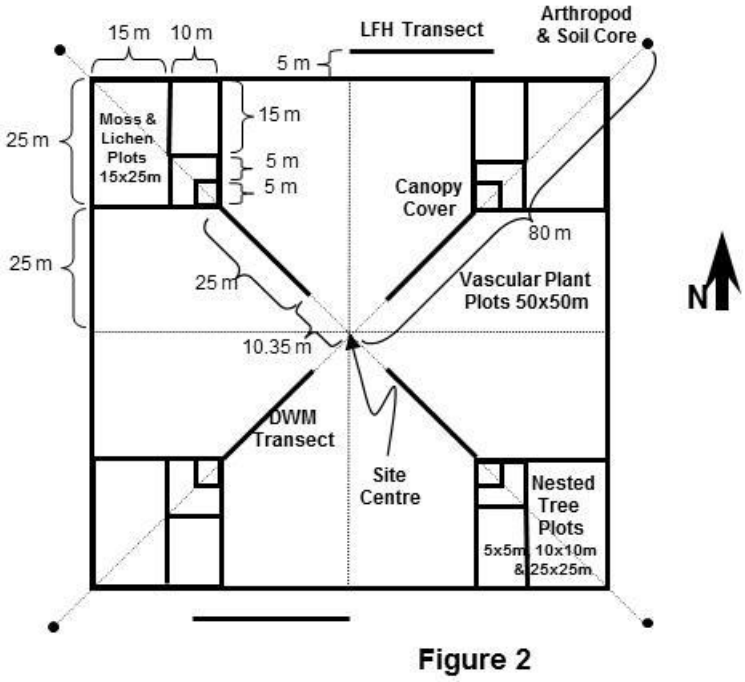

Figure 2

Camera and ARU Stations

- Cameras and ARUs (autonomous recording units) are installed in February/March and collected in July.
- Four cameras that trigger automatically based on heat and movement are placed in a square approximately 600 m apart (Figure 3) to record mid- and large-sized mammals at the site.
- Four ARUs are placed at the same corners to record bird vocalizations.
- Sent is placed at NE and SW corners at deployment (see methods below). If a location with sent is within 200 m of a residence select a different corner (clockwise direction if possible) for the sent.

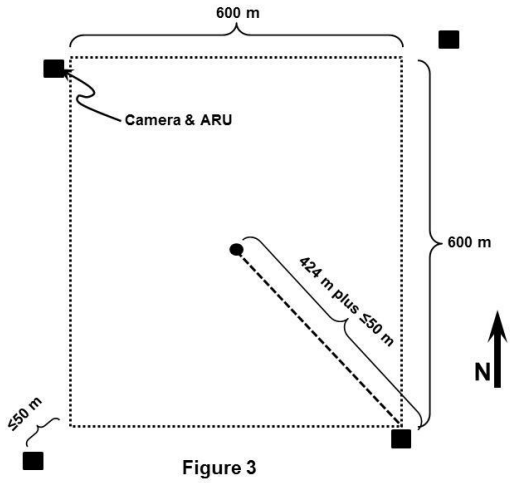

Figure 3

- Ideally the ARUs and cameras are placed at the exact same locations. However, if required, the cameras and ARU may be up to 10 m apart.
- The GPS location for each station (or each camera and ARU if they are not placed together) at each ABMI site is recorded.
- Ideally, cameras and ARUs are placed at the corner of the 600 m square. The camera and ARU are fastened to a secure stake.
- In some cases will be necessary to move the camera/ARU location away from the grid corner.
    - To eliminate biased habitat selection, the new location must be as similar as possible to that found at the original grid corner.
    - **Habitats with trees:** To be efficient, the camera and ARU are attached to the closest suitable tree to the grid corner. Cameras/ARUs are moved a maximum of 50 m to a new location that is in a habitat similar to the grid corner. For example, if the grid corner is under the canopy the new location must be under the canopy, or if the grid corner is on a cutline the new location must be on a cutline. The camera is aimed towards an area that has an unobstructed view at least 5 m wide 10 m long (see deployment methods below).
    - **Open/grassy/shrubby habitats:** Cameras/ARUs are only moved if they cannot be deployed at the grid corner due to safety reasons. Cameras/ARUs are moved a maximum of 50 m to a new location that is in a habitat similar to the grid corner.
    - **Private land:** If the grid corner is in cultivated crops or some other location that is unacceptable to the landowner, then relocate the camera/ARU to a new location that is in a habitat similar to the grid corner (see below - layout on private land).
    - **Water:** If a grid corner is within open water but ≤500 m from vegetation or the lake shore, then relocate the station to the nearest vegetation/shore. If a station is in open water and >500 m from vegetation or the lake shore, then it is not surveyed using cameras and ARUs.
    - **Safety:** If you cannot reach the chosen station due to some type of obstruction (e.g., river or other access issue), then relocate the camera/ARU to a new location that is in habitat as similar as possible to the grid corner. If there are safety reasons for avoiding the chosen location (e.g., bear activity) then continue to the next station and if possible return to the station at a later time/date.

Layout on Private Land, National Parks, Provincial Parks, DND, and Reserve Lands

- Care is taken to minimize impact on crops and livestock while laying out plots, transects and stations and collecting data on private land.
- Plots and transects are laid out the same as that for sites on public land.
    - To avoid using permanent markings at sites on private property, the plots and transects are laid out at the start of each field visit and all flagging/pigtails are removed at the end of each visit. Permanent stakes are not used, rather a GPS that is accurate to <30 cm is used locate site center and mark the inside and far corners of each of the tree plots.
- Cameras and ARUs are installed in consultation with the land owner.
    - If possible, locations of cameras and ARUs are installed similar to that described for public land.
    - If required, cameras and ARUs are moved up to 500 m so that they are in locations acceptable to land owner.
        - When moving camera and ARU locations, a new location that is as similar as possible to the grid corner is selected.
        - The final locations for the four cameras/ARUs must be at least 500 m apart.
    - When moving locations to avoid cultivated fields it is not possible to choose a similar habitat type. In this case, the following order of precedence is used when choosing the new location:
        i. Choose a location at an interface between two cultivated fields with little or no uncultivated ground at the interface.
        ii. Choose a location along a fence adjacent to the cultivated area with as narrow a non-cultivated strip as possible.
        iii. Choose a location adjacent to the cultivated area beside a vegetated trail.

iv. Choose a location adjacent to the cultivated area beside a narrow gravel road.
v. Choose a location adjacent to the cultivated area beside a narrow paved road.
vi. Choose a location adjacent to the cultivated area beside a highway.
vii. In all cases, avoid trees and large shrubs as much as possible.

- At locations with livestock, a small enclosure is used to ensure animals do not damage the camera and ARU.
- The GPS location of each camera/ARU station is recorded.

3. FIELD SURVEYS

3.1 Site Characteristics

- General site characteristics are described at site center and at each of the other eight bird point count stations.
- Site conditions are designed to be completed within 2-3 minutes from a standing position.
- A reduced version of site characteristics is recorded at the surface substrate transects, the soil arthropod sampling locations, and the vegetation plots.

Photographs

- Six photographs are taken using a digital camera with a 35 mm focal length and a quality setting of approximately 3 Mega-pixels.
  - Transect Photos – From site center, landscape photographs are taken at eye level in each of the four sub-ordinal directions.
  - Representative Site Photo – From anywhere within the 1 ha plot; a single photograph is taken that best represents the physical and vegetation characteristics of the site.
  - Canopy Photo – Standing at site center, a photograph of the canopy is taken from waist height with the camera pointing directly up.
- Except for the canopy photo, a sheet of paper with the site number is included approximately 5 m from the camera for scale.
- Check the quality of the photos and re-take if they are blurry.

Physical Conditions

- Physical conditions are determined at site center and at the location of cameras and ARUs.
- Elevation is determined using the digital elevation GIS layer that is maintained by the Alberta provincial government.
- Aspect (direction in degrees when looking down-hill) is determined using a compass.
- Slope is determined using a compass and recorded in degrees. From a standing position, sight to a reference point that is eye-level above the ground 20 m away in the direction of maximum slope.

Tree Composition

- General tree characteristics are assessed within the central 1ha area and within a 50 m radius circle around the camera and ARU locations.
- Trees are defined as any woody species that that normally grows ≥1.3 m tall and that does not have multiple stems originating together. The list of tree species includes but is not limited to: trembling aspen, balsam popular, paper birch, lodgepole pine, jack pine, white pine, white spruce, black spruce, Engelmann spruce, subalpine fir, Douglas fir, balsam fir, larch, and ornamental trees.
- Tree characteristic are determined for both the primary (most common) and secondary ecosite types.
- For each of the three height strata, tree species composition (in 10% increments), average distance between trees (in 1 m increments), and average height (in 5 m increments) are recorded. The height strata are:
  - Veteran Trees – see description in Section 3.2 below.
  - Dominant and Co-dominant Trees – see description in Section 3.3 below.
  - Intermediate and Suppressed Trees – see description in Section 3.3 below.
- Some stands may be missing one or more of the strata.
- Dead trees (snags) are not included when determining tree composition, density or height.

Low Vegetation

- Low vegetation characteristics are assessed within the central 1ha area and within a 50 m radius circle around the camera and ARU locations.
- Low vegetation characteristic are determined for both the primary (most common) and secondary ecosite types.
- The most common shrub species (based on % cover) in two height categories ≤1.3 m, and >1.3 m is identified. If no shrubs are present then the species is recorded as "none".
- For both height categories, shrub cover is estimated as one of five categories (0, 1-25%, 26-50%, 51-75%, >75%), based on what would be obtained if a photograph had been taken from above the shrubs.
- The type of ground vegetation (grass, herbs, shrub, sedge/rush, moss, or lichen) that has the highest % cover based on what would be obtained if a photograph had been taken from 0.5 m above the ground is recorded. If there is no ground vegetation, then the category "none" is recorded.
- The % bare ground (defined as ground surface without vegetation) is recorded as 0, <1, and 5% increments.
- The % of the ground surface covered by water is recorded in as 0, <1, and 5% increments.

Ecological Site Type

- Ecosite types are assessed within the central 1ha area and within a 50 m radius circle around ARUs, and cameras.
- Ecological (ecosite) site types identify the dominant vegetative community present, or that would have been present pre-disturbance.
- Ecosite site types are named based on soil characteristics, soil nutrients, moisture status and vegetation community.
- Structural stage describes the composition and structure of vegetation within an ecosite. Structural stages often vary among seral stages as vegetation regrows following disturbance.
- Historic/natural ecosite site type and structural stage
  - The most common (primary) ecosite type and structural stage is recorded along with the % (in 10% cover increments) of the area that is occupied by this type.
  - If there is more than one ecosite type and structural stage present, and the second type occupies more than 20% of the area, then determine the secondary ecosite site type and structural stage and the % (in 10% cover increments) of the area occupied by this secondary type.
  - Secondary ecosite types must make up ≥0.1 ha of a continuous habitat (i.e., be ~ 35 m in diameter) otherwise they are considered part of the primary ecosite.
  - The sum of the primary and secondary ecosite types may be less than 100% if more than two ecosite types are present.
- Current ecosite site type and structural stage
  - Current ecosite type will only differ from historical/natural ecosite type if the topography, hydrology or soils have been altered by anthropogenic activities.
  - The most common (primary) ecosite type and structural stage present and the secondary ecosite type and structural stage within the area are recorded.
- Ecosite types are determined differently among natural regions; thus two designations are assigned to each ABMI site.
  - First ecosite types are classified in the lab based on AGRASID (AGRASID 3.0, Alberta Soil Information Center 2001), GVI (Grassland Vegetation Inventory 2006) soil types and vegetation information from the site (Table 3).
  - Second, ecosite types are classified in the field based on forest conditions (Table 4).

Table 3. Thirty-three land classes based on AGRASID and GVI.

Primary Class	Land Sub-Class	Site Type	Description	ABMI Code
Open Water	Lentic	Standing water	Permanent open standing-water with no emergent vegetation, generally larger than 1.0 ha and >15 cm deep.	LenW
	Lotic	River	Open water of rivers, generally rivers wider than 20 m.	LtcR
Native / Natural Lentic	Lentic	Temporary	Water present <3 weeks (dry by July) <15 cm deep.	LenT
		Seasonal	Water usually present >3 weeks (usually dry by July) >15 cm deep.	LenS
		Alkali	Water present >3 weeks and >15 cm deep	LenA
		Semi-Permanent to Permanent	Throughout the year except during periods of extreme drought (present in autumn in 70% of the years); often occurs adjacent to LenW; includes the march zones; water is generally >15 cm deep; if open water is present it is smaller than 1.0 ha	LenSP
Native / Natural Lotic	Lotic	Coniferous	Coniferous trees with a combined canopy cover of greater than 25%.	LtcC
		Deciduous	Deciduous trees with a combined canopy cover of greater than 25%.	LtcD
		Shrub	Shrubs have a combined cover of at least 10%.	LtcS
		Herbaceous	Herbaceous species (including sedges) have a combined cover of at least 5%.	LtcH
Native / Natural Grassland	Grassland	Subirrigated	Water table is close to surface during growing season, but rarely above. Does not have a defined depressional edge.	Sb
		Overflow	Areas subject to water spreading and sheet flow. Typically on gentle inclines or terraces above the frequent flood zone. For locations where flood frequency is less than once every ten years.	Ov
		Clayey	Clayey-textured soils including silty clay, sandy clay, clay, and heavy clay. Generally >40% clay.	Cy
		Loamy	Includes loam, silt loam, silt, clay loam, sandy clay loam, and silty clay loam.	Lo
		Sandy	Sandy-loam-textured soils.	Sy
		Limy	Eroded or immature soils with free lime ($CaCO_3$) at the soil surface. Soil pH generally >7.5.	Li
		Sand	Loamy sand and sand soils, and not with a duned surface.	Sa
		Blowouts/ Solonetzic Order	Areas with Solonetzic (hardpan) soils. The surface may or may not have eroded pits.	BlO
		Choppy Sandhills	Loamy sand and sand soils with a duned land surface.	CS
		Thin Breaks	Areas with bedrock at or near the soil surface. Amount of vegetation is intermediate between Limy and Badlands. TB may include thin, eroded or immature soils on gentle to steep slopes.	TB
		Shallow to Gravel	Soil with 20 to 50 cm of a sandy or loamy surface overlying a gravel or cobble- rich substrate.	SwG
		Saline Lowland	Areas with negligible vegetation due to electrical conductivity (salts) and/or sodium adsorption ratio limitations.	SL
		Gravel	Dominated by gravels or cobbles (>50% coarse fragments). May be covered by a mantle <20 cm thick with some gravels.	Gr
		Badlands/ Bedrock	Nearly barren or barren lands, with exposures of soft rock, hard rock, or surficial geology. Includes steep valley walls.	BdL
Anthropogenic	Crop	Irrigated	Row crops (small grains, oilseeds, and fallow) with water supplemented by anthropogenic means.	CI
		Non-irrigated	Includes row crops without water supplementation.	CN
	Tame Pasture	Irrigated	Planted grasses or legumes for livestock grazing or the production of hay with water supplemented by anthropogenic means.	PI
		Non-irrigated	Planted grasses or legumes without water supplementation.	PN
	Industrial	Pits	Vegetative cover removed for the extraction of surface deposits; may be active or inactive.	Pit
		Developed	Invasive developments that are very difficult to return to crop, pasture, or native/natural conditions; does not include urban.	Dev
	Settled	Urban	Areas where much of the land is covered by structures and the population density is high (cities, towns, villages, hamlets, cottage development, strip developments, cemeteries, and shopping centers).	Ur
		Rural	Sparsely populated areas outside urban (country residential developments (acreages), farmsteads, golf courses, parks and campgrounds).	Ru
Unknown	No Data	Not Determined	No information in AGRASID and GVI	UNK

Table 4. Ecosite categories based on a simplified forest classification.

