Saskatchewan Rangeland Ecosystems

Ecosites and Communities of Forested Rangelands

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1. INTRODUCTION

Forest grazing is a major land use in the Aspen Parkland and Boreal Transition Ecoregions of Saskatchewan[1]. Forest grazing is carried out on private farmland, in PFRA and provincial community pastures, and in the provincial forests and provincial parks. In order to increase the sustainability of this land use, and to reduce conflicts with other uses, a range planning approach is needed. One of the fundamental tools in range planning is ecosite classification. Information is needed on the different types of forested ecosites that are used for livestock grazing, sustainable stocking rates for each ecosite, and assessment procedures for determining whether rangelands are being degraded by grazing impact. This information has been developed for the native grasslands of southern Saskatchewan (Abouguendia 1990, Thorpe 2007a). However there is much less information available for forested rangelands. The purpose of this report is to fill in this gap, providing better information for sustainable management of forest grazing.

Most forest grazing occurs in hardwood and mixedwood stands dominated by poplars (trembling aspen and balsam poplar), with stands of white birch, green ash, and Manitoba maple playing a smaller role. Softwood stands have low production of forage suitable for livestock, and are usually considered non-use areas where they do occur in grazing parcels. Therefore, the focus of this report is on poplar-dominated hardwood and mixedwood stands. Wetland vegetation such as meadows and fens is also a focus of livestock grazing within forested parcels, but is not addressed in this report.

Forest grazing is assumed to mean grazing by beef cattle during spring through fall, as this is the predominant practice in the region. Grazing management for other domestic animals (or for wild ungulates) would require different information, because of differences in food habits.

The main regions where forest grazing occurs are:

- The Aspen Parkland, where the native vegetation is a mosaic of grasslands and poplar bluffs. This mainly coincides with the Aspen Parkland Ecoregion, but there are smaller areas in the northern part of the Moist Mixed Grassland Ecoregion that have parkland-like vegetation.
- The southern edge of the Boreal Forest, where agricultural settlement (including livestock grazing) has extended into forested land. Most of this area is included in the Boreal Transition Ecoregion, but there are smaller areas in the Mid-Boreal Upland and Mid-Boreal Lowland Ecoregions that are affected by agricultural land use.

Several major tasks were completed to provide better information for forest grazing management:

- establishment and monitoring of a network of monitoring plots to obtain better data on the level of forage production in Saskatchewan forests.
- classification of ecosites and community types used for grazing in Saskatchewan forests.
- calculation of recommended stocking rates for ecosites and community types.
- presentation of the above information in standardized ecosite descriptions.

2. PRODUCTION MONITORING

A network of forest plots in the Aspen Parkland and southern Boreal Forest was initiated, consisting of 24 ungrazed reference plots established in 2005, and 25 grazed plots established in 2006. Plot locations are given in Appendix 1. Plots were stratified according to region (Boreal Forest and Aspen Parkland)

[1] Regions referred to in this report follow the standard *Ecoregions of Saskatchewan* (Padbury and Acton 1994).

and approximate site type (sandy, loamy, and moist). The Boreal Forest plots were also stratified according to tree canopy closure (open stands with less than 50% canopy cover, and closed stands with more than 50% cover) (Table 1).

Table 1 Numbers of monitoring plots, stratified by region, site, and canopy closure.

	number of ungrazed plots	number of grazed plots
Boreal Forest		
Sand sites		
Open stands	3	4
Closed stands	2	1
Loam sites		
Open stands	3	3
Closed stands	3	4
Moist sites		
Open stands	2	
Closed stands	2	4
Aspen Parkland		
Sand sites	3	3
Loam sites	3	3
Moist sites	3	3

Each plot consisted of a 98 m transect, the location of which was recorded with a GPS. The topography of the area was described, and a soil pit was dug nearby to describe the soil profile. The tree layer was described by prism sweeps at three points along the transect to estimate the basal area of each species. Lower vegetation layers were described by percent cover estimates by species in 15 quadrats along the transect. In a subsample of these quadrats (5 quadrats in 2005, 7 quadrats in 2006 and 2007), above-ground material of graminoids, forbs, and browse (current production only) was clipped to a height of 1.5 m. Clipped material was air-dried in the lab and weighed, while subsamples were oven-dried to determine oven-dry to air-dry conversions. Clipping of above-ground production was repeated in subsequent years (2005, 2006, and 2007 for ungrazed plots, and 2006 and 2007 for grazed plots). Details of sampling methods, and complete vegetation descriptions of the plots, are given in previous progress reports (Thorpe and Godwin 2006, 2007).

Yearly forage production data are given in Appendix 2. Average yields over the three years are shown in Appendix 3. For grazed plots, it was not possible to put out exclosure cages, so current-year utilization had affected some of the plots (16 plots in 2006, 10 in 2007) at the time they were sampled. This means that the clipped forage weights may have been less than the actual yields of these plots, because some of the yield had been removed by current-year utilization. To reduce this effect, if there was current-year utilization in one year but not the other, only the unutilized year was used in calculating averages. However, 10 of the 25 plots were affected by current-year utilization in both years, as indicated in Appendix 2.

Yields for ungrazed plots are summarized in Table 2. Graminoid production tended to be much higher on Sand than on Loam or Moist sites, particularly in the Parkland. By contrast, forb production tended to be highest in Open Boreal stands, especially those on Moist sites. Browse production tended to be higher on Loam and Moist sites than on Sand. Total forage yield was highest on Sand in the Parkland, because of the high production of graminoids, and was lowest in Boreal Closed stands on all sites. The higher forage production in Boreal Open stands, and in Parkland stands which also tended to be open, is to be expected

because of the greater light resources available for herbs and shrubs. Overall, forage production in aspen stands averaged around 1200 kg/ha, with a range of roughly ±300 kg/ha, depending on region and site.

Table 2 Average forage yields (oven-dry, kg/ha) over three years for ungrazed plots.

Site	Parkland	Boreal		Overall
		Open	Closed	
	GRAMINOIDS			
Sand	632	206	221	370
Loam	79	84	81	81
Moist	184	130	73	137
Overall	299	141	119	194
	FORBS			
Sand	320	431	337	366
Loam	312	363	276	317
Moist	342	601	257	392
Overall	325	448	288	355
	BROWSE			
Sand	640	629	526	607
Loam	816	680	707	734
Moist	732	693	570	675
Overall	729	664	616	675
	TOTAL FORAGE			
Sand	1592	1266	1084	1343
Loam	1207	1127	1064	1133
Moist	1259	1425	899	1204
Overall	1353	1254	1023	1223

Year-to-year variability in forage production is summarized in Table 3 in terms of the changes from the base-year (2005). However, because the destructive sampling could not be done at exactly the same locations in successive years, the changes could also reflect small-scale spatial variability within the stands. While there were a few large changes in individual components, the overall changes were modest in most cases. This suggests that the occasional large changes were caused by sampling variation rather by a real difference between years. It should be noted that the three years of measurement did not include a severe drought year. If it had, larger overall changes in forage yield would be expected.

The use of these forage yield results in determining recommended stocking rates is discussed in Section 4.

The production monitoring plots gave a large database on which to explore the relationship between forage yield and percent cover estimates. There were 331 quadrats in which both percent cover and yield were measured, for total herbs and total browse (up to a height of 1.5 m). Regression analysis gave the following relationships:

ln(herb yield in kg/ha) = 2.315 + 1.071 * ln(% herb cover); R^2 = 70.5%
ln(browse yield in kg/ha) = 2.576 + 1.044 * ln(% shrub cover); R^2 = 74.1%

These regressions are fairly strong and are based on a large amount of data, so they should be useful for estimating yield from percent cover in future work.

Table 3 Changes from year to year in forage yield (oven-dry, kg/ha)

Site	CHANGE FROM 2005 TO 2006				CHANGE FROM 2005 TO 2007			
	Parkland	Boreal		Overall	Parkland	Boreal		Overall
		Open	Closed			Open	Closed	
	GRAMINOIDS							
Sand	154	48	104	102	138	21	-44	49
Loam	2	-21	42	8	6	51	56	38
Moist	75	14	81	59	148	-123	30	37
Overall	77	14	71	54	98	-4	20	41
	FORBS							
Sand	-70	81	50	16	-69	27	-57	-30
Loam	-77	-251	87	-80	-66	-127	101	-31
Moist	-59	366	-60	62	55	184	84	100
Overall	-69	28	34	-7	-27	9	51	8
	BROWSE							
Sand	62	44	450	152	-11	9	31	7
Loam	-19	219	-53	49	100	-175	-129	-68
Moist	146	-203	-72	-16	105	-226	-82	-43
Overall	63	48	85	64	64	-119	-70	-36
	TOTAL FORAGE							
Sand	145	174	603	270	59	57	-71	26
Loam	-93	-53	76	-23	40	-250	28	-61
Moist	161	177	-50	105	308	-165	32	94
Overall	71	89	191	112	135	-114	1	13

3. ECOSITE AND COMMUNITY CLASSIFICATION

Ecological sites or ecosites are the basic land units used for range planning at the level of a grazing operation. SRM (1989) defined an ecological site as: "A kind of land with a specific potential natural community and specific physical site characteristics, differing from other kinds of land in its ability to produce vegetation and to respond to management." For example, a loamy moraine supporting aspen stands, a sand plain supporting jack pine stands, and a poorly drained sedge fen are different ecosites. Their physical site properties are different, they support different kinds of natural vegetation, and they produce different amounts of livestock forage. Therefore, planning for appropriate grazing requires that these ecosites be mapped out and treated differently.

On a given ecosite, different plant communities may occur at different times. In forest vegetation, this community change may be interpreted at two time-scales. At the longer time-scale, communities change through the processes of natural stand development and succession. For example, a well-drained loamy ecosite may support an aspen stand for many decades following a major disturbance, but this may gradually develop into a mixedwood or softwood stand with age. Tree canopy variants within an ecosite

are sometimes referred to as "ecosite phases" (Beckingham et al. 1996). At the shorter time-scale, livestock grazing may change the composition and structure of the understory vegetation within these stand types. For range management purposes, we are mainly concerned with these shorter-term changes in the understory, so we take the state of the tree canopy as a given. In other words, the changes that are dealt with by range managers occur within the setting determined by both the physical site and the composition of the tree canopy.

On a given ecosite with a given type of tree canopy, the community that develops under ungrazed or lightly grazed conditions is referred to as the reference community. It is used as the reference when we assess the amount of change that has been caused by grazing. Other communities may develop under prolonged grazing impact. Certain plant species are preferred by grazers, or are sensitive to trampling damage (e.g. many tall forbs), so they tend to decrease in abundance. Other species that are less palatable or more resistant to livestock use may increase in their relative proportions in the vegetation. Therefore, a series of communities, with transitions between them, can be described within a given ecosite and tree canopy type.

For classification of ecosites and communities, the 49 production monitoring plots were supplemented by vegetation composition data from several other sources:

- A large database of vegetation plots for forest ecosite classification provided by Forest Service Branch, Saskatchewan Environment. Within this database, hardwood and mixedwood plots occurring in the Boreal Transition Ecoregion as well as adjacent portions of the Mid-Boreal Upland and Mid-Boreal Lowland Ecoregions were selected.
- A database of forest range benchmark plots in northeastern Alberta provided by Alberta Sustainable Resource Development.
- A database of range condition monitoring transects in PFRA Pastures provided by Agriculture and Agri-food Canada.
- Other data previously collected by SRC staff (Thorpe 1978, Godwin and Thorpe 1992, Thorpe and Godwin 1993).

Data were divided between two Ecoregions: Aspen Parkland (which included some plots from the northern part of the Moist Mixed Grassland), and Boreal Transition (which included some plots from the southern parts of the Mid-Boreal Upland and Lowland). Ecosites were classified within each Ecoregion.

In classification of ecosites for range management purposes, the emphasis was placed on soil variables rather than on plant indicators. It was important that ecosites be defined in terms of soil features, to allow intepretation of grazed stands in which plant indicators may have been altered. The main variables used were **soil drainage class** and **effective soil texture**. Soil drainage class represents the rate of water removal from the soil in relation to supply (Beckingham et al. 1996), and is affected by topography, soil texture, and the level of the water table (i.e. the level at which the soil is saturated with water). Indicators such as mottling and gleying in the soil profile are used to characterize the water table influence. Soil texture refers to the proportions of different particle sizes (sand, silt, and clay) making up the mineral soil. The various horizons that make up a soil profile often have different textures. To represent the soil profile by a single variable, the effective texture is considered to be the texture of the finest layer that is at least 10 cm thick and that is above 60 cm depth (modified from Beckingham et al. 1996). Other variables, such as geomorphic landform, topography, soil association, and (to a limited extent) plant indicators, were used in some cases to provide indirect evidence on the primary variables of drainage and texture.

Only part of the range of possible ecosites was considered, because the data were restricted to hardwood and mixedwood stands, excluding sites that mainly support conifer stands or wetland vegetation. Ecosites had to

be relatively broad, because of limitations on the amount of soil information in the available data, and because of the need to describe several different communities within each ecosite. Communities were only described if there was a reasonable sample size of plots (generally at least 10) to characterize them, and a finer division of ecosites would have reduced the number of plots for community classification within each ecosite. Because of these considerations, plots were grouped into only three ecosites:

- Submesic Sand – this ecosite included coarse-textured soils with little water-table influence; these sites were considered "submesic" because the more xeric sites on coarse materials typically support jack pine stands (in the Boreal) or grasslands (in the Parkland).
- Mesic Loam – this ecosite included medium to fine-textured soils with little water-table influence.
- Moist – this ecosite included soils in which moist conditions are maintained by a high water table or runoff from upper slopes.

A variety of finer subdivisions of these ecosites were attempted in the classification process, but the available data were inadequate to support them. The classification could be refined in the future if additional data with good characterization of soil variables were available. More details on these ecosites are provided in the descriptions in Section 5.

The next step was community classification on the plots within each ecosite. This was based on the abundances of species. All of the plot data gave abundance as percent cover, so most analysis was based on this variable. However, in the grazed plots in the Boreal Transition, cover values were much higher in plots from one data source than from the other data sources, indicating a difference in cover estimation methods. Therefore, the analysis of Boreal grazed plots was based on relative cover (i.e. the cover values of shrub and herb species were divided by the sum of all shrub and herb species, giving a relative value out of 100). Use of relative cover removed the difference in magnitude between data sources.

Within each ecosite, reference communities were described. In the Boreal Transition, reference communities were characterized by averaging the species abundances found in ungrazed stands, of which there were a large number in the available data. Separate reference communities were developed for mixedwood and hardwood stands, and also for hardwood stands with a dense hazelnut layer (see discussion in Section 5). Communities altered by grazing impact were also described within each ecosite, if sufficient data were available. These were classified by a supervised analysis of the grazed plots, in which plots were sorted using indicators such as the abundance of species that are known to decrease under grazing, and the abundance of exotic invaders which frequently appear in heavily grazed stands. Plots were clustered to form tentative communities, averages of species abundances compared, and the classification refined iteratively with the objective of producing a small number of relatively homogeneous communities that could be interpreted in terms of grazing impact. The ecological status of these communities was measured by their their percent similarity (Sorensen's Index on relative cover values of shrubs and herbs) to the reference community for that ecosite.

In the Aspen Parkland, where there were fewer ungrazed plots, grazed and ungrazed plots were analyzed together, using a supervised approach as in the grazed plots in the Boreal. The community with indicators of lowest grazing impact (e.g. high proportion of decreasers, low proportion of exotics) was interpreted as the reference community. The status of other communities was then interpreted in terms of their similarity to the reference community.

Communities were described using a standard format, and arranged in state-and-transition diagrams representing the interpreted transitions between communities.

4. RECOMMENDED STOCKING RATES

Recommended stocking rates are based on the annual production of cattle forage in the various ecosites and community types. The data sources for estimating recommended stocking rates were:

- The 49 production monitoring plots established in the current project (see Section 2)
- 15 plots (12 in Aspen Parkland, 3 in Boreal Forest) measured by Thorpe et al. (1990).

Production data in both sets of plots was separated into graminoids, forbs and browse. In both cases, the data included current-year growth to a maximum height of 1.5 m. Prostrate shrubs, bryophytes, and lichens were not included.

One of the limitations of the raw production data is that a wide range of plant species are included, some of which are unpalatable to cattle. This is less of an issue in grasslands, because production is dominated by grasses and sedges which are generally palatable. However, in forest vegetation a large fraction of the production can consist of forb or shrub species that cattle are reluctant to eat. Therefore, calculation of recommended stocking rates was based on the proportion of the forage that is considered palatable to cattle.

Available publications rate the forage value of forest species as "good", "fair", or "poor" (Wroe et al. 1986, Sask Forage Council 2007). For herbaceous species, those rated "good" and "fair" were considered to be palatable. For graminoids (grasses and sedges), this included all of the species in the plot data, whereas for forbs it included about 60% of the species. For shrubs, only the "good" species were used. These included aspen, willows, dogwood, saskatoon, cherries, and bush-cranberries. Shrubs were treated differently because it was recognized that, while cattle do browse on shrubs, they prefer herbaceous species, especially graminoids (Thorpe and Godwin 1994). Inclusion of "fair" shrubs would have greatly increased recommended stocking rates in some cases, because of abundant species such as hazelnut and rose. In light of the dietary preferences of cattle, a high supply of "fair" shrub species was not considered to be a good basis for recommending high stocking rates.

The proportion of palatable species in each forage class was estimated from the relative cover values of the species in the plot vegetation data. This proportion was multiplied by the yield of the forage class to estimate the palatable yield. This calculation is shown in Appendix 3 for the production monitoring plots.

Recommended stocking rates in Animal Unit Months per hectare (AUM/ha) are calculated as:

[(palatable yield in kg/ha) * (40% utilization)] / (454 kg/AUM)

The utilization level of 40% represents the fraction of the forage allocated to consumption by livestock, with the remainder allocated to maintenance of plant vigour and ecosystem function. By comparison, Alberta calculates forest stocking rates based on 25% of the total yield (which they say is roughly equivalent to 50% of the yield of "good" and "fair" species) (ASRD 2004). The amount of forage required to support one Animal Unit Month is estimated at 454 kg (ASRD 2004), which is higher than the 354 kg used in other sources (Abouguendia et al. 1990).

The estimation of recommended stocking rates in this publication is intentionally conservative, being based on:

- only the yield from palatable species
- only 40% utilization of the palatable yield
- allocation of 454 kg of yield per AUM

Conservative stocking rates are justified in forest grazing because of the lack of long-term stocking-rate studies in forest, the obstacles to uniform distribution of grazing animals, and the need to reduce conflicts with other forest uses such as wildlife habitat.

In the Boreal Forest, recommended stocking rates were first analyzed in ungrazed stands. Eighteen plots were available, all in hardwood stands. Regression analysis showed that most of the variation in palatable yield could be explained by two variables: canopy closure (open vs. closed) and hazelnut cover. After accounting for these variables, none of the variables related to ecosite type showed significant relationships. Therefore, canopy closure and hazelnut cover were used to group the plots (Table 4). Inspection of the data in Table 4 confirms that these groupings gave sustantially different average yields and recommended stocking rates, and that within these groupings there were no consistent patterns related to ecosite. The pattern will not be surprising to forest range managers: open hardwood stands have higher forage yields than closed hardwood stands, and stands with a dense hazelnut stratum have very low yields of palatable forage. Note that hazelnut, which contributed a large part of the understory biomass in the last group of plots, is considered a "fair" shrub, so was not included in the palatable yield. The averages from Table 4 were used to assign recommended stocking rates to hardwood reference communities in the Boreal Forest (see Section 5).

Table 4 Analysis of yields and recommended stocking rates for ungrazed hardwood forests in the Boreal Transition Ecoregion.

plot	ecosite	palatable yield (kg/ha)	recommended stocking rate (AUM/ha)
CLOSED FORESTS WITHOUT A DENSE HAZELNUT STRATUM			
1989 plot #2	Mesic Loam	416	0.37
1989 plot #3	Mesic Loam	638	0.56
Production plot # 13	Moist	274	0.24
Production plot # 9	Moist	449	0.40
Production plot # 6	Submesic Sand	354	0.31
Production plot # 3	Submesic Sand	666	0.59
Average		**466**	**0.41**
OPEN FORESTS WITHOUT A DENSE HAZELNUT STRAUM			
1989 plot #11	Mesic Loam	328	0.29
Production plot # 8	Mesic Loam	1143	1.01
Production plot # 24	Moist	452	0.40
Production plot # 20	Moist	718	0.63
Production plot # 5	Submesic Sand	844	0.74
Production plot # 4	Submesic Sand	861	0.76
Average		**724**	**0.64**
FORESTS (OPEN OR CLOSED) WITH A DENSE HAZELNUT STRATUM (>25% cover)			
Production plot # 19	Mesic Loam	198	0.17
Production plot # 23	Mesic Loam	209	0.18
Production plot # 12	Mesic Loam	213	0.19
Production plot # 18	Mesic Loam	239	0.21
Production plot # 7	Mesic Loam	412	0.36
Production plot # 15	Submesic Sand	281	0.25
Average		**259**	**0.23**

In mixedwood stands, no production plots were sampled. To permit the estimation of stocking rates for mixedwood communities in the Boreal Forest, 21 quadrats were sampled under areas of spruce canopy within mixedwood stands. The average yield of palatable forage under spruce canopy was 98 kg/ha, significantly less than than the average of 466 kg/ha in closed hardwood stands without a hazelnut stratum (Table 4). Yield of mixedwood stands was estimated as a function of the spruce cover within the stand. For example, if the spruce cover is 20%, the overall yield is estimated as:

(20% * 98 kg/ha) + (80% * 466 kg/ha) = 392 kg/ha

Grazed plots in the Boreal Forest varied in ecosite, stand type, and degree of alteration caused by grazing. Plots with similar situations and yields were grouped (Table 5). Unfortunately, only some of the grazed communities were represented in the available production data. Grazed communities that were similar in composition to the ungrazed reference community, or showed only minor alteration, had similar forage yields to the reference on average. The community on the Submesic Sand Ecosite that showed moderate alteration had substantially lower yield than the reference community. However, communities with significant alteration related to invasion of Kentucky blue grass showed higher yields of palatable forage compared to the reference community. These trends were used to estimate recommended stocking rates for grazed communities.