Dominant Shrub/Herb/Ground Cover	Nutr./ Moist. Code [1]	Tree Species Modifier	Tree Species Composition [2] (In an area without human disturbance)	Structural Stage [3]
Upland Vegetation Communities				
Bearberry/Lichen Bog Cranberry common at some sites	1 - **PX**	1a **Pine**	Pj + Fd > 80%	**A. Tree Dominated Ecosites** *(Trees ≥10% cover)* – Add 4-letter code combining tree height, density, and arrangement. Tree Height **(TS) Short** – ≥50% of canopy cover <10 m tall. **(TT) Tall** – >50% of canopy cover ≥10 m tall. Tree Density **(D) Dense** – Trees ≥1.3 m tall are ≤2 m apart. **(S) Sparse** – Trees ≥1.3 m tall are >2 m apart. Tree Arrangement **(C) Complex (Spatially)** – Tallest trees ≥10 m apart, with smaller trees (~ ½ height) between that receive direct sunlight from above. **(N) Non-complex (Spatially)** – Tallest trees <10 m apart, with few or no smaller trees (~ ½ height) between, that receive direct light from above.
Labrador Tea / Feather Moss Bog Cranberry, Bilberry, Grouse-berry common at some sites	2 - **PM**	2a **Pine**	Pj + Pl > 50%	
		2b **Other**	Aw + Sw + Se +Fa +Pw > 50%	
		2c **Sb**	Sb > 50%	
Hairy Wild Rye Bearberry, Canada Buffalo-berry, Feather Moss common at some sites	3 - **MX**	3a **None**	No Trees	
		3b **Pine**	Pj + Pl > 50%	
		3c **AwMix**	Aw > 20%	
		3d **Spruce**	Sw + Se + La >50%	
Low-bush Cranberry / Canada Buffalo-berry Blueberry, Rose, Alder, Labrador Tea, Bearberry, Thimbleberry, Bog Cranberry, Feather Moss common at some sites	4 -**MM**	4a **Pine**	Pj + Pl + Fa >50%	**B. Non-Tree Dominated Ecosites** *(Trees <10% cover)* **Non-Vegetated** *(<10% Vegetation Cover)* – Add 2-letter code describing dominant substrate type. **(NR) –** Bedrock, cliff, talus, bolder **(NS) –** Sand bar in river/stream (cobble, gravel, sand) **(NB)** – Beach at edge of a lake or wetland **(NM) –** Mineral soil any other reason **(NO) –** Organic soil ny other reason **Note:** If standing water is present, refer to Open Water Communities
		4b **PjMix**	Aw + Bp + Sw >20%, AND Pj >20%	
		4c **Aw**	Aw > 50%	
		4d **AwMix**	Aw >20% AND Sw + Sb + Pl > 20%	
		4e **Spruce**	Sw > 50%	
Horsetail Dogwood, Rose, Willow, Feather Moss common at some sites	5 - **MG**	5a **Poplar**	Pb + Aw > 50%	
		5b **Spruce**	Sw + Se > 50%	
		5c **Sb**	Sb > 50%	
Dogwood / Fern / Feather Moss Rose, Alder, Bracted Honeysuckle, Devil's Club Fir common at some sites	6 - **RG**	6a **Pine**	Pl > 50%	**Only Ground Vegetation Present** *(Shrubs <10%; Trees <10%; Other Vasc. >10%)* – Add 3-letter code combining dominant vegetation type and density Vegetation Type **(GB) Bryoid/Lichen** – Bryophyte and lichen **(GF) Forb** – Non-graminoid herbs and ferns **(GG) Graminoid** – grasses, sedges **(GR) Marsh** – reeds, and rushes Vegetation Density **(D) Dense** – Cover >75% **(M) Moderate** – Cover 25-75% **(S) Sparse** – Cover <25%
		6b **Poplar**	Pb + Aw > 50%	
		6c **Spruce**	Sw + Se + Fa > 50%	
Not Treed	7 - **NT**	7a **Alpine**	Elevation above tree line	
		7b **Flood**[3]	Site disturbed frequently by flooding	
		7c **Ice**	Site disturbed frequently by ice or snow	
		7d Dry	Site in prairies/parkland and receives little precipitation	
		7e **Geo**	Geological features not suitable for tree growth	
		7f **Human**[4]	Site disturbed recently by humans	
				Shrubs Present *(Shrubs >10%; Trees <10%)* – Add 3 letter code combining shrub height and density. Shrub Height **(SL) Low** – Shrubby vegetation <2 m tall **(ST) Tall** – Shrubby vegetation >2 m tall Shrub Density **(D) Dense** – Shrubs cover >75% **(M) Moderate** – Shrubs cover 25-75% **(S) Sparse** – Shrubs cover <25%

Aw – trembling aspen, Pb – balsam poplar, Pc – plains cottonwood, Bp – paper birch, Ba – Alaska birch, Mm – Manitoba maple; Am – western mountain ash, Pl – lodgepole pine, Pj – jack pine, Pw – white pine, Sw – white spruce, Sb - black spruce; Se – Engelmann spruce, Fa – subalpine fir, Fd – Douglas fir, Fb – balsam fir, and Lt – larch

Dominant Shrub/Herb/Ground Cover	Nutr./ Moist. Code [1]	Tree Species Modifier	Tree Species Composition [2] (In an area without human disturbance)	Structural Stage
Lowland/Wetland Vegetation Communities				
Bog - Labrador Tea / Peat Moss / Lichen Bog Cranberry and Cloudberry may also be present (Soil saturated for part or all the year; undecomposed organic soil substrate)	**8 - PD**	**8a Sb[5]**	≥10% tree cover (may only be in shrub/ground strata) Sb > 50%	**C. Open Water Dominated Communities** *(Emergent Vegetation <10%)* – Add 4-letter code combining dominant vegetation type, height and density Vegetation Type **(OV) Vegetated** – Floating or submerged plants ≥ 10% cover **(ON) Non-Vegetated** – Floating or submerged plants < 10% cover (note that only a 2-letter code is used for this category → vegetation height and density are not added to the code) Vegetation Height **(S) Short Submerged** – ≥50% of vegetation extending 0.0 – <0.3 m above the substrate **(M) Medium Submerged** – ≥50% of vegetation extending 0.3 – 1.3 m above the substrate **(T) Tall Submerged** – ≥50% of vegetation extending >1.3 m above the substrate **(F) Floating** – ≥50% of vegetation with floating leaves on the water surface. Vegetation Density **(D) Dense** – Aquatic vegetation covering >75% of the substrate. **(M) Moderate** – Aquatic vegetation covering 25-75% of the substrate. **(S) Sparse** – Aquatic vegetation covering <25% of the substrate.
		8b Shrub	<10% tree cover	
Poor Fen - Labrador Tea / Peat Moss / Sedge Bog Cranberry, Dwarf Birch and Willow may also be present (Soil saturated for part or all the year; undecomposed organic soil substrate)	**9 - MD**	**9a SbLt[5]**	≥10% tree cover (may only be in shrub/ground strata) Sb + Lt > 50%	
		9b Shrub	<10% tree cover	
Rich Fen - Dwarf Birch / Willow / Sedge / Grass / Moss (Soil saturated for part or all the year; undecomposed organic soil substrate; includes floating mats of vegetation)	**10-RDp**	**10a SbLt**	≥10% tree cover (may only be in shrub/ground strata) Sb + Lt ≥ 50%	
		10b Shrub	<10% tree cover AND ≥10% shrub cover	
		10c None	<10% tree cover AND <10% shrub cover	
Wet-Meadow-Rich-Hydric Dominated by sedge, grass, presence of shrub and trees (e.g. willow). Conductivity < 15; Soil, saturated for part or all of the year. Well decomposed, organic soil substrate.	**10.5-RDm**	**10.5a Tree**	≥10% tree cover (may only be in shrub/ground strata; usually along wetland edge)	
		10.5b Shrub	<10% tree cover AND ≥10% shrub cover	
		10.5c None	<10% tree cover AND <10% shrub cover	
Marsh – Cattail / Rush /Reed Conductivity <15 mS/cm, sedge and grass may also be present (Water is above the rooting zone for most or all of the year)	**11-VD**	**11a None**	usually along a water body edge ≥10% emergent vegetation cover <10% tree cover	
Swamp Conductivity <15 mS/cm, trees and shrubs present, poorly developed bryophytes, often with pools of water (Water is above the rooting zone for some of the year, organic soil humified rather than peaty)	**12-SD**	**12a Tree**	>10% tree cover	
		12b Shrub	<10% tree cover	
Alkali Conductivity >15 mS/cm, white salt flats at water's edge, saltwater widgeon grass dominates (Water is above the rooting zone for most or all of the year)	**13-AD**	**13a None**	<10% shrub/tree cover	
Open Water	**14-OW**	**14a Lake**	In standing water <10% emergent vegetation cover	
		14b River	In flowing water <10% emergent vegetation cover	

First, the ecosite classifications (Moisture/Nutrient category) is determined based on Dominant Shrub/Herb/Ground Cover.
Secondly, Tree Species Modifier is determined within the selected Moisture/Nutrient category. Tree species compositions are the "simplified categories" and may not fit perfectly with what is present.
Finally, Structural Stage is determined by assessing if the site is tree-dominated, non-tree dominated, or open-water dominated and then choosing the appropriate code.

1. Moisture nutrient category names are approximate (Nutrient Status: P=Poor, M=Medium, R=Rich, V=Very Rich; Moisture Status: X=Xeric, M=Mesic, G=Hygric, D=Hydric, OW=Open Water; Swamps and Alkali are represented by S and A respectively)
2. Tree species composition is determined from both the dominant/co-dominant (canopy) and intermediate/suppressed (sub-canopy) trees, giving more weight to the dominant and co-dominant trees.
3. Use 7b (NT-Flood) for sites at the edge of rivers, streams, lakes and wetlands where vegetation is disturbed frequently by flooding. The area is either non-vegetated or dominated by grasses, sedges and forbs, with trees/shrubs absent Note that areas with water present seasonally, often with small permanent pools, but with trees/shrubs present, are classified as Swamp.
4. Use 7f (NT-Human) only when other ecosite classifications are not appropriate. Note that NT-Human cannot be used for historic conditions.
5. Poor Fens are often black spruce (Sb) dominated and do not always contain Larch/Tamarack (Lt). The absence of Larch does not indicate that the site is PD – it could still be MD. Differentiation between PD and MD must be determined based on the understory species (i.e., presence of cloudberry and lichen in PD, with the addition of sedge, dwarf/bog birch and willow for MD)

- Note that in addition to site center elevation, aspect, slope, ecosite site type and structural stage are also determined at:
  - All four 5 x 5 m shrub plots
  - All four arthropod / mineral soil sampling locations
  - Both surface substrate sampling transects
  - For these slope measurements category of slope (not slope degree) is recorded:
    - C = Crest – situated in a relatively level area on the top of a hill
    - S = Slope – situated on the side of a hill; a modifier is always included for the category S: 1 (i.e., S1) for slopes 2-5^{o}, 2 for slopes 6-10^{o}, 3 for slopes 11-30^{o}, and 4 for slopes >30^{o}
    - T = Toe – situated at the bottom of a hill where the ground surface transitions from a slope to level
    - L = Level – situated on in an area with <2^{o} slope
    - D = Depression – situated in an area that accumulates water after rains
  - For each of these plots/transects, only the primary ecosite type is determined within the area sampled.

Natural Disturbance

- Natural disturbance is assessed within the central 1ha area and within a 50 m radius circle around the camera and ARU locations.
- Record the type and % (0, <1% or in 5% increments) of the area affected by each natural disturbance.
- Multiple disturbance types, if present, are recorded in order of % cover. The sum of area disturbed naturally cannot exceed 100%.
- Categories of natural disturbance include:

  None – No natural disturbance present

  Fire – Any evidence of scarring or burning (may be human caused); may coincide with salvage-harvesting

  Wind – Evidence of wind throw (i.e., many trees up-rooted and laying on the ground and/or snapped along the bole); often occurring along canopy openings, cut blocks, roads; potentially human induced

  Erosion – Evidence of soil removal by precipitation or wind; potentially human induced; examples include: side of a hill has eroded from rain (natural), culvert under logging haul road is plugged causing run-off through low lying areas undercutting trees

  Flooding – Evidence of high water mark, dead trees, etc.; potentially human induced; examples include: stream overflows its banks in spring and fills in forest depressions and/or "historic" flood plain (natural) evident by standing dead trees, grass and debris build up; road is built through spruce bog not allowing proper water transfer (human) evident by standing water and large stands of dead trees

  Snow/Ice – Evidence of vegetation breakage caused by snow or ice

  Insect – Any evidence of vegetation experiencing insect; it can take several years of defoliation to do permanent damage to the vegetation; identifying 'notable" insect damage is difficult to the untrained eye

  Conifer Stand: budworms, moths, sawflies, needleminers, spider mites, bark/boring beetles, etc.

  Symptoms – tree die off, brown/dead terminal ends and branches; frass at base of trees, larvae galleries on trunk and branches, evidence of woodpecker flaking

  Confirmation – larvae and/or adults on needles, branches, or bark depending on life cycle, evidence of silken webbing or cocoons

  Deciduous Stand: tent caterpillars, moths, leafminers, mites, aphids, etc.; significant damage to deciduous trees may not be noticeable at all times of the year

  Symptoms – complete defoliation, brown or yellow/dying leaves and trees, tree dye-off

  Confirmation – larvae and/or adults on leaves and branches, silken webbing, cocoons, leaf deformity and/or galls

  Disease – Any evidence of vegetation experiencing disease outbreak; it may sometimes be difficult to distinguish between disease and insect damage, especially depending on time of year

  Conifer Stand: mistletoe, witches-broom, burls, blister rust, root rot, etc.

  Symptoms – erratic growth forms (bushy growth) on branches and/or stem (mistletoe/witches broom), trunk deformities (burls), white/yellow/orange fungus growing on trunk/branches, brown needles and/or tree dye-off (especially young trees; root rot)

Confirmation – check for absence of insect damage and describe scenario in comments; tree dye off could be naturally caused by winter-kill and/or drought (especially in young trees)

Deciduous Stand: leaf spot, leaf and twig blight, leaf rust, etc.

Symptoms – colored leaves; round or angular brown spots on leaves (leaf spot), blackening and wilting of young shoots; tips bending back (blight), powdery golden-yellow pustules on leaves; yellow spots (rust)

Confirmation – check for absence of insect damage and describe scenario in comments; can be difficult to assess according to season

Beaver – any evidence of beaver activity altering landscape or vegetation

Other – please describe any other type of disturbance

Unknown – If a crew member cannot decipher what type of disturbance has taken place and it is evident that something has changed the plot area in some way, describe what is observed

General Human Disturbance

- Human disturbance is assessed within the central 1ha area and within a 50 m radius circle around the camera and ARU locations.
- The type and % (as 0, <1% or in 5% increments) of the area affected by each human caused disturbances is recorded. The sum of area disturbed by humans cannot exceed 100%.
- Multiple disturbance types, if present, are recorded in order of decreasing % cover.
- Categories of human disturbance include:

  NONE – No human caused disturbance present
  CULT – Any type of cultivated field that is used to grow agriculture crops including forage
  PAST – Any type of uncultivated pasture (tame or native) with grazing
  PUGG – Livestock trails and pugging/hummocks
  HARV – Any type of forest harvesting (i.e., clear-cut, partial-cut, understory retention, etc. <30 years old)
  PIPE – Pipeline
  POWER – Power line
  SEIS – Any type of cutline or seismic line
  WELL – Any type of area cleared for oil/gas/coal-bed-methane including pump jacks or well heads
  IND – Any type of building, roadway, yard, etc. associated with industrial development
  RES – Any type of residential dwelling, farm building, or farm yard in a rural or acreage setting
  URB – Any type of human dwelling, associated building, or yard/driveway/road in an urban setting
  CAMP – Recreation facilities including improvised campsites
  RAIL – Railway
  ROADP – Any type of road with paved surface
  ROADG – Any type of road with gravel surface
  TRAIL – Any type of truck or ATV trail with an unimproved surface
  BARE – Human caused bare ground for which the cause cannot be determined
  OTHER – Please specify

3.2 Vegetation Disturbance Intensity

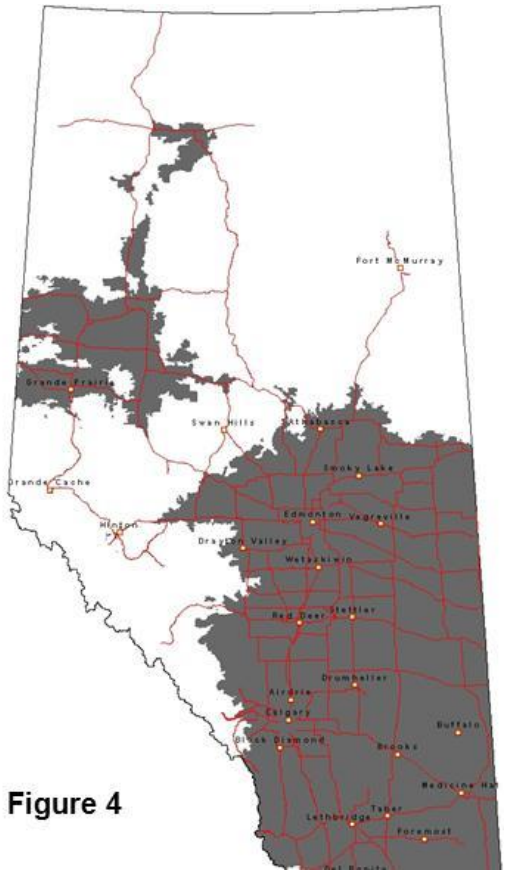

Figure 4

This protocol has been implemented since 2011, but was not conducted at ABMI sites prior to that.

- This protocol is only implemented at ABMI sites where agriculture disturbance including grazing by domestic animals, could occur (Figure 4). Note that vegetation disturbance intensity is not determined in forests where grazing by domestic livestock is prohibited, or in cultivated fields.
- Human disturbance intensity is inferred based on the degree to which vegetation characteristics differ from that expected under undisturbed conditions.
- Assessment of human disturbance intensity is conducted at site center, and the % of the central 1 ha square that the condition applies to is recorded.
- Sampling methods are adapted from the manual "Range health assessment for grassland, forest and tame pasture, Alberta Sustainable Resource Development, Publication Number T/44, B. Adams, G. Ehlert, C. Stone, D. Lawrence, M. Alexander, M. Willoughby, C. Hincz, D. Moisey, A. Burkinshaw, J. Carlson, K. France 2009."
  - In grassland areas, survey methods follow "Grassland" portion of the handbook.
  - In forested and parkland areas, survey methods follow "Forest" portion of the handbook.
- A great deal of experience and training are required to understand the expected vegetation conditions at sites, and to accurately describe the changes that have occurred at that site. At these sites:
  - Surveys must be completed by experts.
  - Published descriptions of vegetation communities found in various combinations of soil and moisture conditions in each natural sub-region are used as background to determine expected undisturbed conditions.
  - Additional information or knowledge about vegetation communities in the region is used to facilitate assessment of expected undisturbed vegetation conditions.
  - To describe the conditions accurately, it is necessary to spend approximately one hour walking in a zigzag pattern throughout the complete 1 ha area
- Less experience and training are required accurately describe the changes in vegetation communities caused by human disturbance at tame pasture sites. Consequently, at these sites surveys are completed by summer technicians.
- For each characteristic that is evaluated, response categories are numbered ordinally with a value of 1 or zero assigned to the most heavily disturbed condition.
- Surveys are conducted between late June and late September when vascular plants are fully developed.

General Site Type

- For site center, record the code from the Alberta soil AGRASID layer.
- For site center, record the code from GVI.
- If there is no GVI information for site center OR if the GVI code is an anthropogenic type, then record the GVI conversion type expected based on AGRASID code.
- Describe soil characteristics at site center:

Sb - Subirrigated - Water table is close to surface during growing season, but rarely above. Does not have a defined depressional edge.
Ov - Overflow - Areas subject to water spreading and sheet flow. Typically on gentle inclines or terraces above the frequent flood zone. For locations where flood frequency is less than once every ten years.
Cy - Clayey - Clayey-textured soils including silty clay, sandy clay, clay, and heavy clay. Generally >40% clay.
Lo - Loamy - Includes loam, silt loam, silt, clay loam, sandy clay loam, and silty clay loam.
Sy - Sandy - Sandy-loam-textured soils.
Li - Limy - Eroded or immature soils with free lime ($CaCO_3$) at the soil surface. Soil pH generally >7.5.
Sa - Sand - Loamy sand and sand soils, and not with a duned surface.
BlO - Blowouts/ Solonetzic Order - Areas with Solonetzic (hardpan) soils. The surface may or may not have eroded pits.
CS - Choppy Sandhills - Loamy sand and sand soils with a duned land surface.
TB - Thin Breaks - Areas with bedrock at or near the soil surface. Amount of vegetation is intermediate between Limy and Badlands. TB may include thin, eroded or immature soils on gentle to steep slopes.
SwG - Shallow to Gravel - Soil with 20 to 50 cm of a sandy or loamy surface overlying a gravel or cobble-rich substrate.
SL - Saline Lowland - Areas with negligible vegetation due to electrical conductivity (salts) and/or sodium adsorption ratio limitations.
Gr - Gravel - Dominated by gravels or cobbles (>50% coarse fragments). May be covered by a mantle <20 cm thick with some gravels.
BdL - Badlands/ Bedrock - Nearly barren or barren lands, with exposures of soft rock, hard rock, or surficial geology. Includes steep valley walls.

Vegetation Assessment

Grassland Sites

- *Question 1: What kind of plants are on the site?*
  Evaluation is based on criteria from 1A in the manual.
  4 – The plant community closely resembles the reference plant community and alteration of the plant community is light.
  3 – Compared to the reference plant community, the plant community shows only minor alteration.
  2 – Compared to the reference plant community, the plant community shows moderate alteration.
  1 – Compared to the reference plant community, the plant community shows significant alterations.
- *Question 2: Are the expected plant layers present?*
  4 – The life form layers closely resemble the reference plant community.
  3 – Compared to the reference plant community, one life form layer is absent or significantly reduced.
  2 – Compared to the reference plant community, two life form layers are absent or significantly reduced.
  1 – Compared to the reference plant community, three life form layers are absent or significantly reduced.
- *Question 3: Is the expected amount of plant litter present?*
  3 – 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 (lb./ac.) is 65-100% of that expected under moderate grazing by native ungulates.
  2 – Litter amounts are slightly or moderately reduced and are somewhat patchy across the site. The standing dead plant material is less frequent than expected with fallen dead plant material and variably decomposed material on the soil surface being the dominant litter types. Litter is 35-65% of that expected under moderate grazing by native ungulates.
  1 – Litter is greatly reduced or absent with little or no standing or fallen litter. Decomposing material on the soil surface is the main type of litter. The distribution of litter is fragmented across the site. Litter is <35% of that expected under moderate grazing by native ungulates.
- *Question 4A: Is there evidence of soil erosion?*

4 – No sign of soil erosion (e.g., no sign of deposition of soil/litter, plant pedestalling, coarse sand or aggregate remnants, flow patterns and/or scouring, or hoof sheering) beyond the natural extent for the site.
3 – Slight evidence of soil erosion that is human-caused beyond the natural extent expected for the site. Old erosion features are stable and vegetated, and flow patterns are short and shallow.
2 – Moderate amounts of soil erosion across site. Erosion features are present and active but with limited extent and with no off-site movement of material. Flow patterns have a well-defined branching pattern. Vegetation (live plants and litter) still protects most of the site.
1 – Extreme amounts of active soil erosion with material being carried off site. Flow patterns are obvious, fan deposits may be present, rills are abundant and deep, gullies are deep with sharp edges, plants are pedestalled and hoof sheering may be common.

- *Question 4B: Is there human-caused bare soil?*
  4 – Less than 10% of the exposed soil is human-caused.
  3 – Between 10 and 20% of the exposed soil is human caused.
  2 – Between 20 and 50% of the exposed soil is human caused.
  1 – Greater than 50% of the exposed soil is human caused.
- *Question 5A: Are noxious weeds present?*
  4 – No noxious weeds are present.
  3 – Noxious weeds cover <1% of the site.
  2 – Noxious weeds cover 1-15% of the site.
  1 – Noxious weeds cover >15% of the site.
- *Question 5B: Are noxious weeds broadly distributed?*
  4 – No noxious weeds are present.
  3 – A few single individuals or patches of noxious weeds are present.
  2 – Sporadic patches of noxious weeds are present.
  1 – Noxious weeds are common and distributed throughout the site.

<u>Forest & Parkland Sites</u>

- *Question 1: What kind of plants are on the site?*
  6 – The plant community resembles the reference plant community and alterations if present are light. There are no invader species present. Increaser and decreaser species are of similar as that found in the reference community.
  5 – The plant community closely resembles the reference plant community and alteration is fairly light. There are no invader species present. Increaser species are more common and decreaser species less common in unprotected portions of the site, but not affected in protected locations.
  4 – Compared to the reference plant community, the plant community shows minor alterations. Small patches of invader species are present. Increaser species are more common and decreaser species less common in unprotected portions of the site, but not affected in protected locations.
  3 – Compared to the reference plant community, the plant community shows moderate alteration. Large patches of invader species are present and/or these species are distributed throughout the site. Increaser species are more common throughout the site and decreaser species are only found in very protected locations or may be absent.
  2 – Compared to the reference plant community, the plant community shows heavy alteration. Invader species dominate the site. Increaser species are common. Decreaser species are absent.
  1 – Compared to the reference plant community, the plant community shows very heavy alteration. Invader species dominate the site. Unpalatable increaser species are common. Palatable invaders and increasers are uncommon. Decreaser species are absent.
- *Question 2: Are there changes to forest community structure?*
  5 – All life form layers closely resemble the reference plant community. Less than 25% of the preferred shrubs are browsed.
  4 – All life form layers are present in comparison to the reference plant community. 25-50% of the preferred shrubs are browsed. Less than 25% of the non-preferred shrubs are browsed.

3 – One life form is significantly reduced or absent in comparison to the reference plant community. 50-75% of the preferred shrubs are browsed. 25-50% of the non-preferred shrubs are browsed.
2 – Two life forms significantly are reduced or absent in comparison to the reference plant community. Preferred shrubs are absent or >75% browsed. 50-75% of the non-preferred shrubs are browsed.
1 – Three life forms are significantly reduced or absent in comparison to the reference plant community. Preferred shrubs are absent or >75% browsed. Non-preferred shrubs are absent or >75% browsed.