In the Aspen Parkland, regression analysis on reference-community plots showed that canopy closure (open vs. closed) and presence of the Submesic Sand Ecosite had significant effects on palatable yield. These variables were used to group the plots in reference communities (Table 6). There were only two plots with dense hazelnut cover, but these did have lower yields than other plots with the same canopy closure, so were separated.

In altered communities in the Aspen Parkland, regression analysis showed than canopy closure (open vs. closed) had a significant effect on palatable forage yield, so plots were grouped on that basis (Table 7). The open plots all had grassy understories, either native grasses or Kentucky blue grass, whereas most of the closed plots had shrubby understories. Again, these trends were used to estimate recommended stocking rates for the various communities (Section 5).

Table 5 Analysis of yields and recommended stocking rates for grazed hardwood forests in the Boreal Transition Ecoregion.

plot	ecosite	palatable yield (kg/ha)	recommended stocking rate (AUM/ha)	current utilization
MOIST ECOSITE, CLOSED STANDS				
COMPOSITION SIMILAR TO REFERENCE COMMUNITY				
Production plot #31	Moist	405	0.36	*
Production plot #34	Moist	620	0.55	
Production plot #42	Moist	186	0.16	
Average		**404**	**0.36**	
Note: similar average to ungrazed reference (closed stands without dense hazelnut stratum).				
Note: exclusion of plot with current utilization had little effect on average.				
MESIC LOAM ECOSITE, OPEN STANDS				
MINOR ALTERATION FROM REFERENCE COMMUNITY				
Production plot #26	Mesic Loam	713	0.63	*
Note: similar average to ungrazed reference (open stands without dense hazelnut stratum)				
MESIC LOAM ECOSITE, STANDS WITH DENSE HAZELNUT STRATUM				
MINOR ALTERATION FROM REFERENCE COMMUNITY				
Production plot #33	Mesic Loam	187	0.16	*
Production plot #35	Mesic Loam	284	0.25	*
Production plot #25	Mesic Loam	278	0.25	*
Production plot #48	Mesic Loam	318	0.28	
Average		**267**	**0.24**	
Note: similar average to ungrazed reference (stands with dense hazelnut stratum).				
Note: average could be affected by current utilization in most of the plots.				
SUBMESIC SAND ECOSITE, OPEN STANDS				
MODERATE ALTERATION FROM REFERENCE COMMUNITY				
Production plot #47	Submesic Sand	242	0.21	*
Production plot #28	Submesic Sand	149	0.13	
Production plot #27	Submesic Sand	301	0.26	
Production plot #38	Submesic Sand	688	0.61	
Average		**345**	**0.30**	
Note: about half of yield of ungrazed reference (open stands without dense hazelnut stratum)				
Note: exclusion of plot with current utilization had little effect on average.				
Note: one outlier (production plot #39) excluded: much higher yield because of abundant aspen sprouts.				
MESIC LOAM AND MOIST ECOSITES, CLOSED STANDS				
SIGNIFICANT ALTERATION (INVASION OF KENTUCKY BLUE GRASS)				
Production plot #40	Mesic Loam	860	0.76	
Production plot #45	Mesic Loam	352	0.31	
Production plot #41	Moist	622	0.55	
Average		**612**	**0.54**	
Note: about 30% higher than ungrazed reference (closed stands without dense hazelnut stratum)				

Table 6 Analysis of yields and recommended stocking rates on reference-community plots in the Aspen Parkland.

plot	ecosite	palatable yield (kg/ha)	recommended stocking rate (AUM/ha)
SUBMESIC SAND ECOSITE			
OPEN HARDWOOD STANDS			
1989 plot #5	Submesic Sand	944	0.83
Production plot #11	Submesic Sand	1076	0.95
Production plot #16	Submesic Sand	1333	1.17
Production plot #1	Submesic Sand	1418	1.25
Average		**1193**	**1.05**
MESIC LOAM AND MOIST ECOSITES			
OPEN HARDWOOD STANDS			
Production plot #17	Moist	586	0.52
Production plot #22	Moist	768	0.68
1989 plot #13	Mesic Loam	632	0.56
Production plot #10	Mesic Loam	849	0.75
Average		**709**	**0.62**
MESIC LOAM AND MOIST ECOSITES			
CLOSED HARDWOOD STANDS			
1989 plot #1	Mesic Loam	332	0.29
Production plot #21	Mesic Loam	506	0.45
1989 plot #14	Moist	451	0.40
Production plot #2	Moist	639	0.56
Average		**482**	**0.42**
MESIC LOAM ECOSITE			
HARDWOOD STANDS WITH DENSE HAZELNUT STRATUM			
1989 plot #9	Mesic Loam (open)	506	0.45
Production plot #14	Mesic Loam (closed)	158	0.14
Average		**332**	**0.29**

Table 7 Analysis of yields and recommended stocking rates in altered communities in the Aspen Parkland

plot	ecosite	palatable yield (kg/ha)	recommended stocking rate (AUM/ha)	current utilization
CLOSED STANDS (MAINLY SHRUBBY)				
MODERATE TO SIGNIFICANT ALTERATION				
1989 plot #12	Submesic Sand	119	0.11	
Production plot #30	Moist	121	0.11	*
Production plot #46	Moist	289	0.25	*
1989 plot #4	Moist	305	0.27	
Production plot #36	Moist	350	0.31	*
1989 plot #7	Mesic Loam	226	0.20	
1989 plot #8	Mesic Loam	330	0.29	
Average		**248**	**0.22**	
Note: about half of yield in closed reference-community plots.				
Note: excluding the plots with current utilization had little effect on the averages.				
OPEN STANDS (MAINLY GRASSY)				
MODERATE TO SIGNIFICANT ALTERATION				
1989 plot #10	Mesic Loam	581	0.51	
Production plot #32	Mesic Loam	581	0.51	
Production plot #43	Mesic Loam	876	0.77	
Production plot #44	Submesic Sand	1054	0.93	
Production plot #37	Submesic Sand	1490	1.31	
1989 plot #6	Submesic Sand	442	0.39	
Production plot #29	Submesic Sand	828	0.73	
Average		**836**	**0.74**	
Note: less than yield in open reference-community plots on Submesic Sand, but more than yield in open reference-community plots on Mesic Loam and Moist Ecosites.				

5. ECOSITE AND COMMUNITY DESCRIPTIONS

5.1 Using the Ecosite and Community Descriptions

The ecosite and community descriptions given below are intended to be used in assessing range health (PCAP 2008) and planning sustainable grazing practices. They apply to forested rangelands in the Aspen Parkland and Boreal Transition Ecoregions of Saskatchewan (Figure 1). Forested rangelands in the Moist Mixed Grassland Ecoregion should be assessed using the information given for Aspen Parkland, while those in the Mid-Boreal Upland and Mid-Boreal Lowland Ecoregions should be assessed using the information given for the Boreal Transition. Note that some upland areas within the Aspen Parkland Ecoregion are more like Boreal Forest than Aspen Parkland, so would be better assessed using the Boreal Transition information. This is especially true of Moose Mountain (Landscape Area H19), but may also apply to parts of the Touchwood Hills (Landscape Area H11) and the Eagle Hills.

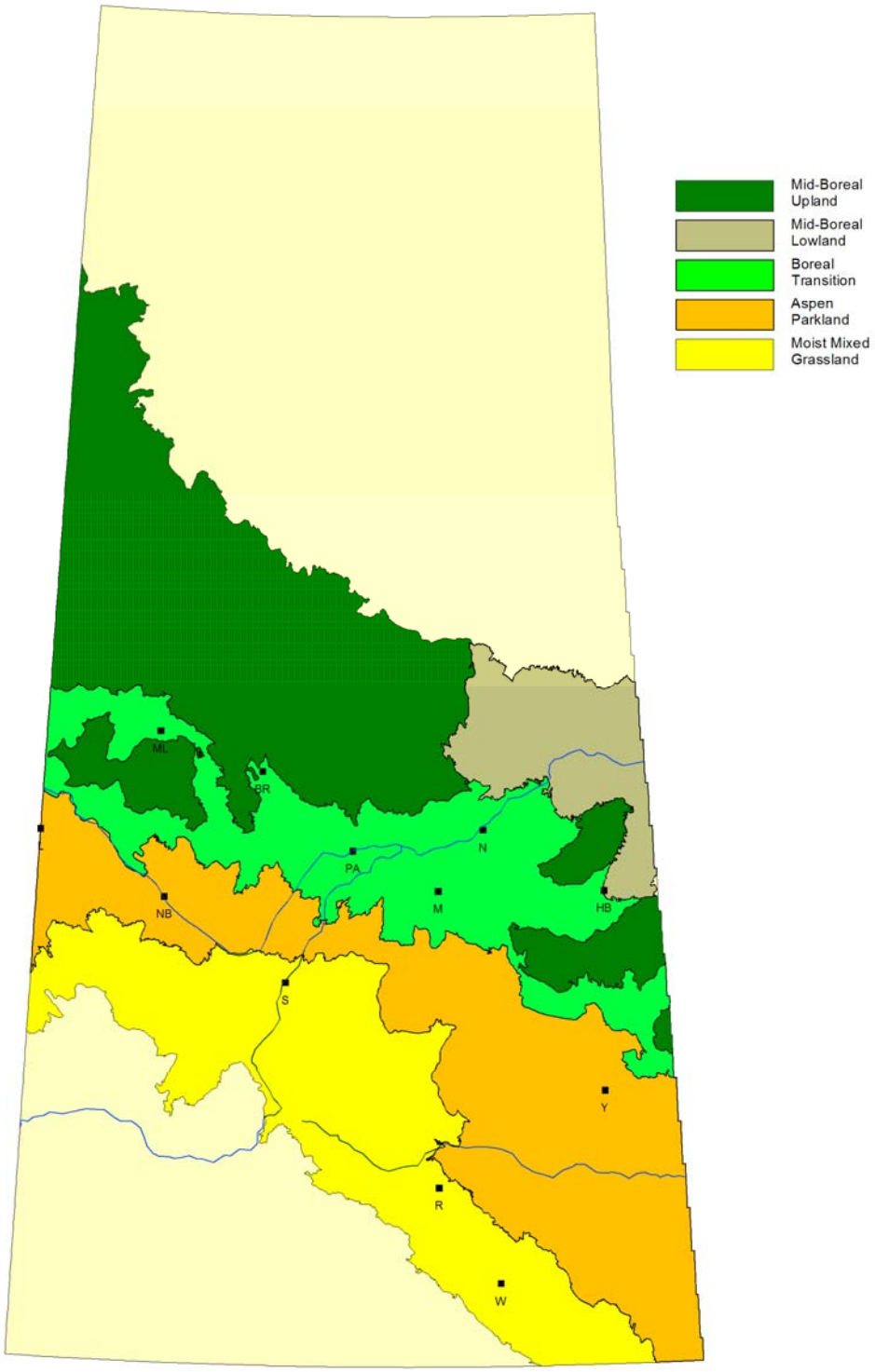


Figure 1 **Ecoregions referred to in the text. For more detail, see the Ecoregions of Saskatchewan map (Padbury and Acton 1994).**

The first step in assessing rangeland is to determine the ecosite. Examine the general topography of the site, including such features as slope steepness and slope position. Dig a soil pit at least 60 cm (2 feet) deep, and study the layers (soil horizons). Soil layers may also be viewed in road-cuts. Consult a soils textbook or seek advice from a soils expert to recognize features in the soil profile. Some of the features that are used in identifying range ecosites:

- Depth of the LFH layer (the layer of decomposing organic matter at the surface of the soil).
- Soil texture of the various horizons
- Mottling – spots of different colour interspersed with the dominant soil colour, indicating intermittent saturation with water; if present, note the depth to this layer.
- Gleying – dull gray or blue colours indicating prolonged saturation with water; if present, note the depth to this layer.
- Visible saturation with water (high water table); if present, note the depth to this layer.

Soil texture is how coarse or fine the soil is, and is determined by the proportions of different particle sizes: sand, silt, and clay. Determining soil texture in the field is a skill that requires training and practice. However, Table 8 gives a key that should lead to approximately the correct texture class. To use this key, take a handful of soil from the profile, and add water to form a moist ball that can be worked in the hand. Try to form the moist soil into a ribbon. Add more water and rub the wet soil between the fingers to determine how it feels: a gritty feel indicates sand; a smooth, soapy feel indicates silt; and a sticky feel indicates clay. The **effective texture** is considered to be the texture of the finest layer at least 10 cm thick that is above 60 cm depth.

Table 8 Key for determining soil texture by hand (modified from Thien 1979)

1 soil does not form a ball	sand
1 soil forms a ball	
2 soil does not form a ribbon	loamy sand
2 soil forms a weak ribbon less than 2.5 cm long before breaking	
3 soil feels very gritty	sandy loam
3 soil feels very smooth	silt loam
3 neither grittiness nor smoothness predominates	loam
2 soil forms a medium ribbon 2.5 to 5 cm long before breaking	
4 soil feels very gritty	sandy clay loam
4 soil feels very smooth	silty clay loam
4 neither grittiness nor smoothness predominates	clay loam
2 soil forms a strong ribbon 5 cm or longer before breaking	
5 soil feels very gritty	sandy clay
5 soil feels very smooth	silty clay
5 neither grittiness nor smoothness predominates	clay

After examining the topography and soil profile, use Table 9 to determine the range ecosite. Before making a final decision, look at the descriptions of the ecosites in Sections 5.2 or 5.3 to make sure that you have picked the most appropriate one. Table 9 also shows the the reference community for each ecosite, depending on the type of tree canopy.

Table 9 Key for determining range ecosites and reference plant communities for forest grazing in the Aspen Parkland and Boreal Transition Ecoregions of Saskatchewan.

a. **Boreal Transition Ecoregion** (or southern parts of Mid-Boreal Upland or Mid-Boreal Lowland Ecoregions)	
b. no prominent mottling in top 50 cm of soil (some mottling may occur in lower part of soil profile); no gleying or visible saturation; may be on slopes or on level ground.	
c. effective texture is sand or loamy sand (rapidly drained)*: **Submesic Sand Ecosite**	
e. aspen stands	**BT-SD-A ref. comm.**
e. aspen-conifer mixedwoods	**BT-SD-C ref. comm.**
e. conifer stands, shrubby or herbaceous vegetation	not classified
c. effective texture is loam, silt loam, clay loam, or clay (well to moderately well drained): **Mesic Loam Ecosite**	
f. aspen stands without dense hazelnut layer	**BT-LM-A ref. comm.**
f. aspen stands with dense hazelnut layer	**BT-LM-E ref. comm.**
f. aspen-conifer mixedwoods	**BT-LM-G ref. comm.**
f. conifer stands, shrubby or herbaceous vegetation	not classified
b. prominent mottling or gleying in top 50 cm of soil (imperfectly to poorly drained); LFH layer usually thicker than on well-drained sites; usually in lower slope or depressional positions: **Moist Ecosite**	
g. aspen or balsam poplar stands	**BT-MO-A ref. comm.**
g. poplar-conifer mixedwoods	**BT-MO-D ref. comm.**
g. conifer stands, shrubby or herbaceous vegetation	not classified
a. **Aspen Parkland Ecoregion** (or northern part of Moist Mixed Grassland Ecoregion)	
b. no prominent mottling in top 50 cm of soil (some mottling may occur in lower part of soil profile); no gleying or visible saturation; may be on slopes or on level ground.	
c. effective texture is sand or loamy sand (rapidly drained)*: **Submesic Sand Ecosite**	
e. aspen stands	**AP-SD-G ref. comm.**
e. grassland or shrubland	not classified
c. effective texture is loam, silt loam, clay loam, or clay (well to moderately well drained): **Mesic Loam Ecosite**	
f. aspen stands	**AP-LM-F ref. comm.**
f. grassland or shrubland	not classified
b. prominent mottling or gleying in top 50 cm of soil (imperfectly to poorly drained); LFH layer usually thicker than on well-drained sites; usually in lower slope or depressional positions: **Moist Ecosite**	
g. aspen or balsam poplar stands	**AP-MO-A ref. comm.**
g. grassland or shrubland	not classified

*Classification of sites with effective texture of sandy loam requires further research. Tentatively they can be placed in the Submesic Sand Ecosite.

Once you have determined the ecosite and reference community, the next step is to determine the community composition of the assessment area. You should be familiar with the main plant species making up the vegetation. If you do not have training in plant identification, it is best to spend some time in the field with someone who knows plants, before you try to do an assessment. For help with plant identification, the following publications are recommended:

- Sask Forage Council. 2007. *Field guide: identification of common range plants of northern Saskatchewan*.
- D. Johnson, L. Kershaw, A. MacKinnon, and J. Pojar. 1995. *Plants of the western boreal forest and aspen parkland*. Lone Pine Publishing, Edmonton, AB.

Community composition can be determined at two levels.

- "eyeball" estimates
- quantitative sampling

Eyeball estimates are suitable for a quick, general assessment of the vegetation. Walk through the area and observe general patterns in the vegetation composition. Look particularly for species that are known to decrease under grazing (Table 10), and for exotic (non-native) species that often invade heavily grazed stands (Table 11). List the major species in the community in approximate order of abundance.

Table 10 Major decreaser species in hardwood forests in the Aspen Parkland and Boreal Transition Ecoregions of Saskatchewan

Decreaser shrubs	
saskatoon	*Amelanchier alnifolia*
red-osier dogwood	*Cornus stolonifera*
pin cherry	*Prunus pensylvanica*
choke cherry	*Prunus virginiana*
low bush-cranberry	*Viburnum edule*
high bush-cranberry	*Viburnum opulus*
Decreaser graminoids	
awned wheat grass	*Agropyron subsecundum*
slender wheat grass	*Agropyron trachycaulum*
fringed brome grass	*Bromus ciliatus*
northern awnless brome grass	*Bromus pumpellianus*
marsh reed grass	*Calamagrostis canadensis*
northern reed grass	*Calamagrostis inexpansa*
tall sedges	*Carex* spp.
Canada wild rye	*Elymus canadensis*
hairy wild rye*	*Elymus innovatus*
rough-leaved rice grass	*Oryzopsis asperifolia*
northern rice grass	*Oryzopsis pungens*
fowl blue grass	*Poa palustris*
purple oat grass*	*Schizachne purpurascens*
Decreaser forbs	
wild sarsaparilla	*Aralia nudicaulis*
showy aster	*Aster conspicuus*
hawk's-beard	*Crepis* spp.
fairybells	*Disporum trachycarpum*
fireweed	*Epilobium angustifolium*
cow-parsnip	*Heracleum lanatum*
cream-coloured vetchling	*Lathyrus ochroleucus*
purple peavine	*Lathyrus venosus*
tall lungwort	*Mertensia paniculata*
spreading sweet-cicely	*Osmorhiza depauperata*
American vetch	*Vicia americana*

* considered increaser species in some references.

Table 11 Exotic species found in hardwood forests in the Aspen Parkland and Boreal Transition Ecoregions of Saskatchewan

Exotic shrubs	
caragana	*Caragana arborescens*
European buckthorn	*Rhamnus cathartica*
Exotic grasses	
quack grass	*Agropyron repens*
smooth brome grass	*Bromus inermis*
timothy	*Phleum pratense*
Kentucky blue grass	*Poa pratensis*
Exotic forbs	
Canada thistle	*Cirsium arvense*
leafy spurge	*Euphorbia esula*
common plantain	*Plantago major*
perennial sow thistle	*Sonchus arvensis*
dandelion	*Taraxacum officinale*
clover	*Trifolium* spp.

Quantitative sampling gives a more detailed and accurate assessment of the vegetation. Lay out a transect running through the stand by following a compass bearing, preferably at least 100 m long. Make sure the transect stays within a single ecosite. At fixed intervals along the transect, lay down quadrats (at least 10 of them, preferably 15 or 20). Small quadrats (e.g. 0.25 m^2) can be used for the herbaceous vegetation, but larger quadrats (e.g. 1 or 2 m^2) should be used for the shrub layers. In the quadrats, estimate the percent cover of each species. Percent cover represents the percentage of the quadrat area covered by leaves or stems of the species. Do not include the gaps between leaves in your cover estimate. Note that the cover values of the several species within a quadrat can total to more than 100%, because of overlap between species. Calculate the average cover of each species over the number of quadrats sampled.

Once you know the community composition, you can compare it to the community descriptions given in Sections 5.2 and 5.3. Each description shows:

- a code for the community type (e.g. BT-LM-A, meaning Boreal Transition Ecoregion, Mesic Loam Ecosite, community type A)
- the name of the community type based on the dominant species
- a general description of the community type, including its interpreted successional relationships with other types
- the structure of the vegetation, represented by the percent cover of each vegetation layer, as well as LFH thickness and bare soil exposure
- the species composition, represented by major species in each vegetation layer with percent cover values
- percent similarity of the community to the reference community for that ecoregion/ecosite
- recommended stocking rates (see Section 4)

The descriptions can be used to pick the community that most closely matches the assessment area. This will give an indication of the degree of alteration from the reference community, which is needed to answer Question 1 of the Saskatchewan Range Health Assessment (PCAP 2008). However, it is important to understand that the community descriptions do not represent every possible variation in species composition. Rather, they represent the major trends. The assessment area may not exactly match any of the described community types. The user should examine the composition trends shown by described types, then attempt to interpret the composition of the assessment area in relation to these trends.