- *Question 3: Is the organic layer compacted?*
  4 – LFH thickness is similar in disturbed and protected locations. Resistance to penetration is similar between disturbed and protected locations.
  3 – LFH thickness is 10-25% less in disturbed that in protected locations. Resistance to penetration is 20-50% greater in disturbed than in protected locations.
  2 – LFH thickness is 25-50% less in disturbed that in protected locations. Resistance to penetration is 50-200% greater in disturbed than in protected locations.
  1 – LFH thickness is >50% less in disturbed that in protected locations. Resistance to penetration is >200% greater in disturbed than in protected locations.
- *Question 4A: Is there evidence of soil erosion?*
  4 – No sign of soil erosion (e.g., no sign of deposition of soil/litter, plant pedestalling, coarse sand or aggregate remnants, flow patterns and/or scouring, or hoof sheering) beyond the natural extent expected for the site.
  3 – Slight evidence of soil erosion that is human-caused and beyond the natural extent expected for the site. Old erosion features are stable and vegetated, and flow patterns are short and shallow.
  2 – Moderate amounts of soil erosion across site. Erosion features are present and active but with limited extent and with no off-site movement of material. Flow patterns have a well-defined branching pattern. Vegetation (live plants and litter) still protects most of the site.
  1 – Extreme amounts of active soil erosion with material being carried off site. Flow patterns are obvious, fan deposits may be present, rills are abundant and deep, gullies are deep with sharp edges, plants are pedestalled, and hoof sheering may be common.
- *Question 4B: Is there human-caused bare soil?*
  4 – Human caused bare soil covers <1% of the site.
  3 – Human caused bare soil covers 1-5% of the site.
  2 – Human caused bare soil covers 5-15% of the site.
  1 – Human caused bare soil covers >15% of the site.
- *Question 5A: Are noxious weeds present?*
  4 – No noxious weeds are present.
  3 – Noxious weeds cover <1% of the site.
  2 – Noxious weeds cover 1-15% of the site.
  1 – Noxious weeds cover >15% of the site.
- *Question 5B: Are noxious weeds broadly distributed?*
  4 – No noxious weeds are present.
  3 – A few single individuals or patches of noxious weeds are present.
  2 – Sporadic patches of noxious weeds are present.
  1 – Noxious weeds are common and distributed throughout the site.

3.3 Trees, Snags & DWM

- Tree data are collected in three nested plots (Figure 5) for three different size categories of trees.
  - The small plot is 5 x 5 m
  - The medium plot is 10 x 10 m, and encompasses the small plot
  - The large plot is 25 x 25 m and encompasses both the small and medium plots.
- Information on size, condition and abundance of trees, snags and stumps are collected in these nested plots.

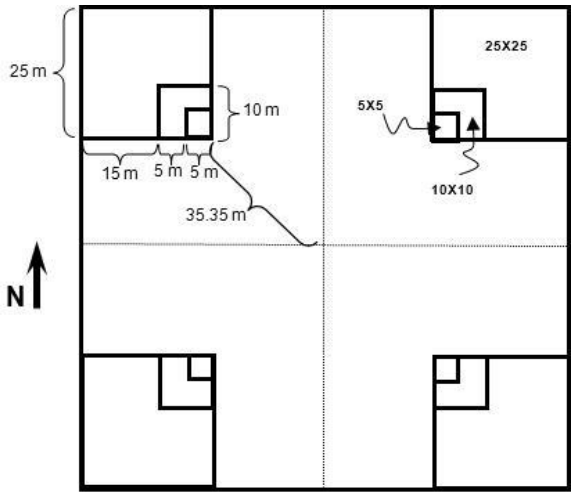

Figure 5

Definitions

Live Trees

Live trees are defined as any living woody species that normally grows ≥1.3 m tall and that does not have multiple stems originating together. The list of tree species includes but is not limited to: trembling aspen, balsam poplar, willow poplar, plains cottonwood, black cottonwood, paper birch, Alaska birch, water birch, green ash, bur oak, European mountain ash, western mountain ash, Sitka mountain ash, American elm, Manitoba maple, rocky mountain maple, balsam fir, rocky mountain alpine fir, subalpine fir, Douglas fir, Engelmann spruce, white spruce, black Spruce, blue spruce, jack pine, lodgepole pine, murraybanks' pine, whitebark pine, limber pine, western white pine, Scots' pine, tamarack, Siberian Larch

- Willow, alder and other shrubby species are not classified as trees because they normally have multiple stems originating together.
- Only trees >1.3 m high are measured in the tree plots; smaller trees are measured as part of the shrub and low vegetation layers.

Snags

- Snags are defined as dead trees ≥1.3 m in length, leaning ≤45°from vertical.
- Snags leaning >45° from vertical are included as part of the DWM.

Stumps

- Stumps are defined as dead trees <1.3 m high.
- Dead saplings <1.3 m high are considered stumps

Down Woody Material

- Down woody material includes:
  - Twigs, stems, branches, and chunks of wood >10 cm long from trees and shrubs with or without bark.
  - Wood above the litter layer or soil; debris is considered no longer above when it is >50% buried beneath a layer of surface organic matter (forest floor) or mineral soil.
  - Fallen or suspended (not self-supporting) dead tree boles and branches, with or without roots attached, that intersect the plane of the transect line and are leaning >45° from vertical. Stems and branches may be suspended on nearby live or dead trees, other coarse woody debris, stumps, or terrain features.
  - Fallen and uprooted (not self-supporting) trees/branches/stumps with or without green foliage that are no longer rooted in the ground and not connected to the tree bole.
  - Recently cut logs.
  - Exposed dead roots of fallen trees/snags.
- Down woody material does not include:
  - Cones, bark flakes, needles, leaves, pithy shrub species and forbs.
  - Live trees, snags, and stumps (still rooted) which are self-supporting and leaning <45° from the vertical.
  - Dead branches still connected to standing trees.
  - Exposed roots of self-supporting trees/snags/stumps.

- A piece of woody material that is decomposed to the point where it could be described as forest floor humus (no discernible shape of log left).

Trees, Snags & Stumps

- All trees, snags and stumps ≥25 cm DBH are measured in the 25 x 25 m plot (note that due to the nested nature of the tree plots this includes both the 10 x 10 m and 5 x 5 m plots).
- All trees, snags and stumps ≥7 cm and <25 cm DBH are also measured in the 10 x 10 m plot (note that due to the nested nature of the tree plots this includes the 5 x 5 m plot).
- All trees, snags and stumps <7 cm DBH are also measured in the 5 x 5 m plot.
- Species code is recorded for every tree, snag and stump measured.
- Trees, snags and stumps on the boundary of the plots are included only if greater than half of the stem is within the plot.

Diameter

- DBH is recorded for every tree and snag measured.
- Diameter of trees and snags are measured at 1.3 m high (this is referred to as diameter at breast height DBH).
- Diameters of stumps are measured inside the bark, at the top of the stump.
- If the diameter is <7 cm, it is measured to the nearest 0.1 cm.
- If the diameter is ≥7 cm, it is measured to the nearest 0.5 cm.

Height

- Top height is only determined for trees in the 10 x 10 m plot (note that due to the nested nature of the tree plots this includes the 5 x 5 m plot).
  - Depending on variation in tree height, one or more trees are selected to be measured explicitly. Measurements are to the highest leaf on the tree (to the nearest 0.1 m) using the vertex hypsometer. These measured trees are used as reference when estimating heights of the other trees.
  - For trees where top height is NOT measured explicitly, estimate heights based on the trees that are measured, and record that these were estimated.
- Canopy base height is only determined for trees >7.0 cm DBH in the 10 x 10 m plot (note that due to the nested nature of the tree plots this includes the 5 x 5 m plot).
  - Base height is measured as the location on the stem where live branches occupy about three-quarters of the stem circumference. Personal judgment may be necessary to determine base height.
  - Depending on variation in canopy base height, one or more trees are selected to be measured explicitly. If possible use the vertex hypsometer and measure base height to the nearest 0.1 m. In some cases it may be easier (and more accurate) to measure base height when standing under the tree and not using the vertex hypsometer.
  - For trees where canopy base height is NOT measured explicitly, estimate base height based on the trees that are measured, and record that these were estimated.
- Since snags and stumps do not have a live crown, only top height is measured.
- Stump height is measured to the nearest 0.1 m using a meter stick.
- Note that since top height is used a surrogate for "length of the main stem", top height for leaning trees and snags must be measured along the length of the stem.

Crown Class

- For each tree, record crown class as:
  - ***Veteran*** - Trees that are considerably older than rest of the stand, usually remaining from a previous forest.
  - ***Dominant*** - Trees with well-developed crowns extending slightly above the general level of surrounding trees, receiving full light from above and partial light from the side.
  - ***Co-dominant*** - Trees with crowns (slightly smaller than dominant and crowded from the sides) forming the general level of surrounding trees, receiving full light from above and little light from the side.

- ***Intermediate*** - Trees with crowns (usually small and quite crowded) below, but extending to, the general level of surrounding trees, receiving little light from above and none from the sides.
- ***Suppressed*** - Trees with crowns entirely below the general level of the surrounding trees, receiving virtually no direct light from above or the side.

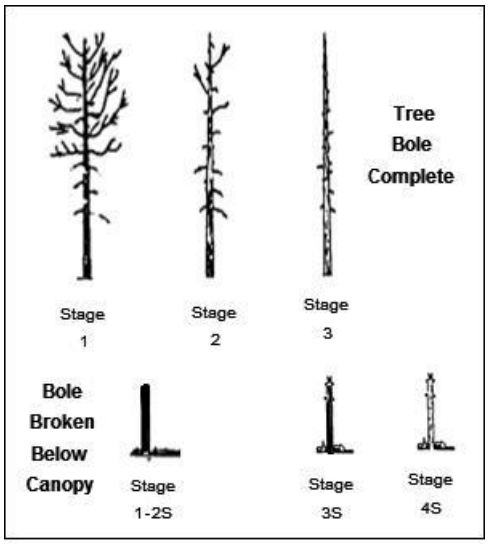

Figure 6

Condition & Decay Stage

- For living trees, condition is recorded as "alive".
- For snags condition is recorded as "dead".
- For snags with complete tops, decay stage (Figure 6) is recorded as:
  - **Stage** 1 - recently killed, all twigs/ branches present, wood hard, bark (normally) intact
  - **Stage 2** - twigs and small branches missing, major branches remain, wood hard
  - **Stage 3** - no branches, bole mostly intact, wood starting to soften.
- If the snag is snapped along the bole so that the presence of twigs and branches cannot be evaluated, then decay is recorded as:
  - **Stage 1-2S** - recently killed, wood hard, bark (normally) intact
  - **Stage 3S** - wood starting to soften
  - **Stage 4S** - wood soft throughout

Down Woody Material

Regular Pieces of DWM

- DWM is measured on four sub-ordinal transects (Figure 7).
- To be included as DWM, the dead wood must intersect the transect and be above the litter layer (i.e., <50% buried).
- Transects start 10.35 m from site center and extend for 25 m to the edge of the nested tree plots.
- DWM is divided into Coarse Woody Debris (CWD; ≥7 cm), Small Woody Debris (SWD; in 3 size classes [1.0-3.0, 3.0-5.0 and 5.0-7.0 cm]) and Fine Woody Debris (FWD; ≤1).
- The number of pieces of FWD that intersect the transect above the litter layer are tallied.
  - FWD are tallied along only the last 5 m of each DWM transect.
  - FWD includes only twigs, stems, and branches of trees and shrubs and does not include cones, bark flakes, fragments of stems and branches <10 cm long, or needles.
  - Pieces of FWD often are short, thus it is necessary to have the tape measure within a few inches of the forest floor to accurately determine whether or not the FWD piece crosses the transect.
- The number of pieces of SWD that intersect the transect above the litter layer are tallied.
  - SWD 3.0-5.0 cm and SWD 5.0-7.0 cm are tallied along the entire 25 m transect.
  - The smallest size class of SWD (1.0-3.0 cm) is only tallied along the last 10 m of each DWM transect.
- CWD is surveyed along the entire 25 m transect.
  - CWD is measured (in 0.5 cm increments) using DBH calipers, at the point where the piece crosses the transect, in a plane perpendicular to the long-axis of the CWD.

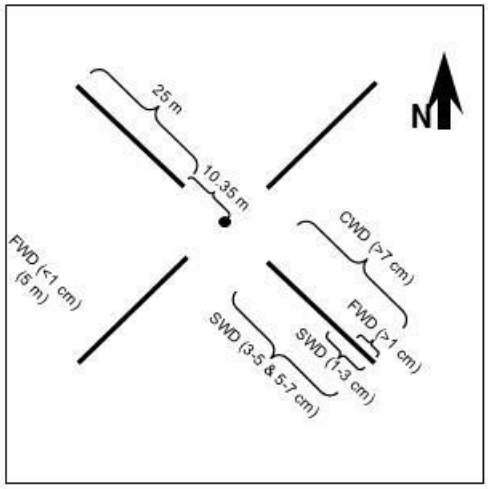

Figure 7

- Odd shaped (i.e. not round) pieces of CWD are assigned an estimated diameter that is determined as if the piece was round.
- Record the species code for each piece of CWD.
- For CWD record decay stage at point of intersection of the transect (Figure 8):
  - Class 1 **Recently Dead** - Bark (normally) attached to the wood; little fungus mycelium developed under patches of loose bark. (~100-95 % of the initial dry density)
  - Class 2 **Weakly Decayed** - Loose bark (intact or partly missing); well-developed fungus mycelium (normally) between bark and wood; rot extends <3 cm radially into the wood (as measured by pushing a knife into the wood). (~ 95-75 % of the initial dry density)

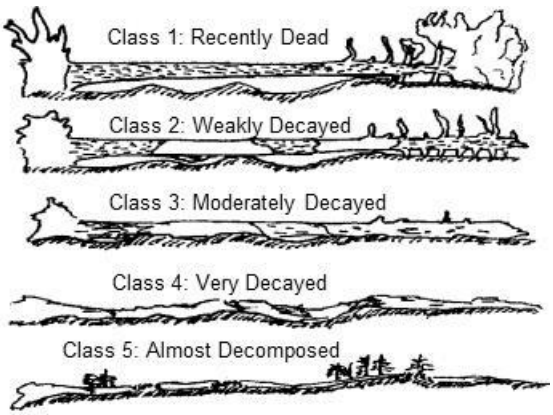

Figure 8

  - Class 3 **Moderately Decayed** - Rot extends >3 cm into the wood (as measured by pushing a knife into the wood) but core still hard; log may be sagging or broken but still supported from forest floor by stones, humps, etc. (~75-50 % of the initial dry density)
  - Class 4 **Very Decayed** - Rotten throughout (entire knife penetrates into wood); log shape conforms to forest floor; often elliptical. (~50-25 % of the initial dry density)
  - Class 5 **Almost Decomposed** - Log completely decomposed in sections; outline of log discernible but strongly fragmented and remaining parts often overgrown; wood disintegrates when lifted. (~25-5 % of the initial dry density)
- Scan closely for logs in a decay class of 5, as some can be hidden by moss and litter. If no clear log can be discerned, then it should be considered organic material and no longer woody debris.