As an aid to this interpretation, the user can calculate the percent similarity (Sorensen's Index; Mueller-Dombois and Ellenberg 1974) between the assessment area and the reference community for the same ecosite. Table 12 shows an example on the Mesic Loam Ecosite in the Aspen Parkland Ecoregion. Only the understory species (shrubs, graminoids, and forbs) are used in the calculation. The description for the reference community (AP-LM-F: Aspen / Saskatoon / Rose) gives average values of percent cover for each major species, as well as totals for minor species. Values determined for the assessment area are entered beside those for the reference community. Any species recorded in the assessment area but not listed in the description would be treated as minor species (even though they may be major species in the assessment area). Percent similarity is then calculated by taking the lesser of the two values for each species. The sum of the lesser values is multiplied by 200, then divided by the sum of the reference values plus the sum of the sample values. The calculation in Table 12 indicates that the species composition of the assessment area is 66% similar to that of the reference community. This similarity value is comparable to the traditional range condition scale.

Percent similarity values can be used directly to judge the extent to which the sample plot has been altered from the reference community. However, the Saskatchewan Range Health Assessment (PCAP 2008) refers to classes of alteration in assigning points for ecological status. The following ranges of similarity can be used as a rough guide for assigning these classes:

- more than 70% - reference community
- 55 - 70% - minor alteration
- 40 - 55% - moderate alteration
- less than 40%, or dominated by exotic species - significant alteration

Table 12 Example of calculating percent similarity to the reference community, for the Mesic Loam Ecosite in the Aspen Parkland Ecoregion.

	PERCENT COVER		
	reference community	**assessment area**	**lesser value**
Major tall shrubs			
saskatoon (*Amelanchier alnifolia*)	9	3	3
beaked hazelnut (*Corylus cornuta*)	3	1	1
chokecherry (*Prunus virginiana*)	2	1	1
willow (*Salix* spp.)	2	2	2
red-osier dogwood (*Cornus stolonifera*)	1	0	0
Major short shrubs			
rose (Rosa spp.)	9	12	9
western snowberry (*Symphoricarpos occidentalis*)	4	15	4
wild red raspberry (*Rubus idaeus*)	2	1	1
currant (*Ribes* spp.)	1	2	1
Major graminoids			
white-grained mountain rice grass (*Oryzopsis asperifolia*)	4	2	2
hay sedge (*Carex siccata*)	2	2	2
Kentucky blue grass (*Poa pratensis*)	2	5	2
bearded wheat grass (*Agropyron trachycaulum* var. *unilaterale*)	1	1	1
hairy wild rye (*Elymus innovatus*)	1	0	0
purple oat grass (*Schizachne purpurascens*)	1	1	1

	PERCENT COVER		
	reference community	assessment area	lesser value
Major forbs			
violet (*Viola* spp.)	4	5	4
smooth wild strawberry (*Fragaria virginiana*)	4	7	4
spreading dogbane (*Apocynum androsaemifolium*)	2	1	1
wild sarsaparilla (*Aralia nudicaulis*)	2	1	1
wild peavine (*Lathyrus venosus*)	2	2	2
Lindley's aster (*Aster ciliolatus*)	1	1	1
common dandelion (*Taraxacum officinale*)	1	3	1
fireweed (*Epilobium angustifolium*)	1	1	1
cream-colored vetchling (*Lathyrus ochroleucus*)	1	0	0
showy aster (*Aster conspicuus*)	1	0	0
American vetch (*Vicia americana*)	1	1	1
two-leaved solomon's seal (*Maianthemum canadense*)	1	1	1
star-flowered solomon's-seal (*Smilacina stellata*)	1	2	1
fairybells (*Disporum trachycarpum*)	1	1	1
veiny meadow-rue (*Thalictrum venulosum*)	1	0	0
northern bedstraw (*Galium boreale*)	1	1	1
Minor tall shrubs	1	0	0
Minor short shrubs	0	1	0
Minor graminoids	1	1	1
Minor forbs	2	1	1
TOTALS	70	78	49
SIMILARITY	= (200 * 49) / (70 + 78)		66

The species composition of the community is used to answer Question 1 of the Saskatchewan Range Health Assessment (PCAP 2008). In addition, reference community descriptions show the structure of the vegetation in terms of the cover of the various layers (tall shrubs, short shrubs, herbs, mosses and lichens). Comparing the structure of an assessment area to the structure in the reference community answers Question 2 of the Range Health Assessment. Question 4.2 compares the bare soil exposure in an assessment area to the amount expected in a reference area, which is also given in the reference community descriptions.

Recommended stocking rates in Animal Unit Months per hectare (AUM/ha) and Animal Unit Months per acres (AUM/ac) are given for each community. These apply only to the areas within a grazing unit that are covered by that community. If there are significant areas of other ecosites or communities, then the overall stocking rate should be calculated from the stocking rates of the various types, weighted by their areas. Recommended stocking rates should be used only as initial estimates. The best practice is to monitor the range health (PCAP 2008) of each grazing unit over the years, and adjust stocking rates accordingly. Declining range health is usually a sign that stocking rates should be reduced.

5.2 Boreal Transition Ecoregion

5.2.1 Submesic Sand Ecosite

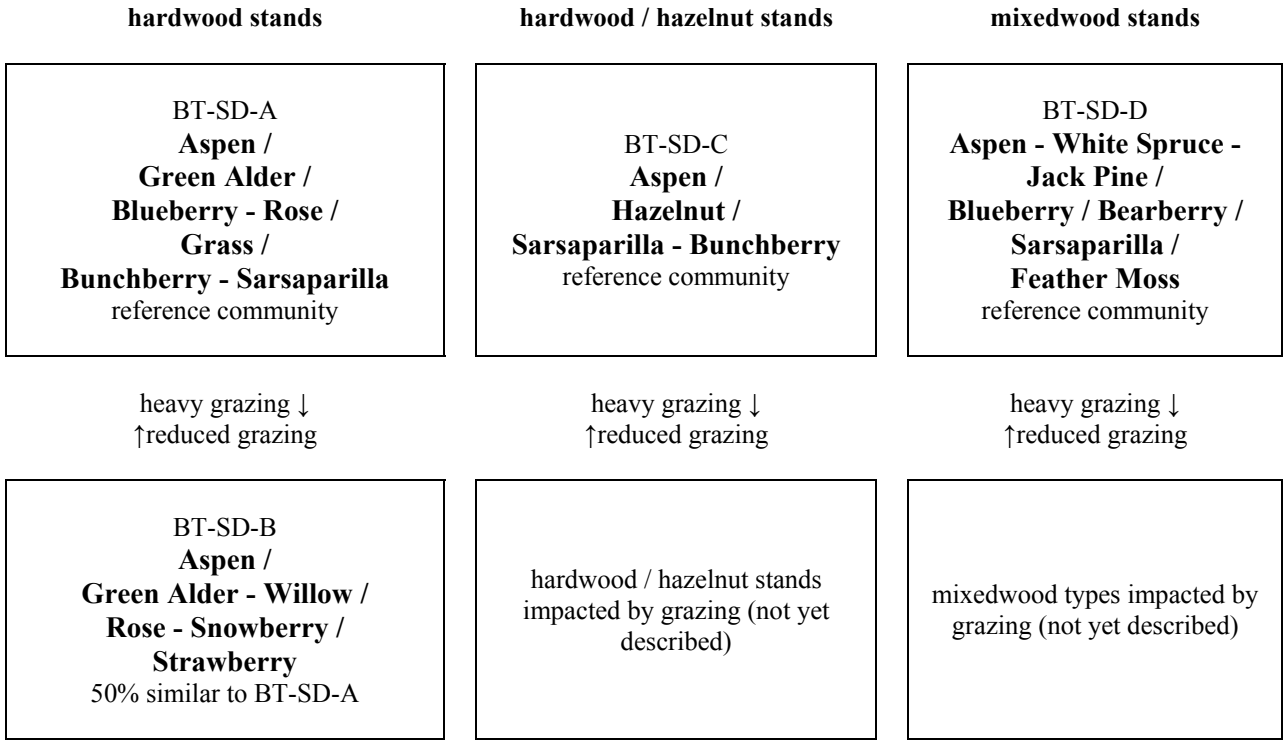
This ecosite includes coarse-textured soils (sands and loamy sands) with no water-table influence. These soils occur mainly on glacio-fluvial or eolian landforms. Since only hardwood and mixedwood stands were used in the classification, this ecosite includes mainly the subxeric to submesic areas on sand deposits, as opposed to the more xeric areas dominated by jack pine. These less xeric areas may be in lower topographic positions, have somewhat finer-textured sands, or have shallower depths of sand above impermeable materials. This ecosite is comparable to the "b – blueberry ecosite" of Beckingham et al. (1996).

Soils are predominantly Eutric Brunisols. The drainage class is usually rated as "rapidly drained" (LRRI 1983)[2] because of the coarse-textured material. Mottling and gleying are normally absent, although some rust-coloured mottles may occur at lower depths (e.g. 90 cm or more). The moisture regime would be described as "subxeric to submesic" (AEP 1994, Beckingham et al. 1996), or as "moderately fresh to fresh" (SE 2004).

Some sandy sites are influenced by the water table in the lower part of the soil profile (e.g. mottling at 50 – 100 cm), and would be rated as "well drained" to "moderately well drained". While hardwood stands undoubtedly occur on this type of land, there were not enough plots in the available data to characterize this ecosite. Sandy sites in which the water table influence is closer to the surface (0 – 50 cm) are considered "imperfectly drained" or "poorly drained", and are included in the Moist Ecosite.

[2] In some data sources, plots on freely drained sands are described as "well drained", but according to the standard scale of drainage classes, they should be called "rapidly drained".

STATE-AND-TRANSITION DIAGRAM
Boreal Transition: Submesic Sand Ecosite



BT-SD-A

Aspen / Green Alder / Blueberry - Rose / Grass / Bunchberry - Sarsaparilla

Boreal Transition: Submesic Sand Ecosite

GENERAL DESCRIPTION: **Reference community** for aspen stands on the Submesic Sand Ecosite. Stands dominated by white birch also occur on this ecosite, but data were insufficient for classification. This community is comparable to the "b2 blueberry tA (wB) ecosite phase" of Beckingham et al. (1996). It is similar to Alberta's "DMC1 Aw/Dwarf bilberry/Bearberry/Mountain ricegrass" community (Willoughby et al. 2004). Recommended stocking rates are based on average yields in ungrazed aspen stands (open and closed).

STRUCTURE

tree cover (n=26)	51% (34 – 76)	LFH thickness (n=29)	6 cm (3 – 9)
tall shrub cover (n=31)	18% (1 – 55)	litter cover (n=17)	72% (24 – 91)
short shrub cover (n=31)	16% (3 – 40)	- leaf litter (n=15)	69% (24 – 88)
prostrate shrub cover (n=31)	7% (0 – 23)	- needle litter (n=15)	0% (0 – 0)
herbaceous cover (n=31)	49% (7 – 89)	- woody material (n=16)	8% (0 – 19)
moss cover (n=31)	3% (0 – 6)	bare soil (n=20)	0% (0 – 0)
lichen cover (n=31)	1% (0 – 3)		

SPECIES COMPOSITION	**% cover**	**relative cover**
Major trees (n=26)		
trembling aspen (*Populus tremuloides*)	44% (25 - 63)	
white spruce (*Picea glauca*)	3% (0 - 10)	
white birch (*Betula papyrifera*)	2% (0 - 3)	
jack pine (*Pinus banksiana*)	1% (0 - 3)	
Major tall shrubs (n=31)		
green alder (*Alnus crispa*)	8% (0 - 38)	8% (0 - 25)
pincherry (*Prunus pensylvanica*)	4% (0 - 8)	3% (0 - 6)
saskatoon (*Amelanchier alnifolia*)	2% (0 - 5)	2% (0 - 5)
low bush-cranberry (*Viburnum edule*)	2% (0 - 6)	2% (0 - 7)
beaked hazelnut (*Corylus cornuta*)	1% (0 - 3)	2% (0 - 6)
willow (*Salix spp*., especially *S. bebbiana*)	1% (0 - 3)	1% (0 - 2)
chokecherry (*Prunus virginiana*)	1% (0 - 3)	1% (0 - 1)
Major short shrubs (n=31)		
velvet-leaf blueberry (*Vaccinium myrtilloides*)	6% (0 - 20)	6% (0 - 21)
prickly rose (*Rosa acicularis*)	5% (0 - 11)	7% (0 - 16)
wild red raspberry (*Rubus idaeus*)	1% (0 - 3)	1% (0 - 5)
few-flowered snowberry (*Symphoricarpos albus*)	1% (0 - 3)	1% (0 - 2)
Wood's rose (*Rosa woodsii*)	1% (0 - 0)	1% (0 - 0)
dwarf bilberry (*Vaccinium caespitosum*)	1% (0 - 0)	0% (0 - 0)
Major prostrate shrubs (n=31)		
twinflower (*Linnaea borealis*)	4% (0 - 10)	4% (0 - 10)
bearberry (*Arctostaphylos uva-ursi*)	3% (0 - 8)	4% (0 - 8)
dry-ground cranberry (*Vaccinium vitis-idaea*)	1% (0 - 3)	1% (0 - 2)

Major graminoids (n=31)		
grasses (undifferentiated)	8% (0 - 20)	11% (0 - 27)
hairy wild rye (*Elymus innovatus*)	2% (0 - 6)	1% (0 - 4)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 - 4)	1% (0 - 5)
sedge (*Carex spp*.)	1% (0 - 5)	1% (0 - 3)
purple oat grass (*Schizachne purpurascens*)	1% (0 - 3)	1% (0 - 2)
marsh reed grass (*Calamagrostis canadensis*)	1% (0 - 3)	0% (0 - 2)

Major forbs (n=31)		
bunchberry (*Cornus canadensis*)	5% (0 - 11)	6% (0 - 17)
wild sarsaparilla (*Aralia nudicaulis*)	5% (0 - 15)	6% (0 - 17)
northern bedstraw (*Galium boreale*)	3% (0 - 4)	3% (0 - 4)
spreading dogbane (*Apocynum androsaemifolium*)	3% (0 - 2)	2% (0 - 2)
two-leaved solomon's seal (*Maianthemum canadense*)	2% (0 - 5)	3% (0 - 7)
fireweed (*Epilobium angustifolium*)	2% (0 - 3)	2% (0 - 3)
cream-colored vetchling (*Lathyrus ochroleucus*)	2% (0 - 8)	2% (0 - 6)
smooth wild strawberry (*Fragaria virginiana*)	2% (0 - 3)	1% (0 - 5)
dewberry (*Rubus pubescens*)	1% (0 - 6)	2% (0 - 4)
wild peavine (*Lathyrus venosus*)	1% (0 - 1)	1% (0 - 2)
Lindley's aster (*Aster ciliolatus*)	1% (0 - 3)	1% (0 - 3)
American vetch (*Vicia americana*)	1% (0 - 3)	1% (0 - 2)
pink wintergreen (*Pyrola asarifolia*)	1% (0 - 3)	1% (0 - 2)
palmate-leaved colt's-foot (*Petasites palmatus*)	1% (0 - 3)	1% (0 - 3)
veiny meadow-rue (*Thalictrum venulosum*)	1% (0 - 3)	1% (0 - 2)
northern star-flower (*Trientalis borealis*)	1% (0 - 3)	1% (0 - 2)

Major bryophytes and lichens (n=24)	
Pleurozium schreberi	1% (0 - 3)

Minor tall shrubs (n=31)	0%	1%
twining honeysuckle (*Lonicera dioica*)		

Minor short shrubs (n=31)	1%	1%
labrador-tea (*Ledum groenlandicum*), blue fly honeysuckle (*Lonicera caerulea*), involucrate honeysuckle (*Lonicera involucrata*), northern gooseberry (*Ribes oxyacanthoides*), swamp red currant (*Ribes triste*), Canada buffaloberry (*Shepherdia canadensis*), narrow-leaved meadowsweet (*Spiraea alba*), western snowberry (*Symphoricarpos occidentalis*)		

Minor graminoids (n=31)	0%	0%
northern rice grass (*Oryzopsis pungens*), fowl blue grass (*Poa palustris*), Kentucky blue grass (*Poa pratensis*)		

Minor forbs and prostrate shrubs (n=31)	6%	7%

woolly yarrow (*Achillea millefolium*), baneberry (*Actaea rubra*), giant hyssop (*Agastache foeniculum*), smooth aster (*Aster laev*is), harebell (*Campanula rotundifolia*), pale comandra (*Comandra pallida*), yellow coral-root (*Corallorhiza trifida*), fairybells (*Disporum trachycarpum*), common horsetail (*Equisetum arvense*), smooth fleabane (*Erigeron glabellus*), northern comandra (*Geocaulon lividum*), dwarf rattlesnake-plantain (*Goodyera repens*), large round-leaved orchid (*Habenaria orbiculata*), Canada hawkweed (*Hieracium canadense*), creeping juniper (*Juniperus horizontalis*), wood lily (*Lilium philadelphicum*), stiff clubmoss (*Lycopodium annotinum*), ground-cedar (*Lycopodium complanatum*), ground-pine (*Lycopodium obscurum*), lungwort (*Mertensia paniculata*), bishop's-cap (*Mitella nuda*), one-sided wintergreen (*Orthilia secunda*), snakeroot (*Sanicula marilandica*), star-flowered solomon's-seal (*Smilacina stellata*), goldenrod (*Solidago spp*.), common dandelion (*Taraxacum officinale*), red clover (*Trifolium pratense*), white clover (*Trifolium repens*), early blue violet (*Viola adunca*), western Canada violet (*Viola canadensis*), kidney-leaved violet *(Viola renifolia*)

Minor bryophytes and lichens (n=24)	4%

Cladina/Cladonia spp., *Dicranum* spp., *Drepanocladus uncinatus*, *Hylocomium splendens*, *Peltigera* spp., *Ptilium crista-castrensis*, other bryophytes and lichens

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
closed stands (>50% canopy closure)	0.41	0.17
open stands (<50% canopy closure)	0.64	0.26

BT-SD-B

Aspen / Green Alder – Willow / Rose – Snowberry / Strawberry

Boreal Transition: Submesic Sand Ecosite

GENERAL DESCRIPTION: Grazed community occurring in aspen sands on the Submesic Sand Ecosite. This community is interpreted as showing **moderate alteration** from the reference community (BT-SD-A) as a result of grazing impact. Because of inconsistencies in cover estimation among data sources, only relative cover is shown for grazed communities (see Section 3 for discussion). The apparent increase in willow from BT-SD-A to BT-SD-B is surprising because most willows are palatable to browsers. Overall plant cover decreases with grazing, so the increase in relative cover of willows may reflect persistence of these tall woody plants, but not an actual increase. Recommended stocking rates are based on average yields in open stands of this community type; rates for closed stands are estimated.

STRUCTURE

tree cover	?	moss cover (n=11)	2% (0 – 4)
tall shrub cover (n=5)	5% (1 – 13)	lichen cover (n=5)	0% (0 – 1)
short shrub cover (n=5)	22% (7 – 37)	LFH thickness (n=5)	4 cm (2 – 6)
prostrate shrub cover (n=5)	3% (0 – 8)	litter cover (n=6)	77% (51 – 95)
herbaceous cover (n=11)	49% (13 – 74)	bare soil (n=11)	1% (0 – 2)

SPECIES COMPOSITION	**relative cover**
Major trees (n=11)	
trembling aspen (*Populus tremuloides*)	90% (69 – 100)
balsam poplar (*Populus balsamifera*)	6% (0 – 20)
white spruce (*Picea glauca*)	3% (0 – 7)
white birch (*Betula papyrifera*)	1% (0 – 2)
jack pine (*Pinus banksiana*)	1% (0 – 3)
Major tall shrubs (n=11)	
green alder (*Alnus crispa*)	10% (0 – 40)
willow (*Salix spp*.)	7% (0 – 19)
saskatoon (*Amelanchier alnifolia*)	1% (0 – 2)
pincherry (*Prunus pensylvanica*)	1% (0 – 2)
beaked hazelnut (*Corylus cornuta*)	1% (0 – 0)
Major short shrubs (n=11)	
prickly rose (*Rosa acicularis*)	15% (1 – 34)
snowberry (*Symphoricarpos spp*.)	7% (0 – 33)
wild red raspberry (*Rubus idaeus*)	4% (0 – 6)
velvet-leaf blueberry (*Vaccinium myrtilloides*)	3% (0 – 8)
Major prostrate shrubs (n=11)	
bearberry (*Arctostaphylos uva-ursi*)	2% (0 – 5)
twinflower (*Linnaea borealis*)	2% (0 – 4)

Major graminoids (n=11)	
sedge (*Carex spp*., especially *C. siccata*)	4% (0 – 10)
Kentucky blue grass (*Poa pratensis*)	4% (0 – 5)
purple oat grass (*Schizachne purpurascens*)	4% (0 – 17)
timber oat grass (*Danthonia intermedia*)	3% (0 – 0)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 – 1)
hairy wild rye (*Elymus innovatus*)	1% (0 – 3)
smooth brome (*Bromus inermis*)	1% (0 – 0)
marsh reed grass *(Calamagrostis canadensis)*	1% (0 – 2)

Major forbs (n=11)	
smooth wild strawberry (*Fragaria virginiana*)	5% (0 – 11)
bunchberry (*Cornus canadensis*)	3% (0 – 6)
Lindley's aster (*Aster ciliolatus*)	3% (0 – 8)
two-leaved solomon's seal (*Maianthemum canadense*)	2% (0 – 5)
dewberry (*Rubus pubescens*)	2% (0 – 11)
wild sarsaparilla (*Aralia nudicaulis*)	1% (0 – 4)
cream-colored vetchling (*Lathyrus ochroleucus*)	1% (0 – 2)
common dandelion (*Taraxacum officinale*)	1% (0 – 2)
northern bedstraw (*Galium boreale*)	1% (0 – 1)
pink wintergreen (*Pyrola asarifolia*)	1% (0 – 2)
veiny meadow-rue (*Thalictrum venulosum*)	1% (0 – 1)
fireweed (*Epilobium angustifolium*)	1% (0 – 2)

Minor tall shrubs (n=11)	1%
red-osier dogwood (*Cornus stolonifera*)	
twining honeysuckle (*Lonicera dioica*)	
chokecherry (*Prunus virginiana*)	
low bush-cranberry (*Viburnum edule*)	

Minor short shrubs (n=11)	1%
involucrate honeysuckle (*Lonicera involucrata*), northern gooseberry (*Ribes oxyacanthoides*), Canada buffaloberry (*Shepherdia canadensis*)	

Minor graminoids (n=11)	1%
slender wheat grass (*Agropyron trachycaulum var. trachycaulum*), bearded wheat grass (*Agropyron trachycaulum var. unilaterale*), fringed brome (*Bromus ciliatus*), muhly (*Muhlenbergia spp*.), northern rice grass (*Oryzopsis pungens*)	

Minor forbs and prostrate shrubs (n=11)	4%
woolly yarrow (*Achillea millefolium*), prairie everlasting (*Antennaria neglecta*), prairie sage (*Artemisia ludoviciana*), smooth aster (*Aster laevis*), harebell (*Campanula rotundifolia*), pale comandra (*Comandra pallida*), Philadelphia fleabane (*Erigeron philadelphicus*), common blue lettuce (*Lactuca pulchella*), wild peavine (*Lathyrus venosus*), ground-cedar (*Lycopodium complanatum*), fringed loosestrife (*Lysimachia ciliata*), lungwort (*Mertensia paniculata*), palmate-leaved colt's-foot (*Petasites palmatus*), star-flowered solomon's-seal (*Smilacina* stellata), golden bean (*Thermopsis rhombifolia*), northern star-flower (*Trientalis borealis*), dry-ground cranberry (*Vaccinium vitis-idaea*), American vetch (*Vicia americana*), early blue violet (*Viola adunca*), western Canada violet (*Viola canadensis*), heart-leaved alexanders (*Zizia aptera*)	

SIMILARITY TO REFERENCE COMMUNITY	50%

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
closed stands (>50% canopy closure)	(0.20)	(0.08)
open stands (<50% canopy closure)	0.30	0.12

BT-SD-C

Aspen / Hazelnut / Sarsaparilla - Bunchberry

Boreal Transition: Submesic Sand Ecosite

GENERAL DESCRIPTION: **Reference community** for aspen stands with a dense hazelnut understory on the Submesic Sand Ecosite. More research is needed on the ecological differences between this community and BT-SD-A (Aspen / Green Alder / Blueberry / Grass). The species composition of BT-SD-C appears to indicate a more mesic moisture regime, but the available data do not show any consistent differences in site variables (e.g. slope position, soil texture, drainage class) between the two communities. BT-SD-C is less common than BT-SD-A, but appears to occur throughout the region. This community is similar in species composition to aspen-hazelnut stands on the Mesic Loam Ecosite (BT-LM-E), but the the coarser soil texture is reflected in greater abundance of green alder, velvet-leaf blueberry, bearberry, and bunchberry. Recommended stocking rates are based on average yields in ungrazed aspen-hazelnut stands.

STRUCTURE

tree cover (n=9)	51% (35 – 67)	LFH thickness (n=11)	9 cm (6 – 10)
tall shrub cover (n=11)	55% (20 – 95)	litter cover (n=6)	82% (66 – 92)
short shrub cover (n=11)	11% (3 – 21)	- leaf litter (n=5)	79% (61 – 88)
prostrate shrub cover (n=11)	6% (0 – 15)	- needle litter (n=5)	0% (0 – 0)
herbaceous cover (n=11)	37% (10 – 61)	- woody material (n=5)	8% (3 – 16)
moss cover (n=11)	2% (0 – 5)	bare soil (n=8)	0% (0 – 0)
lichen cover (n=11)	1% (0 – 1)		

SPECIES COMPOSITION	**% cover**	**relative cover**
Major trees (n=9)		
trembling aspen (*Populus tremuloides*)	48% (32 - 63)	
white spruce (*Picea glauca*)	3% (0 - 11)	
Major tall shrubs (n=11)		
beaked hazelnut (*Corylus cornuta*)	47% (19 - 80)	44% (15 - 69)
pincherry (*Prunus pensylvanica*)	3% (0 - 5)	3% (0 - 3)
green alder (*Alnus crispa*)	2% (0 - 3)	1% (0 - 2)
saskatoon (*Amelanchier alnifolia*)	1% (0 - 3)	1% (0 - 2)
low bush-cranberry (*Viburnum edule*)	1% (0 - 3)	1% (0 - 2)
willow (*Salix spp.*)	1% (0 - 3)	0% (0 - 2)
twining honeysuckle (*Lonicera dioica*)	1% (0 - 3)	1% (0 - 2)
Major short shrubs (n=11)		
prickly rose (*Rosa acicularis*)	4% (0 - 11)	4% (0 - 10)
Canada buffaloberry (*Shepherdia canadensis*)	3% (0 - 3)	3% (0 - 2)
velvet-leaf blueberry (*Vaccinium myrtilloides*)	1% (0 - 3)	1% (0 - 3)
few-flowered snowberry (*Symphoricarpos albus*)	1% (0 - 4)	1% (0 - 4)
wild red raspberry (*Rubus idaeus*)	1% (0 - 3)	1% (0 - 2)
Major prostrate shrubs (n=11)		
twinflower (*Linnaea borealis*)	4% (0 - 10)	4% (0 - 10)
bearberry (*Arctostaphylos uva-ursi*)	1% (0 - 1)	1% (0 - 1)

Major graminoids (n=11)		
hairy wild rye (*Elymus innovatus*)	2% (0 - 4)	2% (0 - 3)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 - 5)	2% (0 - 5)
purple oat grass (*Schizachne purpurascens*)	1% (0 - 3)	1% (0 - 2)
marsh reed grass (*Calamagrostis canadensis*)	1% (0 - 3)	0% (0 - 2)
sedge (*Carex spp*.)	1% (0 - 3)	1% (0 - 2)

Major forbs (n=11)		
wild sarsaparilla (*Aralia nudicaulis*)	6% (1 - 11)	5% (1 - 10)
bunchberry (*Cornus canadensis*)	5% (0 - 11)	4% (0 - 10)
dewberry (*Rubus pubescens*)	2% (0 - 10)	2% (0 - 7)
two-leaved solomon's seal (*Maianthemum canadense*)	2% (0 - 4)	2% (0 - 4)
fireweed (*Epilobium angustifolium*)	2% (0 - 3)	2% (0 - 3)
cream-colored vetchling (*Lathyrus ochroleucus*)	2% (0 - 3)	1% (0 - 3)
pink wintergreen (*Pyrola asarifolia*)	1% (0 - 3)	1% (0 - 2)
smooth wild strawberry (*Fragaria virginiana*)	1% (0 - 3)	1% (0 - 3)
spreading dogbane (*Apocynum androsaemifolium*)	1% (0 - 3)	1% (0 - 2)
northern bedstraw (*Galium boreale*)	1% (0 - 2)	1% (0 - 2)
northern star-flower (*Trientalis borealis*)	1% (0 - 3)	1% (0 - 2)
Lindley's aster (*Aster ciliolatus*)	1% (0 - 3)	1% (0 - 2)
fairybells (*Disporum trachycarpum*)	1% (0 - 3)	0% (0 - 2)
baneberry (*Actaea rubra*)	1% (0 - 3)	0% (0 - 2)
one-sided wintergreen (*Orthilia secunda*)	1% (0 - 3)	0% (0 - 2)

Major bryophytes and lichens (n=8)	
Pleurozium schreberi	1% (0 - 3)
Dicranum spp.	1% (0 - 3)

Minor tall shrubs (n=11)	1%	1%
red-osier dogwood (*Cornus stolonifera*), chokecherry (*Prunus virginiana*)		

Minor short shrubs (n=11)	1%	1%
involucrate honeysuckle (*Lonicera involucrata*), poison-ivy (*Rhus radicans*), northern gooseberry (*Ribes oxyacanthoides*), swamp red currant (*Ribes triste*), Wood's rose (*Rosa woodsii*), shining-leaved meadowsweet (*Spiraea betulifolia*), western snowberry (*Symphoricarpos occidentalis*), dwarf bilberry (*Vaccinium caespitosum*)		

Minor graminoids (n=11)	1%	1%
Kentucky blue grass (*Poa pratensis*)		

Minor forbs and prostrate shrubs (n=11)	4%	3%
showy aster (*Aster conspicuus*), meadow horsetail (*Equisetum pratense*), sweet-scented bedstraw (*Galium triflorum*), fringed loosestrife (*Lysimachia ciliata*), lungwort (*Mertensia paniculata*), bishop's-cap (*Mitella nuda*), palmate-leaved colt's-foot (*Petasites palmatus*), goldenrod (*Solidago spp*.), veiny meadow-rue (*Thalictrum venulosum*), dry-ground cranberry (*Vaccinium vitis-idaea*), American vetch (*Vicia americana*), early blue violet (*Viola adunca*), kidney-leaved violet (*Viola renifolia*)		

Minor bryophytes and lichens (n=8) *Cladina/Cladonia* spp., *Peltigera* spp., other bryophytes and lichens	2%

RECOMMENDED STOCKING RATES	0.23 AUM/ha	0.09 AUM/ac

BT-SD-D

Aspen - White Spruce - Jack Pine / Blueberry / Bearberry / Sarsaparilla / Feather Moss

Boreal Transition: Submesic Sand Ecosite

GENERAL DESCRIPTION: **Reference community** for mixedwood stands on the Submesic Sand Ecosite. This community is comparable to the "b1 blueberry jP-tA" and "b3 blueberry tA-wS" ecosite phases of Beckingham *et al*. (1996). It is similar to Alberta's "DMD2 Pj-Aw/Bearberry" community (Willoughby *et al*. 2004). Recommended stocking rates are based on reducing the hardwood-stand yield in proportion to the amount of conifer cover.

STRUCTURE

tree cover (n=30)	65% (30 – 100)	LFH thickness (n=30)	7 cm (3 – 12)
tall shrub cover (n=30)	10% (0 – 23)	litter cover (n=14)	57% (21 – 88)
short shrub cover (n=30)	14% (1 – 28)	- leaf litter (n=14)	52% (19 – 88)
prostrate shrub cover (n=30)	9% (0 – 23)	- needle litter (n=14)	5% (0 – 11)
herbaceous cover (n=30)	39% (6 – 81)	- woody material (n=12)	10% (0 – 34)
moss cover (n=30)	22% (1 – 73)	bare soil (n=14)	0% (0 – 0)
lichen cover (n=30)	5% (0 – 5)		

SPECIES COMPOSITION	**% cover**	**relative cover**
Major trees (n=30)		
trembling aspen (*Populus tremuloides*)	32% (10 - 63)	
white spruce (*Picea glauca*)	21% (0 - 38)	
jack pine (*Pinus banksiana*)	11% (0 - 38)	
black spruce (*Picea mariana*)	4% (0 - 10)	
white birch (*Betula papyrifera*)	2% (0 - 10)	
balsam fir (*Abies balsamea*)	1% (0 - 0)	
Major tall shrubs (n=30)		
green alder (*Alnus crispa*)	4% (0 - 10)	4% (0 - 11)
low bush-cranberry (*Viburnum edule*)	1% (0 - 3)	2% (0 - 8)
beaked hazelnut (*Corylus cornuta*)	1% (0 - 3)	1% (0 - 4)
willow (*Salix spp*., especially *S. bebbiana*)	1% (0 - 3)	1% (0 - 3)
saskatoon (*Amelanchier alnifolia*)	1% (0 - 3)	1% (0 - 3)
twining honeysuckle (*Lonicera dioica*)	1% (0 - 3)	1% (0 - 3)
pincherry (*Prunus pensylvanica*)	1% (0 - 3)	1% (0 - 2)
Major short shrubs (n=30)		
velvet-leaf blueberry (*Vaccinium myrtilloides*)	6% (0 - 19)	7% (0 - 20)
prickly rose (*Rosa acicularis*)	3% (0 - 10)	6% (0 - 13)
labrador-tea (*Ledum groenlandicum*)	2% (0 - 3)	2% (0 - 5)
Canada buffaloberry (*Shepherdia canadensis*)	1% (0 - 3)	1% (0 - 2)
few-flowered snowberry (*Symphoricarpos albus*)	1% (0 - 3)	2% (0 - 3)
wild red raspberry (*Rubus idaeus*)	1% (0 - 3)	1% (0 - 3)

Major prostrate shrubs (n=30)		
bearberry (*Arctostaphylos uva-ursi*)	5% (0 - 8)	6% (0 - 22)
twinflower (*Linnaea borealis*)	2% (0 - 3)	5% (0 - 9)
dry-ground cranberry (*Vaccinium vitis-idaea*)	2% (0 - 3)	2% (0 - 4)

Major graminoids (n=30)		
grasses (undifferentiated)	3% (0 - 3)	5% (0 - 12)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	1% (0 - 3)	1% (0 - 2)
hairy wild rye (*Elymus innovatus*)	1% (0 - 3)	2% (0 - 3)
sedge (*Carex* spp.)	1% (0 - 3)	1% (0 - 3)
northern rice grass (*Oryzopsis pungens*)	1% (0 - 0)	1% (0 - 0)

Major forbs (n=30)		
wild sarsaparilla (*Aralia nudicaulis*)	5% (0 - 11)	8% (0 - 24)
bunchberry (*Cornus canadensis*)	3% (0 - 10)	5% (0 - 12)
ground-cedar (*Lycopodium complanatum*)	2% (0 - 1)	2% (0 - 4)
two-leaved solomon's seal (*Maianthemum canadense*)	2% (0 - 3)	3% (0 - 7)
sweet-scented bedstraw (*Galium triflorum*)	2% (0 - 0)	2% (0 - 0)
dewberry (*Rubus pubescens*)	2% (0 - 3)	2% (0 - 6)
cream-colored vetchling (*Lathyrus ochroleucus*)	1% (0 - 3)	1% (0 - 3)
fireweed (*Epilobium angustifolium*)	1% (0 - 3)	1% (0 - 3)
northern bedstraw (*Galium boreale*)	1% (0 - 3)	1% (0 - 3)
smooth wild strawberry (*Fragaria virginiana*)	1% (0 - 3)	1% (0 - 4)
northern star-flower (*Trientalis borealis*)	1% (0 - 3)	2% (0 - 4)
one-sided wintergreen (*Orthilia secunda*)	1% (0 - 3)	1% (0 - 3)
Lindley's aster (*Aster ciliolatus*)	1% (0 - 3)	1% (0 - 2)
kidney-leaved violet (*Viola renifolia*)	1% (0 - 3)	2% (0 - 4)
goldenrod (*Solidago spp.*)	1% (0 - 3)	1% (0 - 2)
stiff clubmoss (*Lycopodium annotinum*)	1% (0 - 3)	1% (0 - 3)
palmate-leaved colt's-foot (*Petasites palmatus*)	1% (0 - 3)	1% (0 - 2)
veiny meadow-rue (*Thalictrum venulosum*)	1% (0 - 1)	1% (0 - 2)
American vetch (*Vicia americana*)	1% (0 - 3)	0% (0 - 2)

Major bryophytes and lichens (n=30)	
Pleurozium schreberi	11% (0 - 38)
Hylocomium splendens	7% (0 - 21)
Usnea lapponica	1% (0 - 0)
Hypogymnia physodes	1% (0 - 0)
Dicranum spp.	1% (0 - 3)
Peltigera spp.	1% (0 - 3)
Ptilium crista-castrensis	1% (0 - 3)
Cladina/Cladonia spp.	1% (0 - 3)

Minor tall shrubs (n=30)	0%	1%
red-osier dogwood (*Cornus stolonifera*), chokecherry (*Prunus virginiana*)		

Minor short shrubs (n=30)	1%	2%
blue fly honeysuckle (*Lonicera caerulea*), bristly black currant (*Ribes lacustre*), northern gooseberry (*Ribes oxyacanthoides*), swamp red currant (*Ribes triste*), western snowberry (*Symphoricarpos occidentalis*)		

Minor graminoids (n=30)	1%	1%
slender wheat grass (*Agropyron trachycaulum var. trachycaulum*), fringed brome (*Bromus ciliatus*), marsh reed grass (*Calamagrostis canadensis*), sweet grass (*Hierochloe odorata*), Kentucky blue grass (*Poa pratensis*), purple oat grass (*Schizachne purpurascens*)		

Minor forbs and prostrate shrubs (n=30)	6%	10%
woolly yarrow (*Achillea millefolium*), baneberry (*Actaea rubra*), cut-leaved anemone (*Anemone multifida*), spreading dogbane (*Apocynum androsaemifolium*), showy aster (*Aster conspicuus*), harebell (*Campanula rotundifolia*), prince's-pine (*Chimaphila umbellata*), pale comandra (*Comandra pallida*), golden-thread (*Coptis trifolia*), spotted coral-root (*Corallorhiza maculata*), common horsetail (*Equisetum arvense*), meadow horsetail (*Equisetum pratense*), woodland strawberry (*Fragaria vesca*), northern comandra (*Geocaulon lividum*), dwarf rattlesnake-plantain (*Goodyera repens*), Canada hawkweed (*Hieracium canadense*), creeping juniper (*Juniperus horizontalis*), wood lily (*Lilium philadelphicum*), ground-pine (*Lycopodium obscurum*), cow-wheat (*Melampyrum lineare*), lungwort (*Mertensia paniculata*), bishop's-cap (*Mitella nuda*), one-flowered Indian-pipe (*Monotropa uniflora*), arrow-leaved colt's-foot (*Petasites sagittatus*), three-toothed cinquefoil (*Potentilla tridentata*), pink wintergreen (*Pyrola asarifolia*), green wintergreen (*Pyrola chlorantha*), star-flowered solomon's-seal (*Smilacina stellata*), early blue violet (*Viola adunca*), western Canada violet (*Viola canadensis*)		

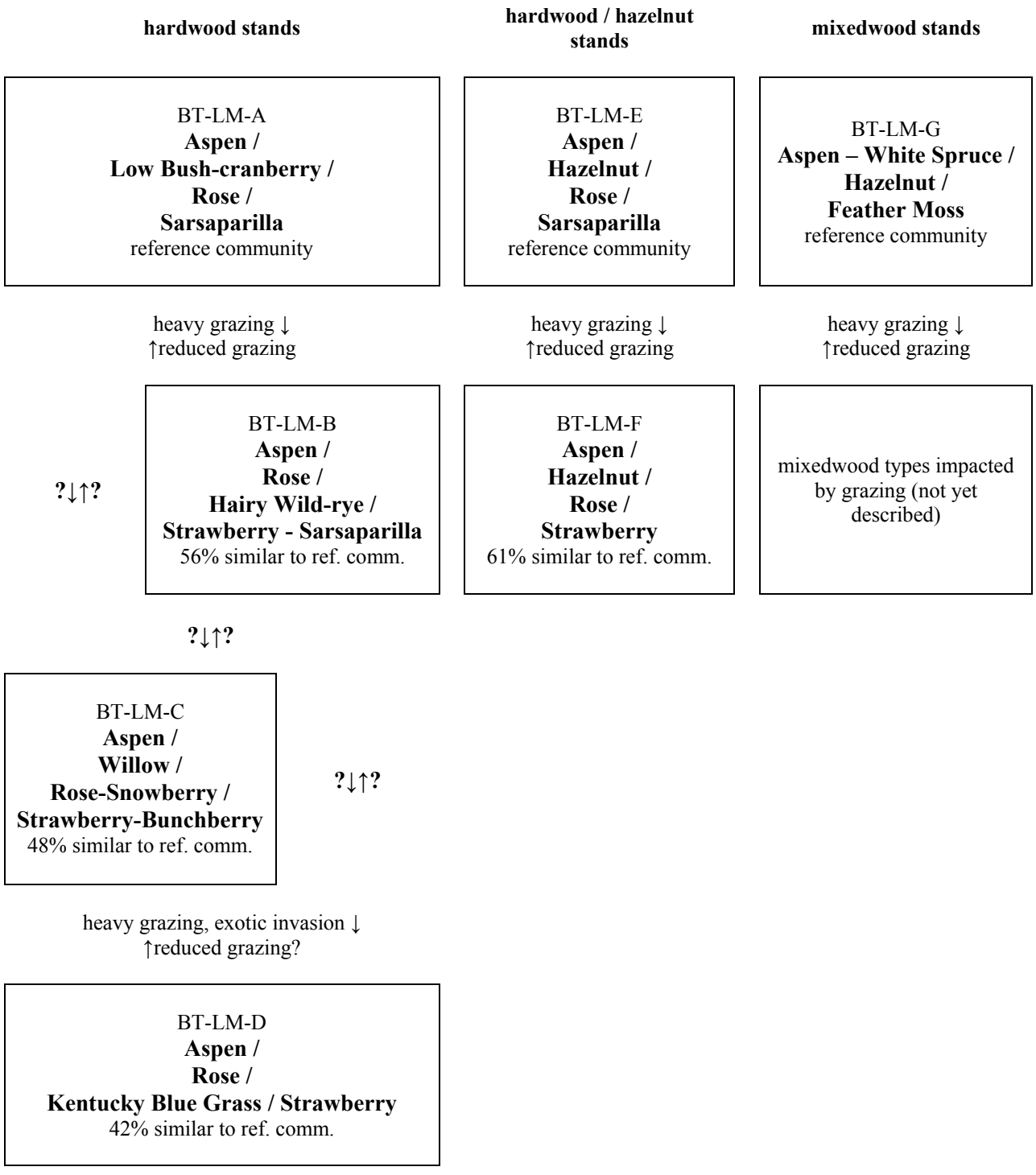
Minor bryophytes and lichens (n=30)	1%
Drepanocladus uncinatus, other bryophytes and lichens	

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
conifer cover 10%	0.38	0.15
conifer cover 20%	0.35	0.14
conifer cover 30%	0.31	0.13
conifer cover 40%	0.28	0.11
conifer cover 50%	0.25	0.10
conifer cover 60%	0.22	0.09
conifer cover 70%	0.18	0.07

5.2.2 Mesic Loam Ecosite

This ecosite includes mesic sites (i.e. sites with intermediate moisture availability) with effective textures of loam, silt loam, clay loam, or clay. These sites mainly occur on morainal or glacio-lacustrine landforms. Soils are predominantly Gray Luvisols. The drainage class is usually rated as "well drained" or "moderately well drained". Gleying is absent, while mottling is either absent or occurs only in the lower part of the soil profile (moderately well drained soils). The moisture regime would be rated as "mesic" (AEP 1994, Beckingham et al. 1996) or "very fresh" (SE 2004). This ecosite is comparable to the "d – low-bush cranberry ecosite" of Beckingham et al. (1996).