<u>Woody Accumulation and/or Slash Piles DWM</u>

- In some cases there are many pieces of downed wood→ measure a portion of these a groups and estimate total amount from that measured:
  - **CWD Piles** (e.g., logging debris or slash piles): If a pile of CWD is encountered along the transect, and it is too time consuming to measure each piece individually, then a portion of the accumulation is measured and the total estimated from that partial measurement.
    - Estimate the horizontal width of the pile, and the average vertical depth of the pile. "Visually" compress the pile to determine the actual cross sectional area of wood, not including the space between the pieces. Based on length and width, estimate an approximate diameter of the accumulation as if it were round.
    - If the pile is at an angle to the transect line, estimate perpendicular diameter at the point of intersect similar to what would be done for a log.
    - Identify the most common species in the accumulation and the most common decay stage.
    - Make a note that the measurement is an estimate from a pile of CWD
  - **Many pieces of FWD and SWD**: If a tree crown has fallen across the transect containing many small branches, a proportion of the branches/pieces are counted and the total number estimated by multiplying by the proportion of length sampled.
    - Measure the entire horizontal length of the debris field crossing the transect (i.e., debris field is 5 m wide along intersect).
    - Choose a representative sub-sample (not just the first portion of transect) and tally the number of FWD and SWD pieces (i.e., 42 pieces of FWD and 25 pieces of SWD 1-3cm tallied within a 50 cm distance).
    - To obtain an accurate estimate of DWM, the length of transect chosen for measurement must have at least 20 pieces for each type. Note that the length used for FWD may be different than the length used for SWD.

- Estimate the number of pieces in the debris field (i.e., in the above scenario multiply by 10; 420 pieces FWD and 250 pieces of SWD in class 1-3cm).

Tree Cores

- Trees to core are selected based on their relative abundance, and DBH
- A maximum of 9 trees are cored at each site
- Obtain a tree core from the **largest** (biggest DBH) live tree within the 1 ha area, regardless of species.
- Obtain a tree core from the **largest** live tree from the **leading** species (species with the highest stem density of dominant and/or co-dominant canopy trees), within each 50 x 50 m quadrant (total of 4 trees per site), not including veteran or residual trees from a former stand.
- Obtain a tree core from the **largest secondary** species (species with the 2nd highest stem density of dominant and/or co-dominant canopy trees), if it occurs, within a 50 x 50 m quadrant (potentially one tree from each quadrant), not including veteran or residual trees from a former stand. To be classified as the secondary species, the species must comprise >20% of the canopy stems in the quadrant.
- For all trees that are cored:
  - Use a vertex hypsometer to determine tree height to the nearest 0.1 m.
  - Use calipers or a DBH tape to record DBH to the nearest 0.5 cm.
  - Record significant tree damage (any condition that could affect the normal height or growth rate of the tree) as:
    - BT – Broken Top
    - DT – Dead Top
    - FC – Fork/Crook
    - S – Scarring
    - O – Other (indicate damage from diseases, insects, wild and/or domestic animals, abiotic natural factors, anthropogenic factors)
- For round trees, face site center and use the increment borer to obtain cores at a height of 1.3 m. If a tree is not round, obtain the core from the narrow width.
- If cores are rotten or break into more than 3 pieces while being extracted, recollect. If three attempts fail due to rot, collect a core from another similar tree. In some cases, a core will not be able to be obtained due to rot; in this case record the DBH, height, and damage for these trees and indicate that a core was not collected and why.
- Preserve the cores in straws. Staple the straw ends (do not tape) and puncture the straws in many places to allow air flow and reduce mold/rot.
- Place all cores/straws in a protective case (to ensure they do not become broken) to transport from site to camp.
- If all trees from the leading and/or secondary species are <10 cm DBH, destructively sample a representative tree from the leading and/or secondary species from **outside** of the quadrant by taking a "cookie" at a height of 1.3 m (i.e., total of 4 trees per site for the leading species and up to 4 trees per site for the secondary species). Place the cookie in a paper bag.
- Label the straws/cookies with the following information: site, quadrant, tree species, tree type (largest, leading, second) and date.
- When back at camp, dry the cores/cookies in a warm environment.
- At the end of the shift, take the samples to the laboratory for processing.

Canopy Cover

- Take a total of 8 canopy cover readings at each site.
- Readings are obtained at two corners of the 10 x 10 m tree plot (Figure 9; at 35.35 m and 49.49 m from site center along each sub-ordinal transect).
- Stand facing site center when obtaining the reading at 35.35 m and stand with your back to site center when taking the reading at 49.49 m.
- Hold the densitometer in the palm of your hand at elbow height (i.e., with your arm bent at right angles) and ensure that it is level.
- Using your dominant eye, imagine four dots equally spaced in each of the 24 squares on the densitometer (4 equal quarters). Count the dots (quarters) that are in canopy openings (i.e. NOT covered) and record the number of open dots (quarters).
- Only estimate canopy coverage for shrubs or trees; high forbs or human structures are not included.

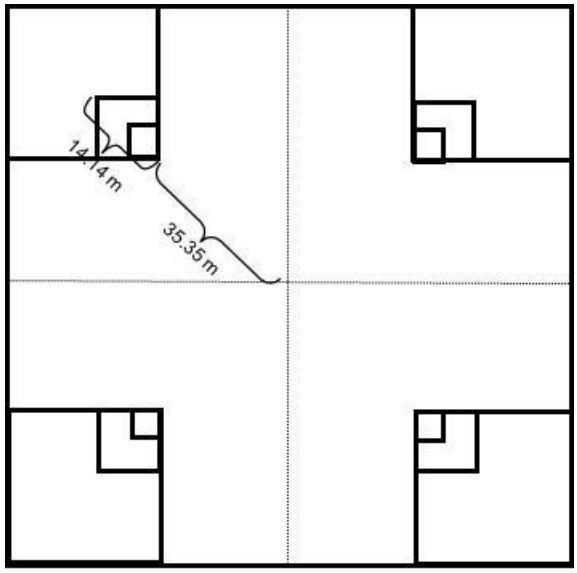

Figure 9

3.4 Soils & Mites

- Surface substrate is measured on two 30 m transects located to the north and south of each 1ha site (Figure 10).
- Soil cores are collected from outside the four corners of each 1ha site (Figure 10). These samples are used to quantify soil mites and obtain chemical composition of the mineral soil
- In order to maintain the integrity of the forest floor within the 1 ha site, all soil surveys are done outside this area.

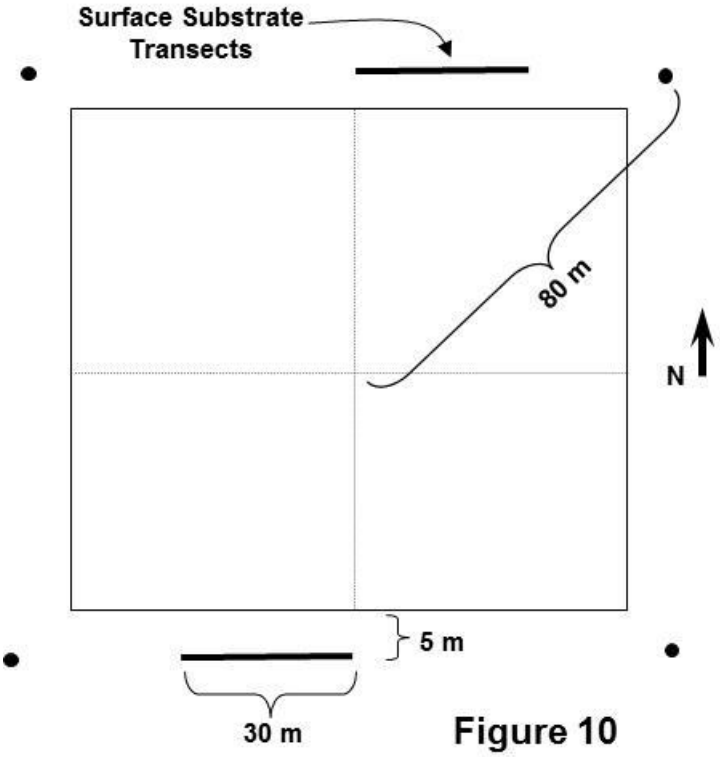

Figure 10

General Ecological Characteristics of Sample Areas

Surface Substrate Transects

- At the start of both surface substrate transects describe slope position (as described above) and direction (looking down hill) in degrees.
- Indicate the amount and cause of the disturbance (either by humans or naturally) and percent area affected (see above description) for the transect (30-m length, 2-m width).

Soil Cores

- Record ecosite type (see methods in Section 3.1) within a 2-m radius circle at the four locations where soil cores will be extracted.
- Record slope position (as described in Section 3.1) and direction (looking down hill) in degrees for each of the four locations.
- Indicate the amount and cause of the disturbance (either by humans or naturally) and percent area affected (see in Section 3.1) for the 2-m radius circle at the soil locations.

LFH Depth

- Depth of organic soil is measured on two 30 m transects, parallel to the 1 ha boundary (Figure 10).
- Organic matter is defined as the litter, fibric, and humic (LFH) layer of the soil horizon.
  - Determining the LFH horizon is usually straight forward based on the color and texture of the soil and resistance of the shovel to penetrate far into the mineral layer.
  - The organic layer is typically dark, coarse and fibrous (containing rooting systems) whereas the mineral soil is typically lighter colored, finely particulate, and lacking most roots.
  - LFH does not include live vegetation on the surface.
- Depth of organic matter and/or buried wood are measured every 2 m along the 30 m transect (15 sampling points per transect).
- At each sampling point, insert the shovel into the ground and pry to one side exposing the LFH.
- After distinguishing the transition from LFH to mineral soil, measure the LFH to the nearest 0.5 cm.
- If leaf litter is present, compress it before measuring LFH depth.
- Gently push the opening closed with your foot after the LFH depth has been measured.
- If the LFH is indistinct from the mineral soil layer (e.g., natural grasslands, cultivated fields, roads, etc.), only the litter is measured. This may only include leaves, grass, or debris on the surface.

- If buried wood is encountered, record depth of LFH and buried wood separately. For this survey buried wood is defined as downed wood, independent of decay stage, that is >50% below the ground surface AND >10 cm in diameter, otherwise it is considered organic matter.
- If the organic layer is deeper than 40 cm, (e.g., bogs, some wetlands) record depth measurements at 4 m intervals (7 measurements along each of the 30 m transects). Use a 5 m soil probe to measure depth to mineral soil or to an impenetrable substrate, such as rock or a frozen layer.
- If only a partial depth of LFH can be obtained at a point because an impenetrable object is contacted, then indicate the following on the data sheet:
    - "HF" for Hit Frost,
    - "HO" for Hit Object (e.g., root, rock, etc.)
- In some cases LFH cannot be measured because the sample point falls on an impenetrable surface:
    - If the sampling point is more than 1 m from an area containing >1 cm of LFH, then note <1 cm as LFH depth and include a code for the reason in the description.
        - "B" for Bedrock
        - "R" for Rocks, cobbles and stones (rock fragments >7.5 cm in diameter)
        - "M" for Mineral soil (unconsolidated mineral soil and cobbles <7.5 cm in diameter, including human created gravel surfaces)
        - "O" for Other human created surfaces (e.g., pavement, cement, building materials, etc.)
        - "D" for large DWM (DWM or stumps in decay class 1 or 2 AND >10 cm in diameter AND >50% above the ground surface)
        - "W" for Water (water above the ground surface before standing on the sample point; note that if water seeps to the surface after standing at the sampling point the location is treated like a regular upland point)). Streams and rivers are treated similar to standing water.
    - If it is possible to move the sampling point <1 m to either side of the transect to an area containing > 1 cm of LFH, then move the sample point, measure the LFH and record the following code in the description:
        - "B-S" for Bedrock–Side
        - "R-S" for Rock–Side,
        - "M-S" for Mineral-Side,
        - "D-S" for DWM–Side, or
        - "W-S" for Water-Side

      If possible move the location north or as close as possible to north. If there are no suitable locations to the north, then move the location to the south.

Organic Soil

- Soil arthropods, organic soil and mineral soil are sampled in four locations at each site (Figure 10).
- Only the organic component of the cores is used when describing organic soil. The organic layer consists of the LFH soil and excludes the mineral soil (Figure 11).
- Determining the boundary between the LFH horizon and mineral soil is usually straight forward based on the color and texture of the soil. The organic layer is typically dark, coarse and fibrous (containing rooting systems), whereas the mineral soil is typically light colored, finely particulate, and lacking roots.

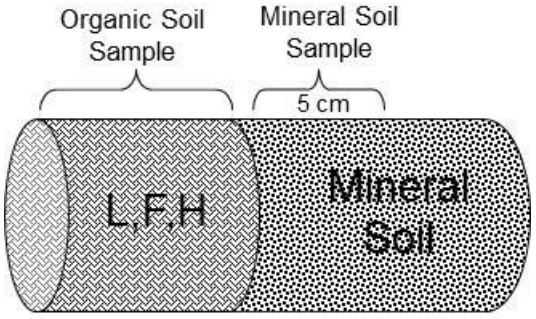

Figure 11

- Visually determine where the transition from LFH to mineral horizon appears. Grasp the LFH in one hand, the mineral soil in the other hand, and gently break these apart. If there are a few roots holding the two sections together, then cut these with a knife.
- If the LFH is indistinct (e.g., native grasslands), only the plant residue (litter) layer and the top 2 cm of the soil are included as organic soil.
- Where LFH layer has been mixed artificially by mechanical equipment (e.g., cultivated agriculture fields), or

where inorganic soil and other materials have been spread over the surface (e.g., roads), only the plant residue (litter) layer on the surface and if possible the top 2 cm of the soil are included as organic soil. Note that this may include only a few leaves, grass, or other debris on the top of the core location.