STATE-AND-TRANSITION DIAGRAM
Boreal Transition: Mesic Loam Ecosite



BT-LM-A

Aspen / Low Bush-cranberry / Rose / Sarsaparilla

Boreal Transition: Mesic Loam Ecosite

GENERAL DESCRIPTION: **Reference community** for aspen stands on the Mesic Loam Ecosite. Stands dominated by white birch also occur on this ecosite, but data were insufficient to characterize them. This community is comparable to the "d2 low-bush cranberry tA ecosite phase" of Beckingham et al. (1996), and within that is most similar to the "d2.4 tA/low-bush cranberry-prickly rose community type". It is similar to Alberta's "DMC2 Aw/Rose/Tall forb" community (Willoughby et al. 2004). Recommended stocking rates are based on average yields in ungrazed aspen stands (open and closed).

STRUCTURE

tree cover (n=25)	64% (37 – 89)	LFH thickness (n=26)	8 cm (4 – 12)
tall shrub cover (n=37)	15% (4 – 27)	litter cover (n=21)	86% (76 – 96)
short shrub cover (n=37)	16% (2 – 27)	- leaf litter (n=18)	84% (75 – 88)
prostrate shrub cover (n=26)	3% (0 – 10)	- needle litter (n=18)	0% (0 – 0)
herbaceous cover (n=36)	51% (16 – 100)	- woody material (n=19)	10% (1 – 20)
moss cover (n=26)	4% (0 – 13)	bare soil (n=22)	0% (0 – 0)
lichen cover (n=26)	2% (0 – 4)		

SPECIES COMPOSITION	% cover	relative cover
Major trees (n=25)		
trembling aspen (*Populus tremuloides*)	55% (33 - 88)	
white spruce (*Picea glauca*)	4% (0 - 10)	
white birch (*Betula papyrifera*)	3% (0 - 3)	
balsam poplar (*Populus balsamifera*)	3% (0 - 10)	
balsam fir (*Abies balsamea*)	1% (0 - 3)	
Major tall shrubs (n=37)		
low bush-cranberry (*Viburnum edule*)	4% (0 – 12)	4% (0 – 13)
saskatoon (*Amelanchier alnifolia*)	3% (0 – 11)	2% (0 – 8)
beaked hazelnut (*Corylus cornuta*)	2% (0 – 9)	4% (0 – 16)
green alder (*Alnus crispa*)	2% (0 – 4)	5% (0 – 17)
willow (*Salix spp*.)	1% (0 – 4)	1% (0 – 3)
red-osier dogwood (*Cornus stolonifera*)	1% (0 – 3)	1% (0 – 3)
chokecherry (*Prunus virginiana*)	1% (0 – 1)	1% (0 – 5)
Major short shrubs (n=37)		
prickly rose (*Rosa acicularis*)	8% (1 – 16)	7% (1 – 18)
wild red raspberry (*Rubus idaeus*)	2% (0 – 6)	2% (0 – 6)
snowberry (*Symphoricarpos spp*.)	2% (0 – 4)	2% (0 – 4)
Wood's rose (*Rosa woodsii*)	1% (0 – 0)	1% (0 – 2)
alder-leaved buckthorn (*Rhamnus alnifolia*)	1% (0 – 2)	1% (0 – 3)
Major prostrate shrubs (n=26)		
twinflower (*Linnaea borealis*)	3% (0 – 10)	4% (0 – 10)

Major graminoids (n=26)		
grasses (undifferentiated)	2% (0 – 3)	3% (0 – 11)
marsh reed grass (*Calamagrostis canadensis*)	1% (0 – 4)	1% (0 – 3)
hairy wild rye (*Elymus innovatus*)	1% (0 – 3)	1% (0 – 2)
slender wheat grass (*Agropyron trachycaulum var. trachycaulum*)	1% (0 – 0)	0% (0 – 0)

Major forbs (n=26)		
wild sarsaparilla (*Aralia nudicaulis*)	9% (0 – 20)	12% (0 – 25)
bunchberry (*Cornus canadensis*)	7% (0 – 20)	8% (0 – 18)
fireweed (*Epilobium angustifolium*)	4% (0 – 15)	3% (0 – 10)
dewberry (*Rubus pubescens*)	3% (0 – 7)	4% (0 – 11)
smooth wild strawberry (*Fragaria virginiana*)	2% (0 – 6)	3% (0 – 7)
cream-colored vetchling (*Lathyrus ochroleucus*)	2% (0 – 7)	2% (0 – 5)
two-leaved solomon's seal (*Maianthemum canadense*)	2% (0 – 4)	3% (0 – 5)
palmate-leaved colt's-foot (*Petasites palmatus*)	2% (0 – 5)	2% (0 – 4)
northern bedstraw (*Galium boreale*)	1% (0 – 3)	2% (0 – 4)
Lindley's aster (*Aster ciliolatus*)	1% (0 – 5)	1% (0 – 4)
lungwort (*Mertensia paniculata*)	1% (0 – 3)	2% (0 – 3)
pink wintergreen (*Pyrola asarifolia*)	1% (0 – 3)	1% (0 – 2)
American vetch (*Vicia americana*)	1% (0 – 3)	1% (0 – 2)
western Canada violet (*Viola canadensis*)	1% (0 – 3)	1% (0 – 3)
veiny meadow-rue (*Thalictrum venulosum*)	1% (0 – 2)	1% (0 – 1)

Major bryophytes and lichens (n=22)	
Cladina/Cladonia spp.	1% (0 – 5)
Peltigera spp.	1% (0 – 2)
Dicranum spp.	1% (0 – 1)
Drepanocladus uncinatus	1% (0 – 0)

Minor tall shrubs (n=37)	1%	2%
mountain maple (*Acer spicatum*), speckled alder (*Alnus tenuifolia*), twining honeysuckle (*Lonicera dioica*), pincherry (*Prunus pensylvanica*), high bush-cranberry (*Viburnum opulus*)		

Minor short shrubs (n=37)	2%	4%
labrador-tea (*Ledum groenlandicum*), involucrate honeysuckle (*Lonicera involucrata*), swamp fly honeysuckle (*Lonicera oblongifolia*), northern gooseberry (*Ribes oxyacanthoides*), swamp red currant (*Ribes triste*), Canada buffaloberry (*Shepherdia canadensis*), shining-leaved meadowsweet (*Spiraea betulifolia*), velvet-leaf blueberry (*Vaccinium myrtilloides*)		

Minor graminoids (n=36)	1%	1%
fringed brome (*Bromus ciliatus*), sedge (*Carex spp.*), white-grained mountain rice grass (*Oryzopsis asperifolia*), purple oat grass (*Schizachne purpurascens*)		

Minor forbs and prostrate shrubs (n=26)	7%	7%

woolly yarrow (*Achillea millefolium*), baneberry (*Actaea rubra*), giant hyssop (*Agastache foeniculum*), Canada anemone (*Anemone canadensis*), spreading dogbane (*Apocynum androsaemifolium*), bearberry (*Arctostaphylos uva-ursi*), showy aster (*Aster conspicuus*), fairybells (*Disporum trachycarpum*), common horsetail (*Equisetum arvense*), horsetail (*Equisetum spp.*), woodland strawberry (*Fragaria vesca*), sweet-scented bedstraw (*Galium triflorum*), blunt-leaved orchid (*Habenaria obtusata*), cow-parsnip (*Heracleum lanatum*), wild peavine (*Lathyrus venosus*), stiff clubmoss (*Lycopodium annotinum*), bishop's-cap (*Mitella nuda*), one-sided wintergreen (*Orthilia secunda*), blunt-fruited sweet cicely (*Osmorhiza depauperata*), arrow-leaved colt's-foot (Petasites sagittatus), green wintergreen (*Pyrola chlorantha*), common shinleaf (*Pyrola elliptica*), stemless raspberry (*Rubus acaulis*), snakeroot (*Sanicula marilandica*), star-flowered solomon's-seal (*Smilacina stellata*), goldenrod (Solidago spp.), common dandelion (*Taraxacum officinale*), meadow-rue (*Thalictrum spp.*), northern star-flower (*Trientalis borealis*), kidney-leaved violet (*Viola renifolia*)

Minor bryophytes and lichens (n=22)	4%

Hylocomium splendens, Pleurozium schreberi, other bryophytes and lichens

RECOMMENDED STOCKING RATES	AUM/ha	AUM/ac
closed stands (>50% canopy closure)	0.41	0.17
open stands (<50% canopy closure)	0.64	0.26

BT-LM-B

Aspen / Rose / Hairy Wild-rye / Strawberry – Sarsaparilla

Boreal Transition: Mesic Loam Ecosite

GENERAL DESCRIPTION: Grazed community occurring in aspen stands on the Mesic Loam Ecosite. This community is interpreted as showing **moderate alteration** from the reference community (BT-LM-A) as a result of grazing impact. It includes grazed stands in which the cover of native grasses has apparently increased. Because of inconsistencies in cover estimation among data sources, only relative cover is shown for grazed communities (see Section 3 for discussion). Because of the relatively high grass production, the recommended stocking rate is unchanged from the reference community.

STRUCTURE

tree cover	?	moss cover (n=14)	1% (0 – 3)
tall shrub cover	?	lichen cover	?
short shrub cover	?	LFH thickness	?
prostrate shrub cover	?	litter cover (n=13)	87% (76 – 94)
herbaceous cover (n=17)	68% (39 – 85)	bare soil (n=14)	1% (0 – 1)

SPECIES COMPOSITION	**relative cover**
Major trees (n=13)	
trembling aspen (*Populus tremuloides*)	85% (78 – 93)
balsam poplar (*Populus balsamifera*)	12% (7 – 19)
white spruce (*Picea glauca*)	2% (0 – 9)
Major tall shrubs (n=16)	
willow (*Salix spp*.)	5% (2 – 9)
green alder (*Alnus crispa*)	3% (0 – 13)
beaked hazelnut (*Corylus cornuta*)	3% (0 – 8)
low bush-cranberry (*Viburnum edule*)	2% (0 – 8)
saskatoon (*Amelanchier alnifolia*)	2% (0 – 4)
Major short shrubs (n=16)	
prickly rose (*Rosa acicularis*)	13% (4 – 23)
wild red raspberry (*Rubus idaeus*)	4% (0 – 9)
snowberry (*Symphoricarpos spp*.)	3% (1 – 5)
Canada buffaloberry (*Shepherdia canadensis*)	1% (0 – 2)
Major prostrate shrubs (n=16)	
twinflower (*Linnaea borealis*)	1% (0 – 3)
bearberry (*Arctostaphylos uva-ursi*)	1% (0 – 4)
Major graminoids (n=16)	
hairy wild rye (*Elymus innovatus*)	8% (1 – 12)
purple oat grass (*Schizachne purpurascens*)	3% (0 – 11)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 – 4)
marsh reed grass (*Calamagrostis canadensis*)	2% (0 – 5)
bearded wheat grass (*Agropyron trachycaulum var. unilaterale*)	1% (0 – 2)
fringed brome (*Bromus ciliatus*)	1% (0 – 2)

Major forbs (n=16)	
smooth wild strawberry (*Fragaria virginiana*)	8% (3 – 13)
wild sarsaparilla (*Aralia nudicaulis*)	6% (0 – 13)
bunchberry (*Cornus canadensis*)	5% (1 – 10)
violet (*Viola spp*.)	3% (0 – 6)
Lindley's aster (*Aster ciliolatus*)	3% (0 – 6)
pink wintergreen (*Pyrola asarifolia*)	3% (0 – 6)
wild peavine (*Lathyrus venosus*)	2% (0 – 7)
northern bedstraw (*Galium boreale*)	2% (0 – 4)
two-leaved solomon's seal (*Maianthemum canadense*)	2% (0 – 4)
cream-colored vetchling (*Lathyrus ochroleucus*)	1% (0 – 4)
lungwort (*Mertensia paniculata*)	1% (0 – 3)
fireweed (*Epilobium angustifolium*)	1% (0 – 2)
showy aster (*Aster conspicuus*)	1% (0 – 2)
dewberry (*Rubus pubescens*)	1% (0 – 3)
goldenrod (*Solidago spp*.)	1% (0 – 2)
American vetch (*Vicia americana*)	1% (0 – 1)
palmate-leaved colt's-foot (*Petasites palmatus*)	1% (0 – 2)
veiny meadow-rue (*Thalictrum venulosum*)	1% (0 – 2)
northern gentian (*Gentianella amarella*)	1% (0 – 2)
snakeroot (*Sanicula marilandica*)	1% (0 – 2)
cow-parsnip (*Heracleum lanatum*)	1% (0 – 2)
common dandelion (*Taraxacum officinale*)	1% (0 – 1)

Minor trees (n=13)	0%
white birch (*Betula papyrifera*)	

Minor tall shrubs (n=16)	0%
red-osier dogwood (*Cornus stolonifera*), twining honeysuckle (*Lonicera dioica*), pincherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*), high bush-cranberry (*Viburnum opulus*)	

Minor short shrubs (n=16)	1%
northern gooseberry (*Ribes oxyacanthoides*), dwarf bilberry (*Vaccinium caespitosum*), velvet-leaf blueberry (*Vaccinium myrtilloides*)	

Minor graminoids (n=16)	1%
slender wheat grass (*Agropyron trachycaulum var. trachycaulum*), hay sedge (*Carex siccata*), Canada blue grass (*Poa compressa*), Kentucky blue grass (*Poa pratensis*)	

Minor forbs and half-shrubs (n=16)	1%
woolly yarrow (*Achillea millefolium*), red Indian paintbrush (*Castilleja miniata*), pale comandra (*Comandra pallida*), fairybells (*Disporum trachycarpum*), common horsetail (*Equisetum arvense*), sweet-scented bedstraw (*Galium triflorum*), Canada hawkweed (*Hieracium canadense*), bishop's-cap (*Mitella nuda*), common plantain (*Plantago major*), star-flowered solomon's-seal (*Smilacina stellata*), meadow-rue (*Thalictrum spp*.), clover (*Trifolium spp*.)	

SIMILARITY TO REFERENCE COMMUNITY	56%

RECOMMENDED STOCKING RATES	AUM/ha	AUM/ac
closed stands (>50% canopy closure)	0.41	0.17
open stands (<50% canopy closure)	0.64	0.26

BT-LM-C

Aspen / Willow / Rose-Snowberry / Strawberry-Bunchberry

Boreal Transition: Mesic Loam Ecosite

GENERAL DESCRIPTION: Grazed community occurring in aspen stands on the Mesic Loam Ecosite. This community is interpreted to show **moderate alteration** from the reference community (BT-LM-A) as a result of grazing impact. It includes grazed stands in which short shrubs have increased in relative cover. It is comparable to Alberta's "DMC3 Aw/Rose/Low forb" community (Willoughby *et al.* 2004). Because of inconsistencies in cover estimation among data sources, only relative cover is shown for grazed communities (see Section 3 for discussion). The apparent increase in willow with grazing is surprising, because most willows are palatable to browsers. Overall plant cover decreases with grazing, so the increase in relative cover of willows may reflect persistence of these tall woody plants, but not an actual increase. No yield data were available; recommended stocking rates are estimated at 75% of the rate in the reference community.

STRUCTURE

tree cover	?	moss cover (n=26)	1% (0 – 2)
tall shrub cover (n=10)	6% (1 – 15)	lichen cover	?
short shrub cover (n=10)	11% (3 – 19)	LFH thickness	?
prostrate shrub cover	?	litter cover (n=25)	89% (77 – 98)
herbaceous cover (n=34)	54% (20 – 77)	bare soil (n=26)	1% (0 – 2)

SPECIES COMPOSITION	relative cover
Major trees (n=24)	
trembling aspen (*Populus tremuloides*)	93% (83 – 100)
balsam poplar (*Populus balsamifera*)	6% (0 – 17)
white spruce (*Picea glauca*)	1% (0 – 0)
Major tall shrubs (n=24)	
willow (*Salix spp*.)	8% (1 – 20)
green alder (*Alnus crispa*)	2% (0 – 5)
beaked hazelnut (*Corylus cornuta*)	1% (0 – 7)
saskatoon (*Amelanchier alnifolia*)	1% (0 – 2)
Major short shrubs (n=24)	
prickly rose (*Rosa acicularis*)	25% (11 – 35)
snowberry (*Symphoricarpos spp*.)	10% (0 – 23)
wild red raspberry (*Rubus idaeus*)	4% (0 – 12)
Canada buffaloberry (*Shepherdia canadensis*)	1% (0 – 3)
velvet-leaf blueberry (*Vaccinium myrtilloides*)	1% (0 – 2)
Major prostrate shrubs (n=24)	
twinflower (*Linnaea borealis*)	2% (0 – 5)
Major graminoids (n=24)	
hairy wild rye (*Elymus innovatus*)	3% (0 – 8)
marsh reed grass (*Calamagrostis canadensis*)	1% (0 – 2)
purple oat grass (*Schizachne purpurascens*)	1% (0 – 3)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	1% (0 – 1)

Major forbs (n=24)	
smooth wild strawberry (*Fragaria virginiana*)	7% (3 – 12)
bunchberry (*Cornus canadensis*)	7% (1 – 17)
dewberry (*Rubus pubescens*)	5% (0 – 10)
pink wintergreen (*Pyrola asarifolia*)	4% (0 – 7)
Lindley's aster (*Aster ciliolatus*)	3% (0 – 7)
wild sarsaparilla (*Aralia nudicaulis*)	2% (0 – 7)
lungwort (*Mertensia paniculata*)	1% (0 – 4)
fireweed (*Epilobium angustifolium*)	1% (0 – 3)
aster (*Aster spp*.)	1% (0 – 3)
palmate-leaved colt's-foot (*Petasites palmatus*)	1% (0 – 2)
two-leaved solomon's seal (*Maianthemum canadense*)	1% (0 – 2)
violet (*Viola spp*.)	1% (0 – 2)
northern bedstraw (*Galium boreale*)	1% (0 – 1)
wild peavine (*Lathyrus venosus*)	1% (0 – 2)

Minor tall shrubs (n=24) 1%
twining honeysuckle (*Lonicera dioica*), pincherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*), low bush-cranberry (*Viburnum edule*)

Minor short shrubs (n=24) 1%
swamp birch (*Betula pumila*), involucrate honeysuckle (*Lonicera involucrata*), northern gooseberry (*Ribes oxyacanthoides*)

Minor graminoids (n=24) 1%
slender wheat grass (*Agropyron trachycaulum var. trachycaulum*), Canada blue grass (*Poa compressa*), fowl blue grass (*Poa palustris*)

Minor forbs and prostrate shrubs (n=24) 3%
woolly yarrow (*Achillea millefolium*), everlasting (*Antennaria spp*.), bearberry (*Arctostaphylos uva-ursi*), prairie sage (*Artemisia ludoviciana*), milk-vetch (*Astragalus spp*.), horsetail (*Equisetum spp*.), cow-parsnip (*Heracleum lanatum*), cream-colored vetchling (*Lathyrus ochroleucus*), bishop's-cap (*Mitella nuda*), one-flowered wintergreen (*Moneses uniflora*), one-sided wintergreen (*Orthilia secunda*), snakeroot (*Sanicula marilandica*), silvery groundsel (*Senecio canus*), common dandelion (*Taraxacum officinale*), veiny meadow-rue (*Thalictrum venulosum*)

SIMILARITY TO REFERENCE COMMUNITY 48%

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
closed stands (>50% canopy closure)	(0.31)	(0.12)
open stands (<50% canopy closure)	(0.48)	(0.19)

BT-LM-D

Aspen / Rose / Kentucky Blue Grass / Strawberry

Boreal Transition: Mesic Loam Ecosite

GENERAL DESCRIPTION: Grazed community occurring in aspen stands on the Mesic Loam Ecosite. This community is similar to Alberta's "DMC3a Aw-Pb/Dandelion/Kentucky bluegrass" community (Willoughby et al. 2004). It is interpreted as showing **significant alteration** from the reference community (BT-LM-A) as a result of grazing impact coupled with exotic invasion. Non-native herbs, including Kentucky blue grass, clover, and dandelion, successfully invade aspen stands in which the native shrubs and herbs have been weakened by grazing impact. Production of palatable forage appears to be higher in BT-LM-D than in the reference community, mainly because of the increased proportion of grass. While the ecological status of this community is low, reducing stocking rates will probably not reverse the invasion of exotic herbs. Therefore, recommended stocking rates are higher than for the reference community. Fire may kill exotic herbs and encourage resprouting of native shrubs, so may aid the transition back to a native community. Recommended stocking rates are based on average yields in closed aspen stands invaded by Kentucky blue grass; rates in open stands are estimated.

STRUCTURE

tree cover	?	moss cover (n=12)	2% (0 - 7)
tall shrub cover	?	lichen cover	?
short shrub cover	?	LFH thickness	?
prostrate shrub cover	?	litter cover (n=9)	86% (74 - 98)
herbaceous cover (n=12)	63% (28 - 85)	bare soil (n=12)	1% (0 - 2)

SPECIES COMPOSITION	**relative cover**
Major trees (n=9)	
trembling aspen (*Populus tremuloides*)	88% (73 - 99)
balsam poplar (*Populus balsamifera*)	11% (1 - 19)
white spruce (*Picea glauca*)	1% (0 - 3)
Major tall shrubs (n=12)	
willow (*Salix spp*.)	5% (1 - 11)
green alder (*Alnus crispa*)	2% (0 - 9)
beaked hazelnut (*Corylus cornuta*)	2% (0 - 7)
saskatoon (*Amelanchier alnifolia*)	1% (0 - 3)
Major short shrubs (n=12)	
prickly rose (*Rosa acicularis*)	11% (4 - 15)
snowberry (*Symphoricarpos spp*.)	5% (0 - 14)
wild red raspberry (*Rubus idaeus*)	4% (0 - 13)
Canada buffaloberry (*Shepherdia canadensis*)	1% (0 - 2)
Major graminoids (n=12)	
Kentucky blue grass (*Poa pratensis*)	6% (0 - 7)
hairy wild rye (*Elymus innovatus*)	4% (0 - 13)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	3% (0 - 5)
bearded wheat grass (*Agropyron trachycaulum var. unilaterale*)	2% (0 - 5)
Canada blue grass (*Poa compressa*)	2% (0 - 3)
fringed brome (*Bromus ciliatus*)	1% (0 - 3)
purple oat grass (*Schizachne purpurascens*)	1% (0 - 2)

Major forbs (n=12)	
smooth wild strawberry (*Fragaria virginiana*)	11% (6 - 17)
Lindley's aster (*Aster ciliolatus*)	4% (0 - 8)
violet (*Viola spp*.)	4% (0 - 9)
wild sarsaparilla (*Aralia nudicaulis*)	3% (0 - 8)
clover (*Trifolium spp*.)	3% (0 - 9)
wild peavine (*Lathyrus venosus*)	3% (0 - 6)
common dandelion (*Taraxacum officinale*)	2% (0 - 4)
northern bedstraw (*Galium boreale*)	2% (0 - 3)
bunchberry (*Cornus canadensis*)	2% (0 - 6)
smooth aster (*Aster laevis*)	1% (0 - 2)
cream-colored vetchling (*Lathyrus ochroleucus*)	1% (0 - 3)
goldenrod (*Solidago spp*.)	1% (0 - 3)
pink wintergreen (*Pyrola asarifolia*)	1% (0 - 4)
dewberry (*Rubus pubescens*)	1% (0 - 1)
two-leaved solomon's seal (*Maianthemum canadense*)	1% (0 - 2)
lungwort (*Mertensia paniculata*)	1% (0 - 3)
showy aster (*Aster conspicuus*)	1% (0 - 2)
palmate-leaved colt's-foot (*Petasites palmatus*)	1% (0 - 2)
American vetch (*Vicia americana*)	1% (0 - 2)
woolly yarrow (*Achillea millefolium*)	1% (0 - 1)
snakeroot (*Sanicula marilandica*)	1% (0 - 2)

Minor tall shrubs (n=12) 1%

red-osier dogwood (*Cornus stolonifera*), twining honeysuckle (*Lonicera dioica*), pincherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*), low bush-cranberry (*Viburnum edule*)

Minor short shrubs (n=12) 1%

birch (*Betula spp*.), northern gooseberry (*Ribes oxyacanthoides*)

Minor graminoids (n=12) 2%

northern wheat grass (*Agropyron dasystachyum*), quack grass (*Agropyron repens*), slender wheat grass (*Agropyron trachycaulum var. trachycaulum*), rough hair grass (*Agrostis scabra*), smooth brome (*Bromus inermis*), marsh reed grass (*Calamagrostis canadensis*), northern reed grass (*Calamagrostis inexpansa*), hay sedge (*Carex siccata*), Canada wild rye (*Elymus canadensis*), timothy (*Phleum pratense*)

Minor forbs and prostrate shrubs (n=12) 3%

anemone (*Anemone spp*.), everlasting (*Antennaria spp*.), sandwort (*Arenaria spp*.), oxe-eye daisy (*Chrysanthemum leucanthemum*), fireweed (*Epilobium angustifolium*), common horsetail (*Equisetum arvense*), fleabane (*Erigeron spp*.), sweet-scented bedstraw (*Galium triflorum*), northern gentian (*Gentianella amarella*), large-leaved avens (*Geum macrophyllum*), cow-parsnip (*Heracleum lanatum*), Canada hawkweed (*Hieracium canadense*), twinflower (*Linnaea borealis*), alfalfa (*Medicago sativa*), yellow sweet-clover (*Melilotus officinalis*), bishop's-cap (*Mitella nuda*), one-sided wintergreen (*Orthilia secunda*), common plantain (*Plantago major*), star-flowered solomon's-seal (*Smilacina stellata*), perennial sow-thistle (*Sonchus arvensis*), veiny meadow-rue (*Thalictrum venulosum*)

SIMILARITY TO REFERENCE COMMUNITY	42%

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
closed stands (>50% canopy closure)	0.54	0.22
open stands (<50% canopy closure)	(0.84)	(0.34)

BT-LM-E

Aspen / Hazelnut / Rose / Sarsaparilla

Boreal Transition: Mesic Loam Ecosite

GENERAL DESCRIPTION: **Reference community** for aspen stands with a hazelnut understory on the Mesic Loam Ecosite. More research is needed on the ecological differences between this community and BT-LM-A (Aspen / Low Bush-cranberry / Rose / Sarsaparilla). Both are considered to be reference communities on Mesic Loam Ecosites, and both are widespread in the region, although BT-LM-E becomes the predominant community in eastern Saskatchewan (e.g. Pasquia Hills, Porcupine Hills, Duck Mountain). Also in the east, there are similar communities but with mountain maple (*Acer spicatum*) in the tall shrub layer. A similar community occurs in the aspen forests of Moose Mountain, but often with green ash (*Fraxinus pensylvanica*) accompanying aspen in the tree layer. BT-LM-E is comparable to the "d2.2 tA/beaked hazelnut community type" of Beckingham et al. (1996). It is similar to the Alberta community "DMC4 Aw-Pb/Hazelnut" (Willoughby et al. 2004). Recommended stocking rates are based on average yields in ungrazed aspen-hazelnut stands.

STRUCTURE

tree cover (n=20)	56% (38 – 71)	LFH thickness (n=25)	9 cm (4 – 13)
tall shrub cover (n=27)	57% (34 – 89)	litter cover (n=17)	87% (83 – 98)
short shrub cover (n=27)	10% (1 – 23)	- leaf litter (n=13)	81% (78 – 88)
prostrate shrub cover (n=27)	1% (0 – 4)	- needle litter (n=13)	3% (0 – 8)
herbaceous cover (n=27)	39% (12 – 65)	- woody material (n=17)	7% (1 – 15)
moss cover (n=27)	2% (0 – 4)	bare soil (n=22)	0% (0 – 0)
lichen cover (n=27)	1% (0 – 1)		

SPECIES COMPOSITION	**% cover**	**relative cover**
Major trees (n=20)		
trembling aspen (*Populus tremuloides*)	51% (38 - 63)	
white birch (*Betula papyrifera*)	3% (0 - 10)	
white spruce (*Picea glauca*)	2% (0 - 10)	
balsam poplar (*Populus balsamifera*)	1% (0 - 2)	
Major tall shrubs (n=27)		
beaked hazelnut (*Corylus cornuta*)	43% (28 - 60)	44% (21 - 71)
saskatoon (*Amelanchier alnifolia*)	3% (0 - 6)	2% (0 - 6)
pincherry (*Prunus pensylvanica*)	3% (0 - 5)	1% (0 - 4)
low bush-cranberry (*Viburnum edule*)	2% (0 - 6)	2% (0 - 4)
mountain maple (*Acer spicatum*)	2% (0 - 0)	1% (0 - 0)
chokecherry (*Prunus virginiana*)	1% (0 - 4)	1% (0 - 3)
green alder (*Alnus crispa*)	1% (0 - 0)	1% (0 - 0)
twining honeysuckle (*Lonicera dioica*)	1% (0 - 3)	1% (0 - 2)
red-osier dogwood (*Cornus stolonifera*)	1% (0 - 4)	1% (0 - 2)
willow (*Salix spp*., especially *S. bebbiana*)	1% (0 - 3)	1% (0 - 3)
high bush-cranberry (*Viburnum opulus*)	1% (0 - 1)	1% (0 - 1)

Major short shrubs (n=27)		
prickly rose (*Rosa acicularis*)	5% (1 - 10)	4% (1 - 6)
snowberry (*Symphoricarpos spp.*)	2% (0 - 4)	2% (0 - 3)
wild red raspberry (*Rubus idaeus*)	1% (0 - 3)	1% (0 - 2)
Wood's rose (*Rosa woodsii*)	1% (0 - 3)	1% (0 - 2)
swamp red currant (*Ribes triste*)	1% (0 - 3)	1% (0 - 2)

Major prostrate shrubs (n=25)		
twinflower (*Linnaea borealis*)	1% (0 - 4)	1% (0 - 4)

Major graminoids (n=27)		
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 - 4)	2% (0 - 3)
hairy wild rye (*Elymus innovatus*)	1% (0 - 1)	0% (0 - 1)

Major forbs and prostrate shrubs (n=25)		
wild sarsaparilla (*Aralia nudicaulis*)	9% (0 - 23)	9% (0 - 23)
dewberry (*Rubus pubescens*)	3% (0 - 7)	3% (0 - 6)
bunchberry (*Cornus canadensis*)	2% (0 - 5)	2% (0 - 4)
two-leaved solomon's seal (*Maianthemum canadense*)	2% (0 - 4)	2% (0 - 5)
western Canada violet (*Viola canadensis*)	2% (0 - 3)	1% (0 - 2)
fireweed (*Epilobium angustifolium*)	2% (0 - 3)	1% (0 - 5)
Lindley's aster (*Aster ciliolatus*)	2% (0 - 4)	1% (0 - 3)
spreading dogbane (*Apocynum androsaemifolium*)	1% (0 - 4)	1% (0 - 4)
smooth wild strawberry (*Fragaria virginiana*)	1% (0 - 3)	1% (0 - 2)
pink wintergreen (*Pyrola asarifolia*)	1% (0 - 3)	1% (0 - 1)
palmate-leaved colt's-foot (*Petasites palmatus*)	1% (0 - 3)	1% (0 - 3)
lungwort (*Mertensia paniculata*)	1% (0 - 3)	1% (0 - 3)
cream-colored vetchling (*Lathyrus ochroleucus*)	1% (0 - 4)	1% (0 - 3)
wild peavine (*Lathyrus venosus*)	1% (0 - 3)	1% (0 - 4)
northern bedstraw (*Galium boreale*)	1% (0 - 3)	1% (0 - 2)
American vetch (*Vicia americana*)	1% (0 - 1)	0% (0 - 1)
fairybells (*Disporum trachycarpum*)	1% (0 - 2)	1% (0 - 1)
bishop's-cap (*Mitella nuda*)	1% (0 - 2)	0% (0 - 1)
showy aster (*Aster conspicuus*)	1% (0 - 2)	0% (0 - 1)

Major bryophytes and lichens (n=16)	
Peltigera spp.	1% (0 - 1)

Minor tall shrubs (n=27)	0%	0%
caragana (*Caragana arborescens*)		

Minor short shrubs (n=27)	1%	1%
involucrate honeysuckle (*Lonicera involucrata*), swamp fly honeysuckle (*Lonicera oblongifolia*), alder-leaved buckthorn (*Rhamnus alnifolia*), northern gooseberry (*Ribes oxyacanthoides*), Canada buffaloberry (*Shepherdia canadensis*)		

Minor graminoids (n=25)	1%	1%
fringed brome (*Bromus ciliatus*), marsh reed grass (*Calamagrostis canadensis*), sedge (*Carex spp*.), purple oat grass (*Schizachne purpurascens*)		

Minor forbs and prostrate shrubs (n=25%)	3%	3%
woolly yarrow (*Achillea millefolium*), baneberry (*Actaea rubra*), Canada thistle (*Cirsium arvense*), spinulose shield fern (*Dryopteris carthusiana*), meadow horsetail (*Equisetum pratense*), woodland strawberry (*Fragaria vesca*), sweet-scented bedstraw (*Galium triflorum*), cow-parsnip (*Heracleum lanatum*), Canada hawkweed (*Hieracium canadense*), one-sided wintergreen (*Orthilia secunda*), green wintergreen (*Pyrola chlorantha*), snakeroot (*Sanicula marilandica*), star-flowered solomon's-seal (*Smilacina stellata*), Canada goldenrod (*Solidago canadensis*), common dandelion (*Taraxacum officinale*), meadow-rue (*Thalictrum spp.*), veiny meadow-rue (*Thalictrum venulosum*), stinkweed (*Thlaspi arvense*), northern star-flower (*Trientalis borealis*), kidney-leaved violet (*Viola renifolia*)		

Minor bryophytes and lichens (n=16)	1%
Cladina/Cladonia spp., *Hylocomium splendens, Pleurozium schreberi*	

RECOMMENDED STOCKING RATE	0.23 AUM/ha	0.09 AUM/ac

BT-LM-F

Aspen / Hazelnut / Rose / Strawberry

Boreal Transition: Mesic Loam Ecosite

GENERAL DESCRIPTION: Grazed community occuring in aspen/hazelnut stands on the Mesic Loam Ecosite. This community is interpreted as showing **minor alteration** from the reference community (BT-LM-E) as a result of grazing impact. Because of inconsistencies in cover estimation among data sources, only relative cover is shown for grazed communities (see Section 3 for discussion). Recommended stocking rates in communities with only minor alteration are unchanged from the reference community.

STRUCTURE

tree cover	?	moss cover (n=11)	3% (0 – 6)
tall shrub cover	?	lichen cover	?
short shrub cover	?	LFH thickness	?
prostrate shrub cover	?	litter cover (n=9)	85% (79 – 93)
herbaceous cover (n=12)	56% (18 – 78)	bare soil (n=11)	1% (0 – 3)

SPECIES COMPOSITION	**relative cover**
Major trees (n=9)	
trembling aspen (*Populus tremuloides*)	87% (81 - 96)
balsam poplar (*Populus balsamifera*)	12% (4 - 19)
white birch (*Betula papyrifera*)	1% (0 - 5)
Major tall shrubs (n=10)	
beaked hazelnut (*Corylus cornuta*)	26% (15 - 49)
green alder (*Alnus crispa*)	4% (0 - 11)
willow (*Salix spp*.)	3% (0 - 7)
saskatoon (*Amelanchier alnifolia*)	2% (0 - 4)
low bush-cranberry (*Viburnum edule*)	1% (0 - 2)
Major short shrubs (n=10)	
prickly rose (*Rosa acicularis*)	7% (4 - 12)
snowberry (*Symphoricarpos spp*.)	3% (1 - 5)
wild red raspberry (*Rubus idaeus*)	2% (0 - 5)
Major prostrate shrubs (n=10)	
twinflower (*Linnaea borealis*)	2% (0 - 4)
Major graminoids (n=10)	
hairy wild rye (*Elymus innovatus*)	5% (0 - 13)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 - 4)
Kentucky blue grass (*Poa pratensis*)	2% (0 - 4)
bearded wheat grass (*Agropyron trachycaulum var. unilaterale*)	1% (0 - 3)
purple oat grass (*Schizachne purpurascens*)	1% (0 - 2)

Major forbs (n=10)	
smooth wild strawberry (*Fragaria virginiana*)	9% (3 - 15)
wild sarsaparilla (*Aralia nudicaulis*)	5% (0 - 13)
bunchberry (*Cornus canadensis*)	3% (0 - 6)
violet (*Viola spp.*)	3% (0 - 5)
wild peavine (*Lathyrus venosus*)	2% (0 - 5)
Lindley's aster (*Aster ciliolatus*)	2% (0 - 5)
two-leaved solomon's seal (*Maianthemum canadense*)	2% (0 - 4)
pink wintergreen (*Pyrola asarifolia*)	2% (0 - 5)
northern bedstraw (*Galium boreale*)	1% (1 - 2)
common dandelion (*Taraxacum officinale*)	1% (0 - 2)
dewberry (*Rubus pubescens*)	1% (0 - 2)
cream-colored vetchling (*Lathyrus ochroleucus*)	1% (0 - 3)
showy aster (*Aster conspicuus*)	1% (0 - 2)
palmate-leaved colt's-foot (*Petasites palmatus*)	1% (0 - 1)

Minor tall shrubs (n=10)	1%
red-osier dogwood (*Cornus stolonifera*), twining honeysuckle (*Lonicera dioica*), pincherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*)	

Minor short shrubs (n=10)	1%
northern gooseberry (*Ribes oxyacanthoides*), Canada buffaloberry (*Shepherdia canadensis*), dwarf bilberry (*Vaccinium caespitosum*)	

Minor graminoids (n=10)	1%
slender wheat grass (*Agropyron trachycaulum var. trachycaulum*), fringed brome (*Bromus ciliatus*), marsh reed grass (*Calamagrostis canadensis*), golden sedge (*Carex aurea*), Dewey's sedge (*Carex deweyana*), Peck's sedge (*Carex peckii*), hay sedge (*Carex siccata*), Canada blue grass (*Poa compressa*)	

Minor forbs and prostrate shrubs (n=10)	5%
woolly yarrow (*Achillea millefolium*), spreading dogbane (*Apocynum androsaemifolium*), bearberry (*Arctostaphylos uva-ursi*), smooth aster (*Aster laevis*), fairybells (*Disporum trachycarpum*), sweet-scented bedstraw (*Galium triflorum*), northern gentian (*Gentianella amarella*), common blue lettuce (*Lactuca pulchella*), lungwort (*Mertensia paniculata*), one-sided wintergreen (*Orthilia secunda*), arrow-leaved colt's-foot (*Petasites sagittatus*), common plantain (*Plantago major*), snakeroot (*Sanicula marilandica*), goldenrod (*Solidago spp.*), veiny meadow-rue (*Thalictrum venulosum*), clover (*Trifolium spp.*), American vetch (*Vicia americana*)	

SIMILARITY TO REFERENCE COMMUNITY (BT-LM-B)	61%

RECOMMENDED STOCKING RATE	0.23 AUM/ha	0.09 AUM/ac

BT-LM-G

Aspen - White Spruce / Hazelnut / Feathermoss

Boreal Transition: Mesic Loam Ecosite

GENERAL DESCRIPTION: **Reference community** for mixedwood stands on the Mesic Loam Ecosite. This community is comparable to the "d3 low-bush cranberry tA-wS ecosite phase" of Beckingham et al. (1996). Recommended stocking rates are based on reducing the hardwood-stand yield in proportion to the amount of conifer cover.