- If a core location is in standing water, no core is taken. However, if a vegetative mat is present above the water table (this is judged prior to a person standing on the mat) a core is taken.
- If the organic layer is deeper than the corer can penetrate (i.e., corer is not long enough to reach the mineral soil) then the entire 40 cm of organic material the corer extracts is collected.
- A minimum of 4 cores are taken (Figure 12) from each sample location.
  - If more than 4 cores are required to accumulate 500 mL of organic material, additional cores are taken in a clockwise fashion (Figure 13) until 500 mL is attained or until 24 cores have been taken.
  - The number of cores required to get 500 mL of organic soil is recorded.
- Do not collect partial cores. If an obstruction prevents reaching the mineral soil, discard the core and move to the next coring location. For each location where a core could not be obtained, the reason for omitting this core is recorded:
  - SW = Standing Water
  - R = Rocks
  - SL = Stumps/Logs
  - RT = Roots

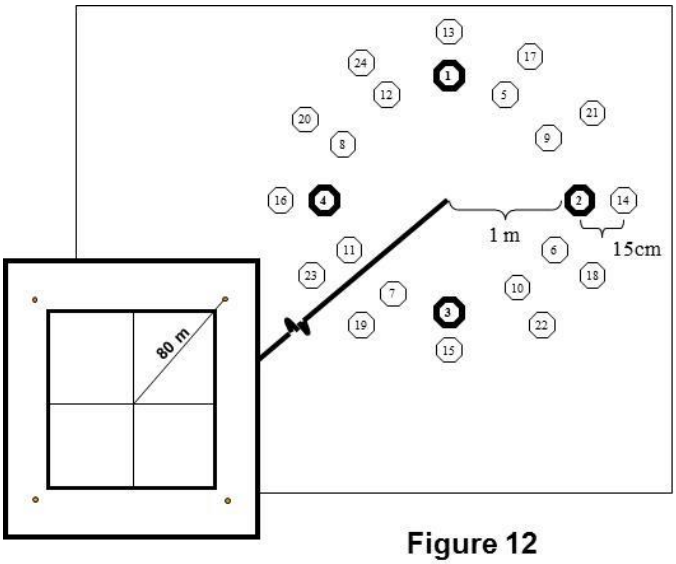

Figure 12

- If cores can be taken, but are unique then record the reason:
  - AM = Animal Material
  - HD = Human Disturbance (i.e., mineral soil, gravel road, pavement, residence))
  - WT = Water Table
  - DWM = Downed Woody Material (i.e., decayed logs, roots, etc.)
- The LFH from all cores at a location are mixed together and a random 500 mL sample is placed into a cloth bag for processing.
- Samples are labeled with the Sample Type (LFH), Collector's Initials, Date, Site Number, and Quadrant.
- If you a sample is not taken for any reason: label a soil bag, state reason with given code and submit with other collected samples.
- The volume of any remaining LFH is measured and returned to the site.
- Since organic material is collected from four locations, a total of 2 L of organic material is sampled per site.
- All samples from a site are placed into an open plastic bag to protect the sample from desiccation or water absorption and placed into a cooler with ice. The plastic bag must remain open to allow the mites to in the sample to live. Samples are separated from the ice in the cooler by a piece of plywood.

Mineral Soil

- Soil arthropods, organic soil and mineral soil are sampled in four locations at each site (Figure 10).
- Only the mineral component of the cores is used when describing mineral soil. The mineral layer is below the organic layer (Figure 11; see description of the organic layer above).
- Four 250 mL composite samples of mineral soil are collected – one in each of the four quadrants at each ABMI site. Each of these samples is created from multiple soil cores.
- When obtaining each core, ensure the corer enters into the mineral horizon for at least 10 cm.
- After removing the LFH layer from the core (see organic soil methods above), use a knife to cut the core 5 cm below the LFH horizon.
- If no mineral soil is present at the sampling point, or if mineral soil is too deep to reach with the soil corer,

record that no mineral soil was collected. In these circumstances include a note stating "No Mineral Soil" when shipping the soil to the lab.

- If after 4 cores at a location more than 250 mL of mineral soil is collected, then mix the mineral soil and sub-sample 250 mL.
- If there is <250 mL of mineral soil after 4 cores at a location, then continue collecting the mineral soil from core samples, via the same sequence as described for organic soil, until a total of 250 mL of soil is collected per quadrant.
- Place the 250 mL of mineral soil sample in a cloth bag.
- Samples are labeled with the Sample Type (Mineral), Collector's Initials, Date, Site Number, and Quadrant.
- If you a sample is not taken for any reason, clearly state the reason.
- Keep samples in a dry place while in the field.
- When back at camp, allow the samples to air dry in a well-ventilated space for 3 days.
- Store mineral soil samples in a dry location until they are shipped to the lab.
- Pack samples in the cooler and ship to the laboratory for processing.

Soil Mites

- Soil arthropods, organic soil and mineral soil are sampled in four locations at each site (Figure 10).
- Only the organic component of the soil cores is used when extracting mites. The organic layer consists of the LFH soil and excludes the mineral soil (Figure 11).
- Organic soil is sampled as described above.
- All organic soil samples from a site are placed into an open plastic bag to protect the sample from desiccation or water absorption and placed into a cooler with ice. The plastic bag must remain open to allow the mites to live. Samples are separated from the ice in the cooler by a piece of plywood.
- After a maximum of 3 days, coolers with fresh ice are couriered to the lab for mite processing. Note that to obtain reasonable samples of mites, extraction must be started within 6 days of the samples being collected.

3.5 Vascular Plants

General Site Characteristics

- General site characteristics are assessed in each 5 x 5 m tree plot (Figure 13).
  - Determine the ecosite type (as described in Section 3.1).
  - Describe slope position (as described in Section 3.1) and direction (looking down hill) in degrees.
  - If the 5 x 5 m plot is disturbed (either by humans or naturally), indicate the cause of the disturbance and the percent area affected (see methods in Section 3.1)

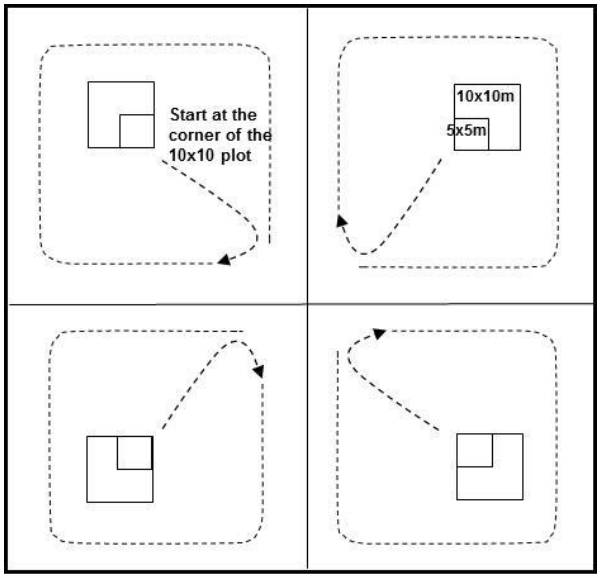

Figure 13

Plot Searches to Determine Species Presence

- To standardize sampling effort a single person completes all of the vascular plant surveys at a site.
- Vascular plant surveys are performed by a person that is capable of identifying >80% of the species encountered (including all common species).
  - This person must have at least one year experience surveying vascular plants and/or courses learning plant identification.
  - This person must spend a minimum of two days in the field "brushing up" on vascular plant identification prior to conducting surveys.
- Walk enough of the boundaries of each 50 x 50 m quadrant to ensure they are well marked prior to starting vascular plant surveys. If necessary, add flagging to better mark the boundaries.
- Spend an initial 10 minutes writing down the names of all the vascular plants observed at a site.
  - This initial listing of plant names is conducted so that the subsequent timed searches of the 50 x 50 m quadrants are spent mainly looking for species, with little time writing down plant names.
  - During the initial 10 minutes when species names are being recorded, locate the most diverse habitat types within the 1 ha area and spend time in these habitats recording species names.
  - Unknown species can be quickly identified during this initial 10-minute search, but if unable to identify the species quickly, collect the specimen from a population of greater than 5 individuals, outside the plot if possible. These unknown specimens are assigned a unique specimen number and carried to avoid multiple collections in each quadrant.
- Spend 20 minutes in each of the four quadrants (a total of 80 minutes) finding and recording presence for as many species of vascular plants as possible.
  - To maintain consistency among observers, start at the center of the quadrant, then move to within 5-10 m of site center, then move in a clockwise direction around the quadrant staying approximately 5-10 m from the quadrant edge (Figure 13).
  - Stop every 4 or 5 steps to examine the plants in the immediate area.
  - Ensure that all habitat types in the quadrant are searched for vascular plants.
  - Always start the surveys in the NE quadrant and progress clockwise to the next quadrant (NE, SE, SW and NW)
- Field guides are not used during the four 20-minute searches; collect specimens of unknown or uncertain vascular plant species.
  - After the 20-minute search in a quadrant is complete, attempt to quickly identify the species you have collected using field guides.
  - Place "unknown" specimens in a plant press and take them to camp for identification during the evening.

  - Ensure that identification numbers for unknown specimens are not repeated for the site. Be especially diligent when collecting specimens from the "extra" low vegetation and shrub cover plots at agriculture sites (see below).
- For any vascular plant categorized as S1 or S2 by Alberta Conservation Information Management System (ACIMS), collect a specimen so its identity can be confirmed by experts. Refer to the "List of Plants to Collect" when deciding whether or not to collect a specimen. Collect the specimen from a population of greater than 5 individuals, outside the 1-ha area if possible.
- For specimens that cannot be identified in the evening, and for ACIMS S1 or S2 specimens, remove them from the field press and place them a different plant press. Ensure that the information (ABMI site number, reference code, date, collector's name) on the data sheet matches the information included with the specimen in the plant press.
- At the end of the field shift, take the plant press with unknown plants to the laboratory. These unknown specimens will be identified by experts.

Assessing Relative Density of Species

- Coarse estimates of density for vascular plant species are determined in the 10 x 10 m tree plots at the center of each quadrant (Figure 13).
- After each 20-minute search in a quadrant, stand at the corner of the 10 x 10 m plot and record which vascular plant species are "common" or "dominant" within the plot.
  - Common species are defined as those that are present in five or more of the plot sub-sections if the plot was divided up into 9 imaginary sub-sections.
  - Of the species labeled as common, determine which has the highest percent cover and label this as the dominant species in the plot. Note that tree species cannot be defined as dominant, but can be recorded as common.
  - Note that some quadrants may contain many common species (vegetatively diverse quadrants) whereas other quadrants may not contain any.

2-Dimensional % Cover for Shrubs / Small Trees

- Shrub cover is estimated in the four 5 x 5 m tree plots, one at the center of each quadrant (Figure 13).
- Estimate 2-dimensional cover (0, <1, and 5% increments) of shrubs plus small trees (a single measurement that includes both).
  - Shrub/small tree cover is estimated independently for two height categories (>0.5 to <1.3 m high, and >1.3 m high). Each of these estimates cannot be greater than 100%.
  - The first estimate of shrub/tree cover is the percent cover that would be recorded if a photo was taken at 1.3 m above the ground and foliage from all shrubs/trees <0.5 m was excluded.
  - The second estimate of shrub/tree cover is the percent cover that would be recorded if a photo was taken at 5.0 m above the ground and foliage from all shrubs/trees <1.3 m was excluded.
  - Note that % cover for shrubs is also estimated in a third height category (<0.5 m high) as part of Low Vegetation measurements below.
- Percent cover is determined by ocular estimation and requires practice before the start of the data collection to ensure the estimates are accurate and consistent.

2-Dimensional % Cover for Low Vegetation

- 2-dimensional cover of the ground layer is measured in the four 5 x 5 m tree plots, one at the center of each quadrant (Figure 13).
- The ground layer is defined as vegetation and physical features <0.5 m high.
- Estimate 2-dimensional cover (0, <1, and 5% increments) as the percentage of the 5 x 5 m plot covered by:
  - shrubs/trees,
  - grasses,
  - sedges/rushes,
  - all "other" vascular plants combined,
  - mosses,
  - lichens,
  - fungi,
  - litter (dead vegetation material plus DWM <2 cm in diameter),
  - wood (live and dead trees >1.3 m tall, plus DWM >2 cm diameter),
  - water,
  - bare ground,
  - rock, and
  - animal matter.
- Estimates are the % cover that would be recorded by a photo taken at 0.5 m above the ground.
- Values of the independent categories must sum to 100%.

3.6 Bryophytes & Lichens

In 2009 ABMI protocols for bryophytes and lichens were revised from that used during earlier years. Prior to 2009, each of four 50 x 50 m plots were searched for a wide variety of microhabitat types, and bryophytes and lichens were sampled from these microhabitats. Starting in 2009, four smaller plots were surveyed, microhabitats were grouped into broad categories, and bryophytes and lichens were sampled from these broad categories (see below).

- Four 25 x 15 m plots are surveyed for bryophytes and lichens (Figure 14).
- A single person spends up to 35 minute in each of 4 quadrants (maximum total 140 minutes) collecting bryophytes.
- A second person independently spends up to 35 minute in each of 4 quadrants (maximum total 140 minutes) collecting lichens.
- Since the two field staff search different substrates it is necessary for them to work separately.
- To have consistent data, field staff do not change taxa throughout the season.

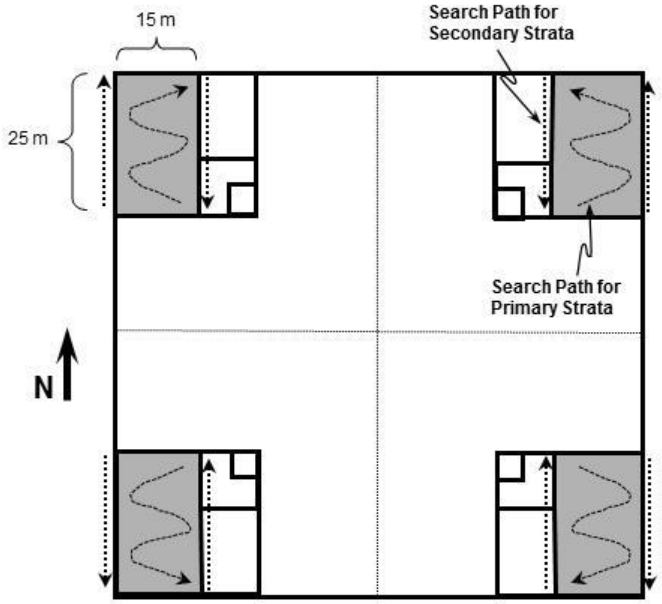

Figure 14

General Site Characteristics

- In each of the four 25 x 15 bryophyte/lichen plots record the % (0, <1% or in 5% increments) of the plot affected by human caused and natural disturbances (see descriptions in Section 3.1).