STRUCTURE

tree cover (n=26)	71% (36 – 100)	LFH thickness (n=26)	9 cm (5 – 14)
tall shrub cover (n=26)	15% (0 – 37)	litter cover (n=17)	70% (45 – 92)
short shrub cover (n=26)	5% (0 – 10)	- leaf litter (n=17)	61% (35 – 88)
prostrate shrub cover (n=26)	3% (0 – 8)	- needle litter (n=17)	9% (0 – 26)
herbaceous cover (n=26)	30% (3 – 61)	- woody material (n=17)	14% (0 – 29)
moss cover (n=26)	25% (2 – 76)	bare soil (n=17)	0% (0 – 0)
lichen cover (n=26)	3% (0 – 8)		

SPECIES COMPOSITION	% cover	relative cover
Major trees (n=26)		
trembling aspen (*Populus tremuloides*)	38% (10 - 63)	
white spruce (*Picea glauca*)	34% (13 - 60)	
balsam poplar (*Populus balsamifera*)	3% (0 - 6)	
balsam fir (*Abies balsamea*)	3% (0 - 10)	
black spruce (*Picea mariana*)	2% (0 - 5)	
jack pine (*Pinus banksiana*)	2% (0 - 0)	
white birch (*Betula papyrifera*)	2% (0 - 6)	
Major tall shrubs (n=26)		
beaked hazelnut (*Corylus cornuta*)	9% (0 - 29)	9% (0 - 32)
low bush-cranberry (*Viburnum edule*)	2% (0 - 4)	5% (0 - 14)
green alder (*Alnus crispa*)	1% (0 - 5)	4% (0 - 8)
willow (*Salix spp*.)	1% (0 - 0)	1% (0 - 0)
twining honeysuckle (*Lonicera dioica*)	1% (0 - 3)	1% (0 - 3)
saskatoon (*Amelanchier alnifolia*)	1% (0 - 3)	1% (0 - 3)
Major short shrubs (n=26)		
prickly rose (*Rosa acicularis*)	3% (0 - 6)	6% (0 - 16)
labrador-tea (*Ledum groenlandicum*)	1% (0 - 3)	1% (0 - 4)
swamp red currant (*Ribes triste*)	1% (0 - 3)	1% (0 - 3)
Major prostrate shrubs (n=26)		
twinflower (*Linnaea borealis*)	3% (0 - 8)	8% (0 - 18)
Major graminoids (n=26)		
grasses (undifferentiated)	2% (0 - 3)	2% (0 - 3)
hairy wild rye (*Elymus innovatus*)	1% (0 - 3)	1% (0 - 4)

Major forbs (n=26)		
bunchberry (*Cornus canadensis*)	4% (0 - 10)	8% (1 - 16)
wild sarsaparilla (*Aralia nudicaulis*)	3% (0 - 8)	8% (0 - 13)
dewberry (*Rubus pubescens*)	2% (0 - 4)	4% (0 - 9)
palmate-leaved colt's-foot (*Petasites palmatus*)	2% (0 - 3)	4% (0 - 7)
lungwort (*Mertensia paniculata*)	2% (0 - 3)	4% (0 - 7)
two-leaved solomon's seal (*Maianthemum canadense*)	1% (0 - 3)	3% (0 - 6)
Lindley's aster (*Aster ciliolatus*)	1% (0 - 3)	2% (0 - 5)
cream-colored vetchling (*Lathyrus ochroleucus*)	1% (0 - 3)	1% (0 - 4)
bishop's-cap (*Mitella nuda*)	1% (0 - 3)	2% (0 - 6)
pink wintergreen (*Pyrola asarifolia*)	1% (0 - 3)	2% (0 - 4)
one-sided wintergreen (*Orthilia secunda*)	1% (0 - 3)	2% (0 - 5)
baneberry (*Actaea rubra*)	1% (0 - 3)	1% (0 - 3)
smooth wild strawberry (*Fragaria virginiana*)	1% (0 - 3)	2% (0 - 4)
green wintergreen (*Pyrola chlorantha*)	1% (0 - 3)	2% (0 - 4)
northern star-flower (*Trientalis borealis*)	1% (0 - 3)	2% (0 - 4)
kidney-leaved violet (*Viola renifolia*)	1% (0 - 3)	1% (0 - 4)

Major bryophytes and lichens (n=26)	
Hylocomium splendens	14% (0 - 38)
Pleurozium schreberi	2% (0 - 4)
Ptilium crista-castrensis	2% (0 - 3)
Peltigera spp.	2% (0 - 4)
Cladina/Cladonia spp.	1% (0 - 5)
Dicranum spp.	1% (0 - 3)
Drepanocladus uncinatus	1% (0 - 3)

Minor tall shrubs (n=26)	1%	1%
red-osier dogwood (*Cornus stolonifera*), pincherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*)		

Minor short shrubs (n=26)	1%	4%
involucrate honeysuckle (*Lonicera involucrata*), skunk currant (*Ribes glandulosum*), northern gooseberry (*Ribes oxyacanthoides*), wild red raspberry (*Rubus idaeus*), few-flowered snowberry (*Symphoricarpos albus*), velvet-leaf blueberry (*Vaccinium myrtilloides*)		

Minor graminoids (n=26)	1%	1%
marsh reed grass (*Calamagrostis canadensis*), sedge (*Carex spp.*), white-grained mountain rice grass (*Oryzopsis asperifolia*), northern rice grass (*Oryzopsis pungens*), purple oat grass (*Schizachne purpurascens*)		

Minor forbs and prostrate shrubs (n=26)	6%	8%
woolly yarrow (*Achillea millefolium*), giant hyssop (*Agastache foeniculum*), bearberry (*Arctostaphylos uva-ursi*), harebell (*Campanula rotundifolia*), yellow coral-root (*Corallorhiza trifida*), fairybells (*Disporum trachycarpum*), fireweed (*Epilobium angustifolium*), wormseed mustard (*Erysimum cheiranthoides*), woodland strawberry (*Fragaria vesca*), northern bedstraw (*Galium boreale*), sweet-scented bedstraw (*Galium triflorum*), northern comandra (*Geocaulon lividum*), dwarf rattlesnake-plantain (*Goodyera repens*), large round-leaved orchid (*Habenaria orbiculata*), American hedysarum (*Hedysarum alpinum var. americanum*), Canada hawkweed (*Hieracium canadense*), wild peavine (*Lathyrus venosus*), stiff clubmoss (*Lycopodium annotinum*), ground-pine (*Lycopodium obscurum*), one-flowered wintergreen (*Moneses uniflora*), Canada goldenrod (*Solidago canadensis*), showy goldenrod (*Solidago nemoralis*), common dandelion (*Taraxacum officinale*), veiny meadow-rue (*Thalictrum venulosum*), dry-ground cranberry (*Vaccinium vitis-idaea*), American vetch (*Vicia americana*), early blue violet (*Viola adunca*), western Canada violet (*Viola canadensis*)		

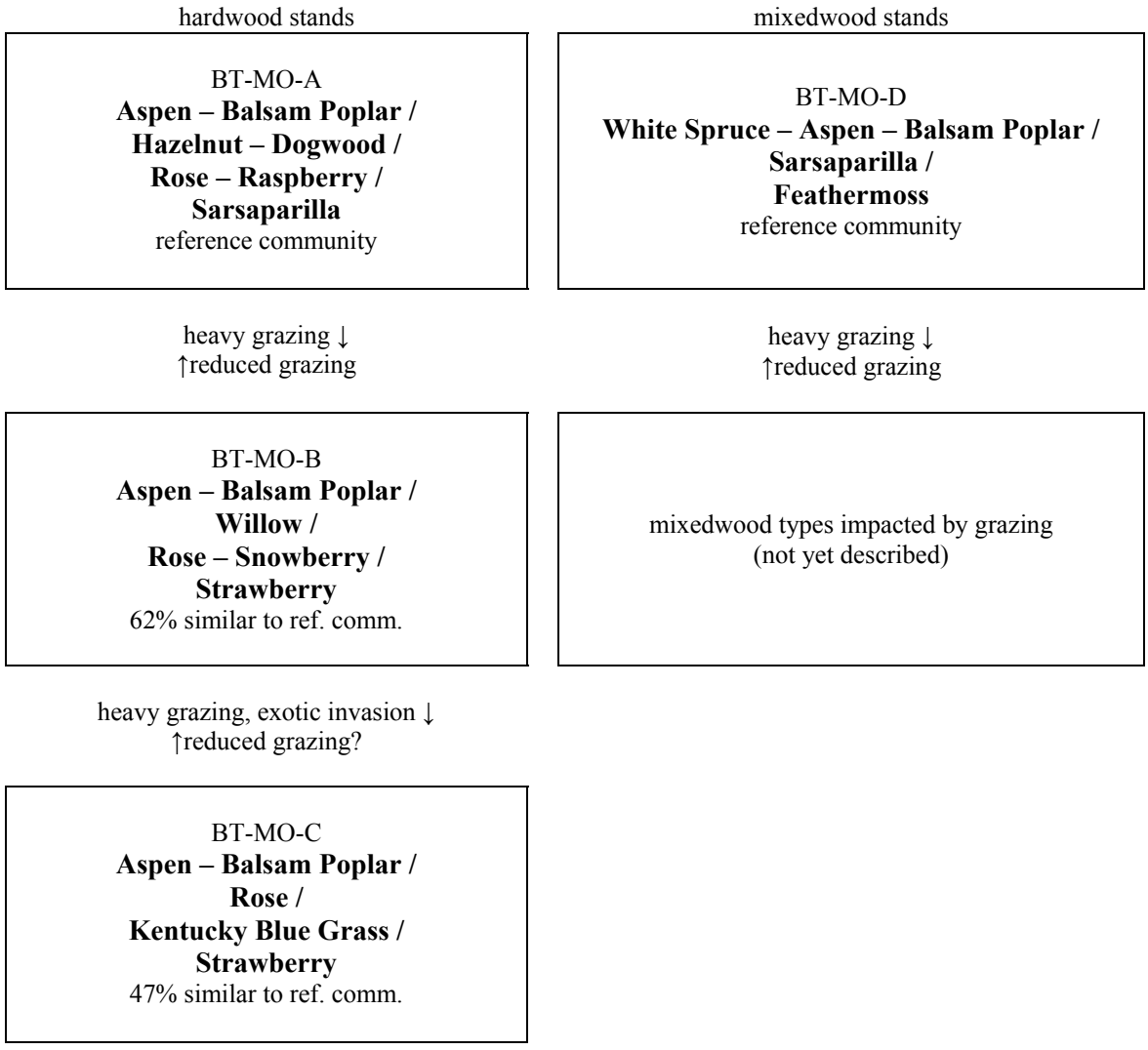
Minor bryophytes and lichens (n=26)	5%
Hypogymnia physodes, Usnea lapponica, other bryophytes and lichens	

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
conifer cover 10%	0.38	0.15
conifer cover 20%	0.35	0.14
conifer cover 30%	0.31	0.13
conifer cover 40%	0.28	0.11
conifer cover 50%	0.25	0.10
conifer cover 60%	0.22	0.09
conifer cover 70%	0.18	0.07

5.2.3 Moist Ecosite

This ecosite includes moist sites that support hardwood or mixedwood stands. These sites may occur on a variety of landforms or soil textures, because the high water table is the controlling factor. Soils are Gleyed Luvisols, Gleyed Brunisols, or Gleysols. The drainage class is usually rated as "imperfectly drained", although some plots are rated as "poorly drained" (LRRI 1983). The LFH layer is usually thicker than on well-drained sites. Prominent mottling usually occurs in the top 50 cm of soil, and gray gley colours may appear in the soil profile. The moisture regime is described as "subhygric to hygric" (AEP 1994, Beckingham et al. 1996) or as "moist to very moist" (SE 2004). This ecosite is comparable to the "e – dogwood ecosite" of Beckingham et al. (1996), but may overlap their "h – horsetail ecosite" in some cases.

STATE-AND-TRANSITION DIAGRAM
Boreal Transition: Moist Ecosite



BT-MO-A

Aspen - Balsam Poplar / Hazelnut - Dogwood / Rose - Raspberry / Sarsaparilla

Boreal Transition: Moist Ecosite

GENERAL DESCRIPTION: **Reference community** for aspen-balsam poplar stands on the Moist Ecosite. Stands dominated by white birch also occur on this ecosite, but data were insufficient to characterize them. This community is comparable to the "e1 dogwood bP-tA ecosite phase" of Beckingham et al. (1996). It is similar to Alberta's "DMC8 Pb-Aw/Red osier dogwood" community (Willoughby et al. 2004). Recommended stocking rates are based on average yields in ungrazed hardwood stands (open and closed).

STRUCTURE

tree cover (n=34)	62% (38 – 92)	LFH thickness (n=39)	10 cm (5 – 21)
tall shrub cover (n=41)	23% (2 – 46)	litter cover (n=36)	87% (70 – 98)
short shrub cover (n=41)	26% (5 – 48)	- leaf litter (n=12)	82% (64 – 88)
prostrate shrub cover (n=41)	2% (0 – 9)	- needle litter (n=12)	0% (0 – 0)
herbaceous cover (n=52)	64% (22 – 100)	- woody material (n=25)	8% (2 – 20)
moss cover (n=52)	4% (0 – 7)	bare soil (n=43)	0% (0 – 0)
lichen cover (n=41)	0% (0 – 1)		

SPECIES COMPOSITION	**% cover**	**relative cover**
Major trees (n=44)		
trembling aspen (*Populus tremuloides*)	43% (5 - 69)	70% (9 - 100)
balsam poplar (*Populus balsamifera*)	19% (0 - 63)	26% (0 - 79)
white birch (*Betula papyrifera*)	3% (0 - 3)	2% (0 - 4)
white spruce (*Picea glauca*)	2% (0 - 4)	2% (0 - 7)
balsam fir (*Abies balsamea*)	1% (0 - 0)	0% (0 - 0)
Major tall shrubs (n=52)		
beaked hazelnut (*Corylus cornuta*)	7% (0 - 16)	6% (0 - 11)
red-osier dogwood (*Cornus stolonifera*)	5% (0 - 10)	4% (0 - 9)
speckled alder (*Alnus tenuifolia*)	2% (0 - 3)	2% (0 - 0)
low bush-cranberry (*Viburnum edule*)	2% (0 - 5)	1% (0 - 4)
willow (*Salix spp*., especially *S. bebbiana*)	2% (0 - 4)	2% (0 - 6)
saskatoon (*Amelanchier alnifolia*)	1% (0 - 3)	1% (0 - 3)
twining honeysuckle (*Lonicera dioica*)	1% (0 - 3)	1% (0 - 2)
green alder (*Alnus crispa*)	1% (0 - 0)	1% (0 - 0)
high bush-cranberry (*Viburnum opulus*)	1% (0 - 2)	1% (0 - 1)
chokecherry (*Prunus virginiana*)	1% (0 - 2)	0% (0 - 1)

Major short shrubs (n=52)		
rose (*Rosa spp.*)	8% (0 - 22)	7% (1 - 15)
wild red raspberry (*Rubus idaeus*)	6% (0 - 16)	5% (0 - 15)
snowberry (*Symphoricarpos spp.*)	3% (0 - 6)	3% (0 - 6)
involucrate honeysuckle (*Lonicera involucrata*)	2% (0 - 3)	1% (0 - 3)
Canada buffaloberry (*Shepherdia canadensis*)	1% (0 - 1)	1% (0 - 1)
swamp red currant (*Ribes triste*)	1% (0 - 3)	1% (0 - 3)
labrador-tea (*Ledum groenlandicum*)	1% (0 - 0)	1% (0 - 0)
northern gooseberry (*Ribes oxyacanthoides*)	1% (0 - 3)	1% (0 - 2)
northern black currant (*Ribes hudsonianum*)	1% (0 - 0)	0% (0 - 0)

Major prostrate shrubs (n=52)		
twinflower (*Linnaea borealis*)	2% (0 - 9)	1% (0 - 5)

Major graminoids (n=52)		
marsh reed grass (*Calamagrostis canadensis*)	1% (0 - 3)	1% (0 - 2)
grasses (undifferentiated)	1% (0 - 1)	2% (0 - 2)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	1% (0 - 2)	1% (0 - 3)
hairy wild rye (*Elymus innovatus*)	1% (0 - 4)	1% (0 - 3)
sedge (*Carex spp.*)	1% (0 - 3)	1% (0 - 2)

Major forbs (n=52)		
wild sarsaparilla (*Aralia nudicaulis*)	13% (0 - 33)	12% (0 - 25)
bunchberry (*Cornus canadensis*)	5% (0 - 13)	4% (0 - 9)
dewberry (*Rubus pubescens*)	4% (0 - 10)	2% (0 - 6)
cream-colored vetchling (*Lathyrus ochroleucus*)	3% (0 - 10)	2% (0 - 6)
fireweed (*Epilobium angustifolium*)	3% (0 - 6)	2% (0 - 6)
smooth wild strawberry (*Fragaria virginiana*)	3% (0 - 7)	3% (0 - 8)
pink wintergreen (*Pyrola asarifolia*)	2% (0 - 6)	1% (0 - 3)
two-leaved solomon's seal (*Maianthemum canadense*)	2% (0 - 7)	2% (0 - 4)
palmate-leaved colt's-foot (*Petasites palmatus*)	2% (0 - 5)	2% (0 - 4)
northern bedstraw (*Galium boreale*)	1% (0 - 4)	1% (0 - 3)
lungwort (*Mertensia paniculata*)	1% (0 - 3)	1% (0 - 3)
American vetch (*Vicia americana*)	1% (0 - 4)	1% (0 - 4)
Lindley's aster (*Aster ciliolatus*)	1% (0 - 3)	1% (0 - 3)
ostrich fern (*Matteucia struthiopteris*)	1% (0 - 0)	0% (0 - 0)
meadow horsetail (*Equisetum pratense*)	1% (0 - 0)	0% (0 - 0)
stiff clubmoss (*Lycopodium annotinum*)	1% (0 - 0)	1% (0 - 0)
violet (*Viola spp.*)	1% (0 - 3)	1% (0 - 4)
baneberry (*Actaea rubra*)	1% (0 - 3)	1% (0 - 2)
goldenrod (*Solidago spp.*)	1% (0 - 3)	1% (0 - 4)
fairybells (*Disporum trachycarpum*)	1% (0 - 3)	0% (0 - 1)
veiny meadow-rue (*Thalictrum venulosum*)	1% (0 - 2)	0% (0 - 1)
bishop's-cap (*Mitella nuda*)	1% (0 - 3)	0% (0 - 1)
sweet-scented bedstraw (*Galium triflorum*)	1% (0 - 3)	0% (0 - 1)
northern star-flower (*Trientalis borealis*)	1% (0 - 3)	0% (0 - 1)

Major bryophytes and lichens (n=21)	
Pleurozium schreberi	3% (0 - 3)
Hylocomium splendens	2% (0 - 3)
Ptilium crista-castrensis	1% (0 - 0)

Minor tall shrubs (n=52)	0%	0%
pincherry (*Prunus pensylvanica*)		

Minor short shrubs (n=52)	1%	1%
swamp birch (*Betula pumila*), blue fly honeysuckle (*Lonicera caerulea*), alder-leaved buckthorn (*Rhamnus alnifolia*), skunk currant (*Ribes glandulosum*), bristly black currant (*Ribes lacustre*), shining-leaved meadowsweet (*Spiraea betulifolia*), dwarf bilberry (*Vaccinium caespitosum*), velvet-leaf blueberry (*Vaccinium myrtilloides*)		

Minor graminoids (n=52)	1%	2%
slender wheat grass (*Agropyron trachycaulum var. trachycaulum*), fringed brome (*Bromus ciliatus*), Kentucky blue grass (*Poa pratensis*), purple oat grass (*Schizachne purpurascens*)		

Minor forbs and prostrate shrubs (n=52)	6%	7%
woolly yarrow (*Achillea millefolium*), nodding onion (*Allium cernuum*), Canada anemone (*Anemone canadensis*), spreading dogbane (*Apocynum androsaemifolium*), showy aster (*Aster conspicuus*), purple-stemmed aster (*Aster puniceus*), Virginia grape-fern (*Botrychium virginianum*), enchanter's nightshade (*Circaea alpina*), Canada thistle (*Cirsium arvense*), tall larkspur (*Delphinium glaucum*), spinulose shield fern (*Dryopteris carthusiana*), common horsetail (*Equisetum arvense*), common scouring-rush (*Equisetum hyemale*), woodland horsetail (*Equisetum sylvaticum*), woodland strawberry (*Fragaria vesca*), hemp-nettle (*Galeopsis tetrahit*), northern comandra (*Geocaulon lividum*), yellow avens (*Geum aleppicum*), large-leaved avens (*Geum macrophyllum*), dwarf rattlesnake-plantain (*Goodyera repens*), cow-parsnip (*Heracleum lanatum*), Canada hawkweed (*Hieracium canadense*), tall blue lettuce (*Lactuca biennis*), wild peavine (*Lathyrus venosus*), running clubmoss (*Lycopodium clavatum*), wild mint (*Mentha arvensis*), blunt-leaved sandwort (*Moehringia lateriflora*), one-sided wintergreen (*Orthilia secunda*), green wintergreen (*Pyrola chlorantha*), common shinleaf (*Pyrola elliptica*), snakeroot (*Sanicula marilandica*), marsh skullcap (*Scutellaria galericulata*), star-flowered solomon's-seal (*Smilacina stellata*), marsh hedge-nettle (*Stachys palustris*), common dandelion (*Taraxacum officinale*), clover (*Trifolium spp.*), stinging nettle (*Urtica dioica*), dry-ground cranberry (*Vaccinium vitis-idaea*)		

Minor bryophytes and lichens (n=21)	4%
Dicranum spp., *Drepanocladus uncinatus*, Peltigera spp., other bryophytes and lichens	

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
closed stands (>50% canopy closure)	0.41	0.17
open stands (<50% canopy closure)	0.64	0.26

BT-MO-B

Aspen - Balsam Poplar / Willow / Rose - Snowberry / Strawberry

Boreal Transition: Moist Ecosite

GENERAL DESCRIPTION: Grazed community occuring in aspen-balsam poplar stands on the Moist Ecosite. This community is interpreted to show **minor alteration** from the reference community (BT-MO-A) as a result of grazing impact. Because of inconsistencies in cover estimation among data sources, only relative cover is shown for grazed communities (see Section 3 for discussion). The apparent increase in willow from BT-SD-A to BT-SD-B is surprising because most willows are palatable to browsers. The increase in relative cover of willows may reflect persistence of these tall woody plants, but not an actual increase in cover. Recommended stocking rates in communities showing only minor alteration are unchanged from the reference community.