Plot Searches to Determine Species Presence

- Surveys for bryophytes and lichens are started in the NE quadrant and progress clockwise through the quadrants (NE, SE, SW, NW).
- In each quadrant, surveys are divided into two periods:
  - **First Period**: the strata (i.e., the appropriate microhabitat types describe in Table 5) that have diverse communities are searched in the 25 x 15 m plot.
    - **For bryophytes:** Strata #1 logs/ stumps, strata #3 wetlands/peatlands and strata #4 rocks and cliffs (Table 5) are searched.
    - **For lichens:** Strata #1 logs/stumps, strata #2 trees and other vertical woody structures and strata #4 rocks and cliffs (Table 5) are searched.
    - To maximize the number of species detected, begin by surveying one example from each stratum that has the most diverse community. This must be completed within a maximum of 5-10 minutes. For example, large-diameter soft logs often have the highest diversity of both taxa, and when present in the plot, should be targeted early in the search.
    - Continue searching the three primary strata by zigzagging through the plot (Figure 14).
    - Stop every 4 or 5 steps to examine the microhabitat types in the immediate area. When examples of the any of the primary strata are found, search these as you encounter them.
    - Note that if there are no examples of the any of the primary strata in the plot, then the search can be terminated after 5 minutes. A minimum of 5 minutes **must** be spent looking for examples of the primary stratum in each plot as some microhabitats are small and dispersed (e.g., rocks).
    - Specimen collection from primary strata may terminate after 10 minutes in a plot if all examples of the appropriate microhabitat have been searched (for example, if you are searching for lichens and there is a single tree, no logs, and no rocks/cliffs in the plot then sampling may be terminated after 10 minutes).
    - All forested plots with trees and/or logs should be searched for the full 25 minutes.

Table 5. Strata, and microhabitat types within strata, used during searches for Bryophytes and Lichens

Stratum #1: Logs and Stumps (samples in 1 bag)
Microhabitat Type A: Soft stumps & logs (decay classes 3-5) - sample roots and all sides
Microhabitat Type B: Hard stumps & logs (decay classes 1-2) - sample roots and all sides
Stratum #2: Trees, Shrubs and Other Vertical Structures (samples in 1 bag)
Microhabitat Type C: Deciduous Trees - all sides of the roots, bases, trunks, and branches of both live and dead deciduous trees
Microhabitat Type D: Coniferous Trees - all sides of the roots, bases, trunks, and branches of both live and dead coniferous trees
Microhabitat Type E: Shrubs - all sides of the roots, bases, stems, and branches of live & dead shrubs
Microhabitat Type F: Human Structures - vertical and horizontal parts of the structures (survey from the ground)
Stratum #3: Wetlands and Peatlands (samples in 1 bag)
Microhabitat Type G: Wetlands, marshes, & fens - within the wetland survey both under and away from trees
Microhabitat Type H: Shores/banks of wetlands, ponds, lakes, & streams - survey on organic or mineral soil adjacent the water's edge
Microhabitat Type I: Moist depressions/seasonal wetlands dry at time of survey - sample sides and bottom in the area influenced by water
Microhabitat Type J: Peatlands with or without standing water - survey both standing water and vegetation hummocks
Stratum #4: Rocks and Cliffs (samples in 1 bag)
Microhabitat Type K: Boulders (>50 cm diam.) - survey all surfaces (top, sides, and base) from the soil upwards
Microhabitat Type L: Rocks (<50 cm diam.) - survey all surfaces (top, sides, and base) from the soil upwards
Microhabitat Type M: Cliffs (steep high rock face) - survey all of the faces, ledges, and crevices that can be accessed safely
Stratum #5: Upland Soils (samples in 1 bag)
Microhabitat Type N: Humus soils under trees/shrubs (shaded by canopy) - survey as large a variety as possible
Microhabitat Type O: Humus soils without trees/shrubs (open to sunlight) - survey as large a variety as possible
Microhabitat Type P: Agriculturally cultivated soils
Microhabitat Type Q: Mineral soil in upland areas from any causes

  - **Second Period:** the strata (i.e., the microhabitat types) that have less diverse communities are searched in a 50 m belt transect following the 2 long sides of the 25 x 15 m plot (Figure 14). Walk along the plot boundary and sample within 1 m of either side of the transects. This results in two 25 x 2 m transects in each of the 4 quadrants.
    - **For bryophytes:** Strata #2 trees and other vertical woody structures and strata #5 upland soils (Table 5) are searched.
    - **For lichens:** Strata #3 wetlands/peatlands and strata #5 upland soils (Table 5) are searched.
    - Ensure that examples of both secondary strata are searched if they occur in the transect.
    - Search as many examples (or as much area) of the secondary strata as possible as you encounter them.
    - If a variety of microhabitats are present in a stratum, then collect specimens from as many of these as possible (e.g., if many different tree species occur, then collect bryophytes from as many different tree species as possible).
    - Use a time constrained search that is exactly 10 minutes long.
- In each stratum in each plot/transect collect examples of all the bryophytes/lichens that appear distinctive.
- When collecting specimens:
  - Where possible, select homogenous samples that fit in the palm of your hand; if this would remove half or more of a single thallus or community, take a smaller sample to ensure the species diversity at the site is not depleted.
  - If the specimen is growing on soil, wrap the sample with toilet paper so it does not break apart (and disintegrate) once the soil dries.
  - If the specimen is growing on a large boulder/rock/cliff, wet it thoroughly to help detach it from the substrate.

  - Place small/fragile specimens in paper packets so they don't get damaged or lost.
  - When in doubt about whether a specimen is unique or has been collected already, collect it again.
  - Do not collect crustose lichen; however, when in doubt about whether a specimen is crustose, collect it.
- For each taxon (bryophytes/lichens), all specimens collected from a stratum are placed as a composite sample into a single paper bag. Note that there are multiple microhabitat types in each strata, and specimens for these are combined.
  - Create 5 paper bags with location and strata type clearly labeled for each quadrant.
  - Be diligent to not collect the same species over and over again from a stratum as it takes considerable time to sort through duplicates in the lab.
- If no specimens are found in a stratum of a plot/transect, then indicate "None" on the empty paper bag and on the field data sheet.
- Once the surveys are completed, ensure there are 20 paper bags for bryophytes and 20 paper bags for lichens.
- Take the collections to camp, and dry them for 3 days by spreading out the paper bags, checking the contents to ensure they're dry at the end of that time.
- Once dry, place all bryophyte sample bags into one large paper bag and label it with the location and "Bryophyte". Do the same for Lichens.
- Fill a large cloth bag with all the bryophyte samples and another with all the lichen samples, and transfer these to the laboratory.
- Specimens are sorted into species groups in the laboratory, and then identified by experts.

3.7 Mammal & Bird Survey Using Remote Detectors

Prior to 2015 mammals were surveyed during the winter by counting tracks while traversing a10km snow transect (see descriptions in earlier ABMI protocol documents). Prior to 2015 (prior to 2016 for sites in Grassland and Parkland natural regions) birds were surveyed using a grid of nine point counts where all vocalizations were recorded for one 10 minute period at each site during June (see descriptions in earlier ABMI protocol documents). Starting in 2015 mammals and birds are surveyed using remote cameras and ARUs respectively (see below).

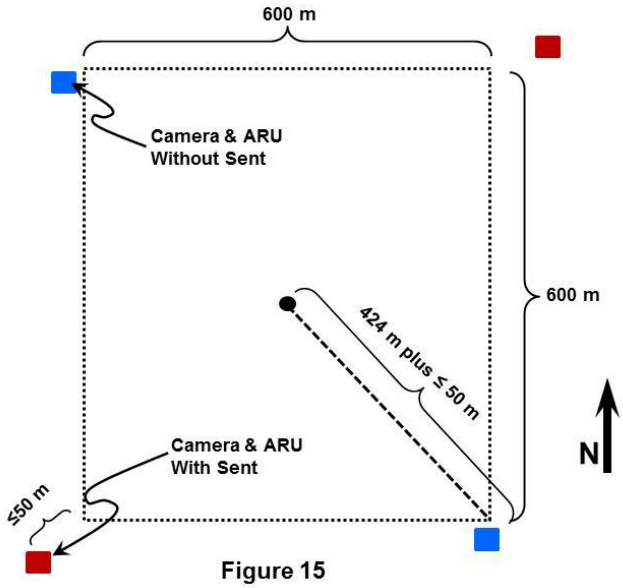

Figure 15

- Mid- and large-sized mammals are surveyed throughout Alberta using Reconyx PC900 cameras that are triggered based on heat and movement in front of the camera.
- Birds are surveyed using Wildlife Acoustic Song Meter (series 2, 3 and 4) audio recording units (ARUs).
- During the fall or winter one camera and one ARU are installed near each corner of a 600 m x 600 m square centered on the ABMI site (Figure 15).
- Choosing the exact camera/ARU location is described in Section 2.3.
- Ideally at each station the camera and ARU are placed on the same tree/shrub/stake. If required the camera and ARU are installed on different trees up to 10 m apart.
- Cameras and ARUs are retrieved in July, with pictures form the cameras, and vocalizations from the ARUs, interpreted by experts with the aid of computer programs.
- If it is not possible to access a station due to some type of obstruction (e.g., bear activity, etc.), the camera and ARU are not installed and the reason for the absence of data recorded.

General Station Characteristics

- General site characteristics are recorded at each of the four stations during camera/ARU pick up in July.
- Record the general site conditions within the 50 m radius circle around for each of the four camera/ARU stations at an ABMI site.
  - Record physical characteristics, tree composition, low vegetation and ecosite type around the camera/ARU stations (see Section 3.1).
  - Indicate the amount and cause of the disturbance (either by humans or naturally) and percent area affected at the stations (see Section 3.1).
- In addition, record conditions in a pie-shaped area immediately in front of each of the four cameras (15m long and 15m wide at the end of the pie)
  - Record presence of wet habitat: Water, Alkali, Marsh, Swamp, Beaver Dam, Lake, River, Stream, Wet Margin Lake, Wet Margin Wetland, Wet Margin River/Stream
  - Record presence of human created open areas: Harvest, Cultivation, Pasture, Well site
  - Record presence of natural open areas: Fire, Wind, Ravine edge, Other natural funnel
  - Record presence of human created linear features: Railway, Road Paved, Road Gravel, Trail, Seismic Line, Pipeline, Power Line, Fence, Windrow
- Record the GPS location of for each camera/ARU station
- Record whether the camera and ARU are within, or on the edge of, human disturbed habitats and the type of human disturbance present (use the same categories as in Section 3.1)
- For each of the four cameras and four ARUs, record their unit numbers and the appropriate station (NE, SE, SW, NW) on the data sheet.

Camera & ARU Installation

Cameras

- The camera is fastened to the selected tree/shrub using wood screws (or the appropriate bracket if a stake is used).
  - To ensure the correct height, a snow probe is used to determine snow depth.
  - A locking cable is fed through the hole in the camera, around the tree/shrub/stake and locked to secure the camera in place and reduce theft.
- Install a painted conduit stake 5 m in front of the camera to aid photo interpretation and analysis.
  - Drive the 1.3 m conduit stake into the ground, so that 1 m of it remains above the ground.
  - The conduit is painted with a variety of colors in 10 cm bands. Starting from the top of the stake, the bands are: black, yellow, red, grey, orange, blue, yellow, green, red.
- Position the camera to detect mid- and large-sized mammals in the target area 5 m in front from camera.
  - Fasten the camera 1 m above the ground to the tree/shrub/stake.
  - Position the camera so that it is aimed at the painted stake 0.8 m above the ground.
  - In open habitats the camera is set facing north (or south) to avoid direct sunlight.
  - In forests and shrubby areas the camera is pointed towards an unobstructed view of at least 5 m wide and 10 m long. Where necessary, branches and shrubs that will obstruct the camera field of view when vegetation is "leafed out" are removed.
  - Record any problems encountered while setting up the camera.
  - Ensure the camera lens is clean.
  - If the camera is handled for any reason during the session, ensure the field of view does not change.
- Scent is used at the Northeast and Southwest stations at each ABMI sites to increase detection of mammals.
  - One tablespoon of scent (O'Gorman's Long Distance Call by O'Gorman Long Line Lures; Broadus, MT) is placed into a PVC tube.
  - The PVC tube is pinned to the ground using the conduit stake 5 m in front of the camera.
- After the camera has been installed wait for it to "self-arm".
  - The camera will automatically "self-arm" and begin taking pictures after a two minute period during which it does not detect any motion.
  - Walk perpendicularly through the camera field of view at three distances (at 5, 10, and 15 m) in front of the camera.
  - These pictures are as reference when interpreting subsequent photos to establish where in the field of view animals are detected

ARUs

- A tree or shrub with a diameter sufficient to hold the ARU, but not wider than 18 cm is chosen to mount the ARU.
  - A tree/shrub with a diameter greater than 18 cm cannot be used because it will interfere with sound reaching the microphones.
  - Remove branches that interfere with the ARU microphones.
  - If a suitable tree/shrub is not present a stake is used to mount the ARU.
- Fasten the ARU 1.5 m above the ground to the selected tree/shrub using wood screws (or the appropriate bracket if a stake is used).
  - To ensure the correct height, a snow probe is used to determine snow depth.
- A locking cable is fed through a hole in the ARU, around the tree/shrub/stake and locked to secure the ARU in place and reduce theft. Ensure the cable does not touch the microphones.
- Position the ARU on the north side of the tree/shrub/stake (microphones facing east-west) to reduce heating from direct sunlight.

Installing Cameras and ARUs at Stations That Do Not Have Trees/Shrubs

- At stations where there are no trees or shrubs (or other suitable structures) within 50 m of the grid corner, it is necessary to install a stake on which the camera and ARU are mounted.
- Absence of trees, shrubs and structures occurs most often in agriculture areas, marshes, fens and bogs.
- Ensure the stake is stabilized so that it does not fall over between when the camera and ARU are deployed in February/March and when they are retrieved in July.
- Additional protection for the stakes (and the cameras and ARUs) is required in areas where domestic livestock may rub against and/or destroy the equipment.

Photo of Camera/ARU Set-up

- After installation of cameras and ARUs has been completed, take a photo (or two photos if the camera and ARU are on different trees) that shows the installed ARU, camera and the immediate surrounding area.
- Ensure the ground is visible at the bottom the photos with the camera and ARU in the center of the image.

Camera & ARU Activation

Cameras

- A Reconyx PC900 camera is used to survey mid- and large-sized mammals at each station.
- Ensure that the SD card is properly inserted and that the date and time are properly set on the camera.
- Record the SD card number on the data sheet.
- Review camera sensitivity settings, and change if required, to ensure consistent pictures are obtained from all cameras:
    - Set camera to take the picture as fast as possible after the trigger, with one picture in each burst.
    - Allow subsequent pictures to be taken with no waiting time.
    - Use the standard internal motion trigger.
    - Schedule a reference pictures to be taken every second hour (e.g., at 1:00 am, 3:00 am, 5:00, etc.) for a total of 12 pictures each day
    - Set time laps to ON.
    - Label images based on ABMI site, station number (e.g., for the NE station at ABMI site 1642 the label is ABMI-1642-NE).
    - Set brightness to medium-low.
    - Set contrast to medium-high.
    - Set sharpness to medium.
    - Set saturation to medium.
    - Set temperature to Celsius.
    - Set clock to 24 hour.
    - Set night shutter speed to medium.
    - Set night ISO sensitivity to medium.
    - Set resolution to high.
    - Set no border for prints.
- Ensure the camera is aimed correctly at the target area. Rest a laser pointer on top of the camera and fine tune the direction and angle so that the laser beam hits the conduit stake at 80 cm above the ground.
- Switch the camera to “Walk Test”, and test the responsiveness of the camera in the target area:
    - Walk once slowly through the target area 5 m in front of the camera. Ensure the red light flashes.
    - Crawl once through the target area. Ensure the red light flashes.
    - If the red light on the camera did not flash during the walk/crawl test, repeat the set up and walk/crawl test.
- Create a photo sheet with the ABMI site number, station number, camera number and date.
    - Wait for the camera to “arm” itself and take a photo 1 m in front of the camera.
    - Hold the photo sheet tilted slightly downward to avoid sun glare.
- Record any problems encountered while setting up the camera.
- Before leaving the station, check that the camera lens is clean and if required clean it.

- The camera will automatically "self-arm" and begin taking pictures after a two minute period during which it does not detect any motion.

ARUs

- A Wildlife Acoustic Song Meter 3 or Song Meter 4 audio recording unit (ARU) is used to record vocalizations of birds (and other animals) at each station. Note that Song Meter 2 units are sometimes used at ABMI targeted (off-grid) sites.
- Ensure that the two 16 Gig SD cards are properly inserted and that the date, time and location are properly entered in the ARU.
- Record the SD card numbers on the data sheet.
- Review microphone sensitivity settings, and change if required, to ensure consistent detections of vocalizations for all ARUs:
    - Set sample rate to 44100
    - Use stereo channels
    - Set file compression to WAC0
    - For SM2 units left gain is set to +0.0 dB and right gain to +0.0 dB
    - For SM3 units gain is set to 19.5 dB in both left and right channels
    - For SM4 units gain is set to 12.5 dB in both left and right channels
- Set the daily recording periods for each ARU to be:
    - 10 minutes at midnight
    - 3 minutes at 2:00 am
    - 10 minutes at 30 minutes after sunrise
    - 3 minutes 2 hours after sunrise
    - 3 minutes at noon
    - 3 minutes at 3:00 pm
    - 3 minutes 1 hour before sunset
    - 3 minutes 1 hour after sunset
- Set the location to latitude 54.40 N and longitude 115.00 W.
- Set time zone to "mountain standard daylight savings time".
- Set mode to sunrise/sunset.
- Start the ARU, and conduct 1-minute test recording.
- Set the ARU label based on ABMI site, station number, and camera number (e.g., for the NE station at ABMI site 1642 the label is ABMI-1642-NE
- Record any problems encountered while setting up the ARU.

Camera & ARU Retrieval

- Immediately after getting to the site take a photo (or two photos if the camera and ARU are on different trees/stakes) that shows the ARU, camera and the immediate surrounding area at time of pick-up. Ensure the ground is visible at the bottom this photo with the camera and ARU in the center of the image.
- Note whether the camera is located/focused on a natural animal trail, a human trail, a fence line, a vegetative strip, or a wetland.
- Take six additional site photos at each station (see Section 3.1).
- On the data sheet, record ABMI site, station number, camera/ARU numbers, card numbers for both the camera and ARU, date, time, and condition of the camera and ARU.
- Unlock the camera and ARU, remove them from the tree/shrub/stake and deactivate them.
- Check that the station programed in the camera and ARU, match the station you are at.
- Record the number of pictures on the camera SD card, how full (%) each of the cards are, and remaining battery life (%) for the camera and for the ARU.
- At the end of each field shift, SD cards are transferred to the lab.

4. Supplemental Data Collection

4.1 Supplementary Data Collection at Sites in the Grassland and Parkland Regions

Some of the attributes measured during field sampling (e.g., Trees/Snags/Stumps and Downed Woody Material) are absent or at very low densities in sites dominated by agricultural activities. At these sites grasses, herbs and shrubs are the dominant habitat elements. To better quantify low vegetation in the Grassland and Parkland Natural Regions (Figure 16), supplemental sampling is done for shrubs, grasses and herbs.

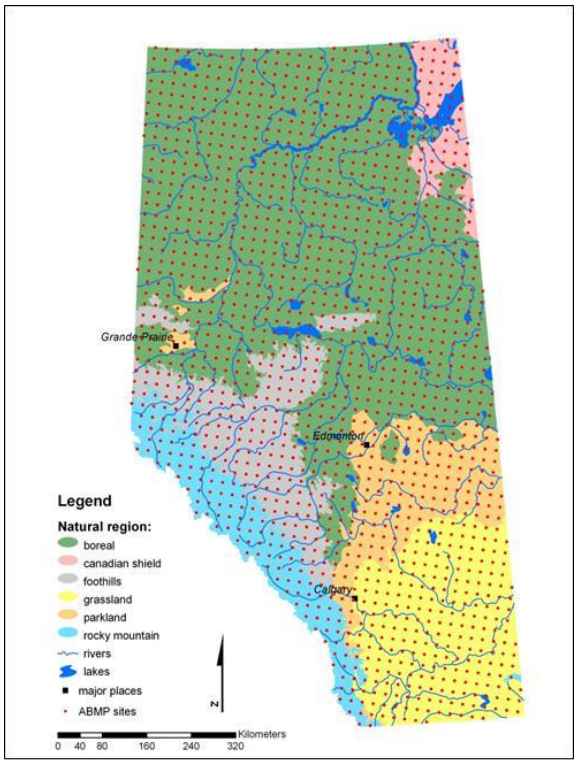

Figure 16

- All survey protocols conducted in the outside Grassland and Parkland regions are also conducted in Grassland and Parklands.
- In addition, 2-dimensional low vegetation protocols are more detailed in the Grassland Parkland regions than elsewhere.
- Also one new protocol is conducted in the Grassland and Parkland regions:
  - A 5th vegetation plot is established in the center of the most common ecosite type (Figure 17).
  - The new protocol – % cover of vascular plant species – is also conducted in the 5th plot.
  - 2-dimensional % cover for shrub/small trees and low vegetation are completed in the 5th plot.
  - The detailed version of the 2-dimensional % cover for low vegetation and ground features is completed in the 5th plot.

Enhanced 2-Dimensional % Cover for Low Vegetation

- In the Grassland and Parkland natural regions, 2-dimensional % cover for low vegetation and ground features are measured in more detail than in other natural regions.
- 2-dimensional cover is estimated in four height classes (<10 cm, 11-25 cm, 26-50 cm, >50 cm).
  - In the <10 cm height class estimates must sum to 100%.
  - For the other three height classes, estimates often sum to < 100% because the categories of bare ground, water and animal matter will not be present.
- Enhanced 2-dimensional cover is measured in the four 5 x 5 m tree plots plus in the 5th vegetation plot described below.
- Other than using more height classes, protocols for collecting 2-dimensional cover for low vegetation and ground features are similar to that described in Section 3.5.

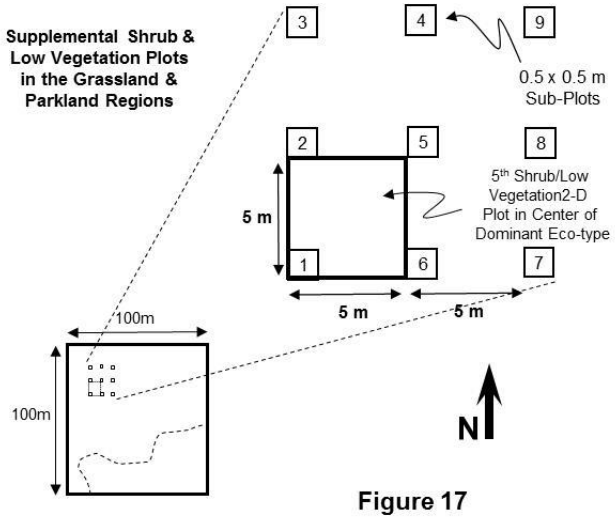

Figure 17

The 5th Vegetation Plot

- The primary (most common) ecosite type in the 1 ha area is identified.
- A large relatively homogenous area of the primary ecosite type in or near the 1 ha area is located, and the 5th plot established so that it is totally contained within the primary ecosite type.
- 2-dimensional shrub and low vegetation plots (5 x 5 m) plus nine vascular plant cover plots (0.5 x 0.5 m) are established in the 5th plot (Figure 17).
- The exact coordinates of the SW corner of all plots is are recorded so that the same plots can be re-measured during each visit.

Site Characteristics in the 5th Vegetation Plot

- Determine slope position and direction using the protocols described in Section 3.1.
- Determine the ecological site type using the protocols described in Section 3.1
- Take a single photo of the 5th plot based on protocols described in Section 3.1. Stand 1 m SW of the SW corner of plot 1 and take the photo towards the NE corner
- Record amount of the 5th plot that is disturbed by humans and the amount that is naturally disturbed (based on protocols described in Section 3.1).

2-Dimensional % Cover for Shrubs/Small Trees and Low Vegetation

- 2-dimensional % cover for shrubs/small trees is measured in the 5th vegetation plot using methods described in Section 3.5.
- 2-dimensional % cover for low vegetation is measured in the 5th vegetation plot using the enhanced methods described above (Section 4.1).

Cover for Vascular Plant Species

- Estimate percent cover (0, <1, and 5% increments) for each vascular plant species (including shrubs but excluding trees) in each of the nine 0.5 x 0.5 m sub-plots within the 5th plot (Figure 17).
- Percent cover is determined by ocular estimation and requires practice before the start of the data collection to ensure the estimates are precise.
- All leaves and stems (regardless of height) are included when estimating % cover.
- Vascular plants do not need to be rooted within the plot to be included in the estimation.
- Due to overlapping of leaves at different heights, % cover for each species (and all species combined) can be greater than 100%.
- Collect voucher specimens of unknown or uncertain specimens from outside the plot if possible. Take the voucher specimens to camp for identification during the evening.
- For any vascular plant categorized as S1 or S2 by ACIMS, collect a specimen so it's identity can be confirmed by experts. Collect the specimen from a population of greater than 5 individuals, outside the plot if possible.
- When collecting voucher specimens, record the location and a unique reference number. Ensure that reference numbers do not repeat those collected during the vascular plant search.
- For specimens that cannot be identified in the evening, remove them from the field press and place them a different plant press for temporary storage. Ensure that the information (location, reference number, date, collector's name) on the data sheet matches the information included with the specimen in the plant press.
- At the end of the shift, take unidentified and S1/S2 to the laboratory for identification.

4.2 Supplementary Data Collection at Agricultural Dominated Sites in Mountain, Foothills, Boreal and Shield Regions

Some sites outside the Grassland and Parkland natural regions (Figure 18) have had the trees removed to facilitate agriculture activities. At these sites, little information will be collected for trees and DWM, and the bryophyte and lichen communities may be much simpler than found in sites with trees. As such, at sites within the Mountain, Foothills, Boreal and Shield natural regions that have had >60% of the vegetation in the central 1 ha area modified by cultivation, supplemental survey is conducted. To better quantify low vegetation in these agricultural dominated sites, additional measurements are done for shrubs, grasses and herbs.

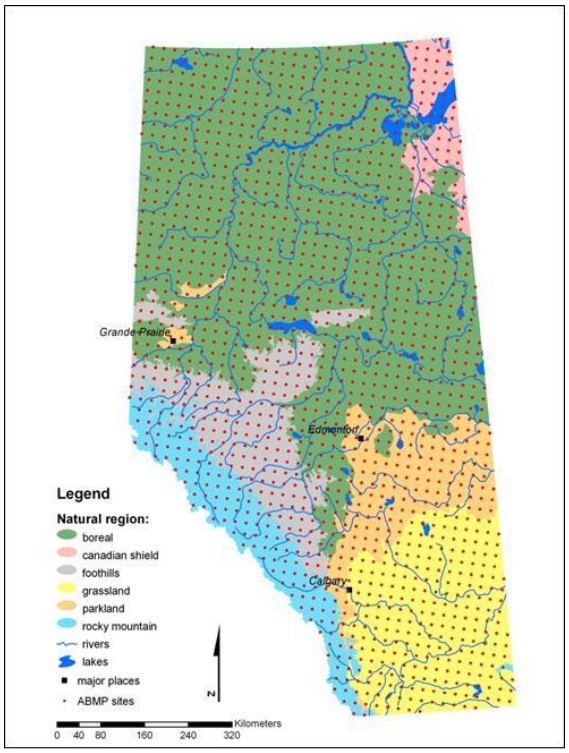

Figure 18

- All survey protocols conducted at other sites outside the "agricultural dominated sites" are also conducted at the agricultural dominated sites.
- Supplementary protocols are conducted at "agricultural dominated sites":
  - A 5th vegetation plot is established in the center of the most common ecosite type to collect detailed information on low vegetation and shrubs.
    - Shrub and low vegetation protocols (described in 3.5) are completed in this 5th plot.
    - Similar to that in the agricultural zone, an additional protocol – % cover of low vascular plant species – is also conducted.

The 5th Vegetation Plot

- The primary (most common) ecosite type in the 1 ha area is identified.
  A large relatively homogenous area containing the primary ecosite type is identified in or near the 1 ha area, and the 5th plot established so that it is totally contained within the primary ecosite type (Figure 19).
- The exact coordinates of the SW corner of the plots are recorded so that the same plots can be re-measured during the next visit.
- Data collection is similar to that described for the 5th vegetation plot in the Grassland and Parkland natural regions (Section 4.1).

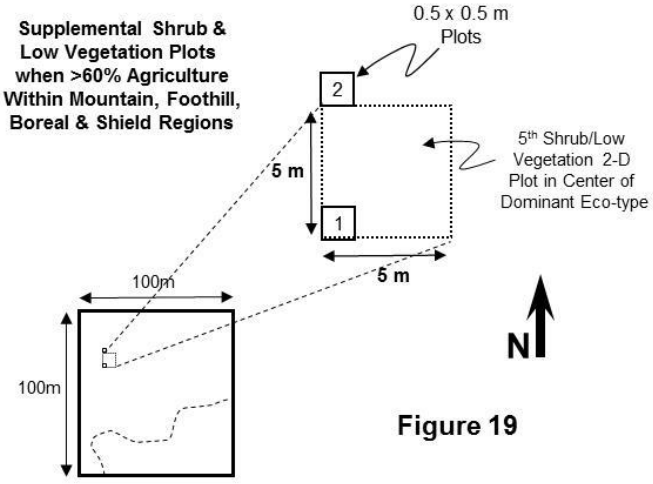

Figure 19