STRUCTURE

tree cover	?	moss cover (n=33)	4% (0 – 7)
tall shrub cover	?	lichen cover	?
short shrub cover	?	LFH thickness	?
prostrate shrub cover	?	litter cover (n=33)	91% (84 – 98)
herbaceous cover (n=33)	69% (55 – 83)	bare soil (n=33)	0% (0 – 1)

SPECIES COMPOSITION	**relative cover**
Major trees (n=33)	
trembling aspen (*Populus tremuloides*)	63% (41 - 82)
balsam poplar (*Populus balsamifera*)	34% (15 - 58)
white spruce (*Picea glauca*)	2% (0 - 7)
Major tall shrubs (n=33)	
willow (*Salix spp*.)	7% (1 - 14)
beaked hazelnut (*Corylus cornuta*)	3% (0 - 10)
green alder (*Alnus crispa*)	3% (0 - 12)
saskatoon (*Amelanchier alnifolia*)	2% (0 - 5)
red-osier dogwood (*Cornus stolonifera*)	1% (0 - 3)
Major short shrubs (n=33)	
rose (*Rosa spp*.)	13% (4 - 19)
snowberry (*Symphoricarpos spp*.)	6% (1 - 11)
wild red raspberry (*Rubus idaeus*)	4% (0 - 12)
Canada buffaloberry (*Shepherdia canadensis*)	1% (0 - 4)
northern gooseberry (*Ribes oxyacanthoides*)	1% (0 - 2)
Major prostrate shrubs (n=33)	
twinflower (*Linnaea borealis*)	1% (0 - 3)

Major graminoids (n=33)	
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 - 6)
hairy wild rye (*Elymus innovatus*)	2% (0 - 7)
purple oat grass (*Schizachne purpurascens*)	1% (0 - 4)
Kentucky blue grass (*Poa pratensis*)	1% (0 - 4)
marsh reed grass (*Calamagrostis canadensis*)	1% (0 - 2)
slender wheat grass (*Agropyron trachycaulum var. trachycaulum*)	1% (0 - 2)
northern wheat grass (*Agropyron dasystachyum*)	1% (0 - 2)
fringed brome (*Bromus ciliatus*)	1% (0 - 2)
bearded wheat grass (*Agropyron trachycaulum var. unilaterale*)	1% (0 - 2)

Major forbs (n=33)	
smooth wild strawberry (*Fragaria virginiana*)	7% (4 - 12)
dewberry (*Rubus pubescens*)	4% (0 - 10)
bunchberry (*Cornus canadensis*)	4% (0 - 7)
wild sarsaparilla (*Aralia nudicaulis*)	3% (0 - 9)
violet (*Viola spp.*)	2% (0 - 5)
common dandelion (*Taraxacum officinale*)	2% (0 - 4)
baneberry (*Actaea rubra*)	2% (0 - 5)
palmate-leaved colt's-foot (*Petasites palmatus*)	2% (0 - 3)
wild peavine (*Lathyrus venosus*)	2% (0 - 6)
two-leaved solomon's seal (*Maianthemum canadense*)	1% (0 - 3)
northern bedstraw (*Galium boreale*)	1% (0 - 2)
lungwort (*Mertensia paniculata*)	1% (0 - 4)
Lindley's aster (*Aster ciliolatus*)	1% (0 - 4)
pink wintergreen (*Pyrola asarifolia*)	1% (0 - 3)
aster (*Aster spp.*)	1% (0 - 3)
goldenrod (*Solidago spp.*)	1% (0 - 3)
common horsetail (*Equisetum arvense*)	1% (0 - 2)
cream-colored vetchling (*Lathyrus ochroleucus*)	1% (0 - 2)
snakeroot (*Sanicula marilandica*)	1% (0 - 2)
American vetch (*Vicia americana*)	1% (0 - 2)
showy aster (*Aster conspicuus*)	1% (0 - 3)
sweet-scented bedstraw (*Galium triflorum*)	1% (0 - 2)
clover (*Trifolium spp.*)	1% (0 - 1)

Minor trees (n=33)	0%
white birch (*Betula papyrifera*), black spruce (*Picea mariana*)	

Minor tall shrubs (n=33)	1%
river birch (*Betula occidentalis*), pincherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*), low bush-cranberry (*Viburnum edule*), high bush-cranberry (*Viburnum opulus*)	

Minor short shrubs (n=33)	1%
birch (*Betula spp.*), involucrate honeysuckle (*Lonicera involucrata*), blueberry (*Vaccinium spp.*)	

Minor graminoids (n=33) 1%

rough hair grass (*Agrostis scabra*), smooth brome (*Bromus inermis*), northern reed grass (*Calamagrostis inexpansa*), northern rice grass (*Oryzopsis pungens*), timothy (*Phleum pratense*), Canby's blue grass (*Poa canbyi*), Canada blue grass (*Poa compressa*)

Minor forbs and prostrate shrubs (n=33) 4%

woolly yarrow (*Achillea millefolium*), giant hyssop (*Agastache foeniculum*), bearberry (*Arctostaphylos uva-ursi*), smooth aster (*Aster laevis*), Canada thistle (*Cirsium arvense*), golden-thread (*Coptis trifolia*), fireweed (*Epilobium angustifolium*), northern gentian (*Gentianella amarella*), large-leaved avens (*Geum macrophyllum*), spurred gentian (*Halenia deflexa*), cow-parsnip (*Heracleum lanatum*), Canada hawkweed (*Hieracium canadense*), wood lily (*Lilium philadelphicum*), fringed loosestrife (*Lysimachia ciliata*), wild mint (*Mentha arvensis*), bishop's-cap (*Mitella nuda*), common plantain (*Plantago major*), cinquefoil (*Potentilla spp*.), wintergreen (*Pyrola spp*.), star-flowered solomon's-seal (*Smilacina stellata*), tall meadow-rue (*Thalictrum dasycarpum*), veiny meadow-rue (*Thalictrum venulosum*)

SIMILARITY TO REFERENCE COMMUNITY 62%

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
closed stands (>50% canopy closure)	0.41	0.17
open stands (<50% canopy closure)	0.64	0.26

BT-MO-C

Aspen - Balsam Poplar / Rose / Kentucky Blue Grass / Strawberry

Boreal Transition: Moist Ecosite

GENERAL DESCRIPTION: Grazed community occurring in aspen-balsam poplar stands on the Moist Ecosite. This community is interpreted to show **significant alteration** from the reference community (BT-MO-A) as a result of grazing impact coupled with exotic invasion. It is similar to Alberta's "DMC18 Pb-Bw/Kentucky bluegrass" community (Willoughby et al. 2004). Non-native herbs, including Kentucky blue grass, smooth brome, clover, and dandelion, successfully invade aspen-balsam poplar stands in which the native shrubs and herbs have been weakened by grazing impact. Production of palatable forage appears to be higher in Kentucky blue grass stands than in reference communities, mainly because of the increased proportion of grass. While the ecological status of this community is low, reducing stocking rates will probably not reverse the invasion of exotic herbs. Therefore, recommended stocking rates are higher than for the reference community. Fire may kill exotic herbs and encourage resprouting of native shrubs, so may aid the transition back to a native community. Recommended stocking rates are based on average yields in closed poplar stands invaded by Kentucky blue grass; rates in open stands were estimated.

STRUCTURE

tree cover	?	moss cover (n=12)	2% (0 – 4)
tall shrub cover	?	lichen cover	?
short shrub cover	?	LFH thickness	?
prostrate shrub cover	?	litter cover (n=11)	69% (45 – 83)
herbaceous cover (n=12)	72% (62 – 83)	bare soil (n=12)	3% (0 – 6)

SPECIES COMPOSITION	**relative cover**
Major trees (n=10)	
trembling aspen (*Populus tremuloides*)	60% (43 - 75)
balsam poplar (*Populus balsamifera*)	39% (25 - 56)
Major tall shrubs (n=12)	
willow (*Salix spp.*)	5% (1 - 8)
beaked hazelnut (*Corylus cornuta*)	4% (0 - 10)
green alder (*Alnus crispa*)	3% (0 - 4)
red-osier dogwood (*Cornus stolonifera*)	1% (0 - 3)
Major short shrubs (n=12)	
rose (*Rosa spp.*)	6% (3 - 11)
snowberry (*Symphoricarpos spp.*)	3% (0 - 6)
wild red raspberry (*Rubus idaeus*)	3% (0 - 6)
northern gooseberry (*Ribes oxyacanthoides*)	1% (0 - 2)
Major prostrate shrubs (n=12)	
twinflower (*Linnaea borealis*)	1% (0 - 3)

Major graminoids (n=12)	
Kentucky blue grass (*Poa pratensis*)	9% (2 - 14)
hairy wild rye (*Elymus innovatus*)	5% (0 - 12)
bearded wheat grass (*Agropyron trachycaulum var. unilaterale*)	3% (0 - 7)
purple oat grass (*Schizachne purpurascens*)	2% (0 - 7)
slender wheat grass (*Agropyron trachycaulum var. trachycaulum*)	1% (0 - 3)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	1% (0 - 1)
fringed brome (*Bromus ciliatus*)	1% (0 - 2)
smooth brome (*Bromus inermis*)	1% (0 - 0)

Major forbs (n=12)	
smooth wild strawberry (*Fragaria virginiana*)	10% (5 - 14)
clover (*Trifolium spp.*)	4% (0 - 9)
violet (*Viola spp.*)	4% (1 - 8)
Lindley's aster (*Aster ciliolatus*)	4% (0 - 8)
wild peavine (*Lathyrus venosus*)	4% (0 - 12)
bunchberry (*Cornus canadensis*)	3% (0 - 6)
common dandelion (*Taraxacum officinale*)	2% (0 - 3)
northern bedstraw (*Galium boreale*)	2% (1 - 4)
goldenrod (*Solidago spp.*)	2% (0 - 6)
American vetch (*Vicia americana*)	2% (0 - 4)
woolly yarrow (*Achillea millefolium*)	1% (0 - 3)
palmate-leaved colt's-foot (*Petasites palmatus*)	1% (0 - 2)
two-leaved solomon's seal (*Maianthemum canadense*)	1% (0 - 2)
veiny meadow-rue (*Thalictrum venulosum*)	1% (0 - 1)
sweet-scented bedstraw (*Galium triflorum*)	1% (0 - 0)
cow-parsnip (*Heracleum lanatum*)	1% (0 - 2)
plantain (*Plantago spp.*)	1% (0 - 0)

Minor trees (n=10)	1%
white birch (*Betula papyrifera*), white spruce (*Picea glauca*)	

Minor tall shrubs (n=12)	1%
saskatoon (*Amelanchier alnifolia*), pincherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*), low bush-cranberry (*Viburnum edule*)	

Minor short shrubs (n=12)	1%
poison-ivy (*Rhus radicans*), Canada buffaloberry (*Shepherdia canadensis*)	

Minor graminoids (n=12)	2%
quack grass (*Agropyron repens*), rough hair grass (*Agrostis scabra*), marsh reed grass (*Calamagrostis canadensis*), june grass (*Koeleria macrantha*), timothy (*Phleum pratense*), Canada blue grass (*Poa compressa*)	

Minor forbs and prostrate shrubs (n=12) 5%

Canada anemone (*Anemone canadensis*), wild sarsaparilla (*Aralia nudicaulis*), bearberry (*Arctostaphylos uva-ursi*), showy aster (*Aster conspicuus*), many-flowered aster (*Aster ericoides ssp. pansus*), smooth aster (*Aster laevis*), pale comandra (*Comandra pallida*), fireweed (*Epilobium angustifolium*), common horsetail (*Equisetum arvense*), northern gentian (*Gentianella amarella*), wild licorice (*Glycyrrhiza lepidota*), Canada hawkweed (*Hieracium canadense*), cream-colored vetchling (*Lathyrus ochroleucus*), lungwort (*Mertensia paniculata*), bishop's-cap (*Mitella nuda*), arrow-leaved colt's-foot (*Petasites sagittatus*), common plantain (*Plantago major*), dewberry (*Rubus pubescens*), snakeroot (*Sanicula marilandica*), star-flowered solomon's-seal (*Smilacina stellata*), perennial sow-thistle (*Sonchus arvensis*), heart-leaved alexanders (*Zizia aptera*)

SIMILARITY TO REFERENCE COMMUNITY 47%

RECOMMENDED STOCKING RATES	AUM/ha	AUM/ac
closed stands (>50% canopy closure)	0.54	0.22
open stands (<50% canopy closure)	(0.84)	(0.34)

BT-MO-D

White Spruce - Aspen - Balsam Poplar / Sarsaparilla / Feathermoss

Boreal Transition: Moist Ecosite

GENERAL DESCRIPTION: **Reference community** for mixedwood stands on the Moist Ecosite. This community overlaps the the "e2 dogwood bP-wS" and "h2 horsetail bP-wS" ecosite phases of Beckingham et al. (1996). It is similar to Alberta's "DMD13 Sw-Pb/Red osier dogwood" community (Willoughby et al. 2004). Recommended stocking rates are based on reducing the hardwood-stand yield in proportion to the amount of conifer cover.

STRUCTURE

tree cover (n=37)	67% (32 – 100)	LFH thickness (n=37)	15 cm (7 – 30)
tall shrub cover (n=37)	14% (0 – 39)	litter cover (n=21)	57% (15 – 90)
short shrub cover (n=37)	11% (2 – 24)	- leaf litter (n=21)	49% (15 – 88)
prostrate shrub cover (n=37)	2% (0 – 5)	- needle litter (n=21)	7% (0 – 6)
herbaceous cover (n=37)	43% (7 – 93)	- woody material (n=21)	12% (1 – 29)
moss cover (n=37)	23% (1 – 81)	bare soil (n=21)	0% (0 – 0)
lichen cover (n=37)	2% (0 – 5)		

SPECIES COMPOSITION	% cover	relative cover
Major trees (n=37)		
white spruce (*Picea glauca*)	28% (0 - 63)	
trembling aspen (*Populus tremuloides*)	22% (0 - 38)	
balsam poplar (*Populus balsamifera*)	15% (0 - 38)	
black spruce (*Picea mariana*)	4% (0 - 20)	
balsam fir (*Abies balsamea*)	3% (0 - 10)	
white birch (*Betula papyrifera*)	2% (0 - 5)	
jack pine (*Pinus banksiana*)	2% (0 - 1)	
tamarack (*Larix laricina*)	1% (0 - 0)	
Major tall shrubs (n=37)		
speckled alder (*Alnus tenuifolia*)	3% (0 - 10)	4% (0 - 15)
red-osier dogwood (*Cornus stolonifera*)	3% (0 - 10)	4% (0 - 8)
beaked hazelnut (*Corylus cornuta*)	3% (0 - 5)	4% (0 - 7)
low bush-cranberry (*Viburnum edule*)	2% (0 - 4)	3% (0 - 7)
saskatoon (*Amelanchier alnifolia*)	1% (0 - 3)	1% (0 - 3)
willow (*Salix spp.*)	1% (0 - 3)	1% (0 - 2)
twining honeysuckle (*Lonicera dioica*)	1% (0 - 3)	1% (0 - 3)
Major short shrubs (n=37)		
prickly rose (*Rosa acicularis*)	4% (0 - 7)	6% (0 - 14)
snowberry (*Symphoricarpos spp.*)	1% (0 - 3)	1% (0 - 2)
swamp red currant (*Ribes triste*)	1% (0 - 3)	2% (0 - 3)
involucrate honeysuckle (*Lonicera involucrata*)	1% (0 - 3)	1% (0 - 3)
wild red raspberry (*Rubus idaeus*)	1% (0 - 3)	1% (0 - 2)
alder-leaved buckthorn (*Rhamnus alnifolia*)	1% (0 - 1)	1% (0 - 1)
northern gooseberry (*Ribes oxyacanthoides*)	1% (0 - 3)	1% (0 - 2)

Major prostrate shrubs (n=37)		
twinflower (*Linnaea borealis*)	2% (0 - 3)	3% (0 - 9)

Major graminoids (n=37)		
grasses (undifferentiated)	2% (0 - 4)	4% (0 - 6)
sedge (*Carex spp.*)	1% (0 - 3)	1% (0 - 3)

Major forbs (n=37)		
wild sarsaparilla (*Aralia nudicaulis*)	7% (0 - 12)	10% (0 - 26)
common horsetail (*Equisetum arvense*)	4% (0 - 7)	4% (0 - 7)
dewberry (*Rubus pubescens*)	4% (0 - 10)	5% (0 - 14)
bishop's-cap (*Mitella nuda*)	2% (0 - 5)	3% (0 - 10)
palmate-leaved colt's-foot (*Petasites palmatus*)	2% (0 - 10)	4% (0 - 11)
bunchberry (*Cornus canadensis*)	2% (0 - 6)	5% (0 - 11)
smooth wild strawberry (*Fragaria virginiana*)	2% (0 - 3)	2% (0 - 4)
lungwort (*Mertensia paniculata*)	1% (0 - 3)	3% (0 - 5)
two-leaved solomon's seal (*Maianthemum canadense*)	1% (0 - 3)	2% (0 - 3)
northern star-flower (*Trientalis borealis*)	1% (0 - 3)	2% (0 - 4)
Lindley's aster (*Aster ciliolatus*)	1% (0 - 3)	1% (0 - 3)
sweet-scented bedstraw (*Galium triflorum*)	1% (0 - 3)	1% (0 - 3)
pink wintergreen (*Pyrola asarifolia*)	1% (0 - 3)	1% (0 - 2)
fireweed (*Epilobium angustifolium*)	1% (0 - 3)	1% (0 - 2)
northern bedstraw (*Galium boreale*)	1% (0 - 3)	1% (0 - 2)
western Canada violet (*Viola canadensis*)	1% (0 - 3)	1% (0 - 3)
baneberry (*Actaea rubra*)	1% (0 - 3)	1% (0 - 3)
kidney-leaved violet (*Viola renifolia*)	1% (0 - 3)	1% (0 - 2)
American vetch (*Vicia americana*)	1% (0 - 3)	0% (0 - 2)

Major bryophytes and lichens (n=37)	
Hylocomium splendens	9% (0 - 38)
Pleurozium schreberi	8% (0 - 26)
Ptilium crista-castrensis	1% (0 - 3)
Peltigera spp.	1% (0 - 4)

Minor tall shrubs (n=37)	1%	1%
mountain maple (*Acer spicatum*), green alder (*Alnus crispa*), pincherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*), western mountain-ash (*Sorbus scopulina*)		

Minor short shrubs (n=37)	2%	4%
labrador-tea (*Ledum groenlandicum*), blue fly honeysuckle (*Lonicera caerulea*), swamp fly honeysuckle (*Lonicera oblongifolia*), wild black currant (*Ribes americanum*), skunk currant (*Ribes glandulosum*), hairy-stem gooseberry (*Ribes hirtellum*), northern black currant (*Ribes hudsonianum*), bristly black currant (*Ribes lacustre*), Canada buffaloberry (*Shepherdia canadensis*), velvet-leaf blueberry (*Vaccinium myrtilloides*)		

Minor graminoids (n=37)	1%	1%
slender wheat grass (*Agropyron trachycaulum var. trachycaulum*), fringed brome (*Bromus ciliatus*), marsh reed grass (*Calamagrostis canadensis*), northern reed grass (*Calamagrostis inexpansa*), slender wood grass (*Cinna latifolia*), hairy wild rye (*Elymus innovatus*), white-grained mountain rice grass (*Oryzopsis asperifolia*), purple oat grass (*Schizachne purpurascens*)		

Minor forbs and prostrate shrubs (n=37) 8% 10%
woolly yarrow (*Achillea millefolium*), giant hyssop (*Agastache foeniculum*), spreading dogbane (*Apocynum androsaemifolium*), showy aster (*Aster conspicuus*), American milk-vetch (*Astragalus americanus*), marsh-marigold (*Caltha palustris*), enchanter's nightshade (*Circaea alpina*), Canada thistle (*Cirsium arvense*), spotted coral-root (*Corallorhiza maculata*), scapose hawk's-beard (*Crepis runcinata*), fairybells (*Disporum trachycarpum*), spinulose shield fern (*Dryopteris carthusiana*), meadow horsetail (*Equisetum pratense*), dwarf scouring-rush (*Equisetum scirpoides*), woodland horsetail (*Equisetum sylvaticum*), woodland strawberry (*Fragaria vesca*), hemp-nettle (*Galeopsis tetrahit*), northern comandra (*Geocaulon lividum*), yellow avens (*Geum aleppicum*), dwarf rattlesnake-plantain (*Goodyera repens*), blunt-leaved orchid (*Habenaria obtusata*), cow-parsnip (*Heracleum lanatum*), Canada hawkweed (*Hieracium canadense*), cream-colored vetchling (*Lathyrus ochroleucus*), wild peavine (*Lathyrus venosus*), wood lily (*Lilium philadelphicum*), stiff clubmoss (*Lycopodium annotinum*), running clubmoss (*Lycopodium clavatum*), ground-cedar (*Lycopodium complanatum*), white adder's-mouth orchid (*Malaxis monophylla*), wild mint (*Mentha arvensis*), blunt-leaved sandwort (*Moehringia lateriflora*), one-flowered wintergreen (*Moneses uniflora*), one-sided wintergreen (*Orthilia secunda*), arrow-leaved colt's-foot (*Petasites sagittatus),* vine-leaved colt's-foot *(Petasites vitifolius),* green wintergreen *(Pyrola chlorantha),* snakeroot (*Sanicula marilandica*), star-flowered solomon's-seal (*Smilacina stellata*), Canada goldenrod (*Solidago canadensis*), hairy goldenrod (*Solidago hispida*), marsh hedge-nettle (*Stachys palustris*), northern stitchwort (*Stellaria calycantha*), long-leaved stitchwort (*Stellaria longifolia*), common dandelion (*Taraxacum officinale*), tall meadow-rue (*Thalictrum dasycarpum*), veiny meadow-rue (*Thalictrum venulosum*), dry-ground cranberry (*Vaccinium vitis-idaea*), marsh violet (*Viola palustris*)

Minor bryophytes and lichens (n=37) 6%
Cladina / *Cladonia* spp., *Climacium dendroides, Dicranum* spp., *Drepanocladus uncinatus*, other bryophytes and lichens

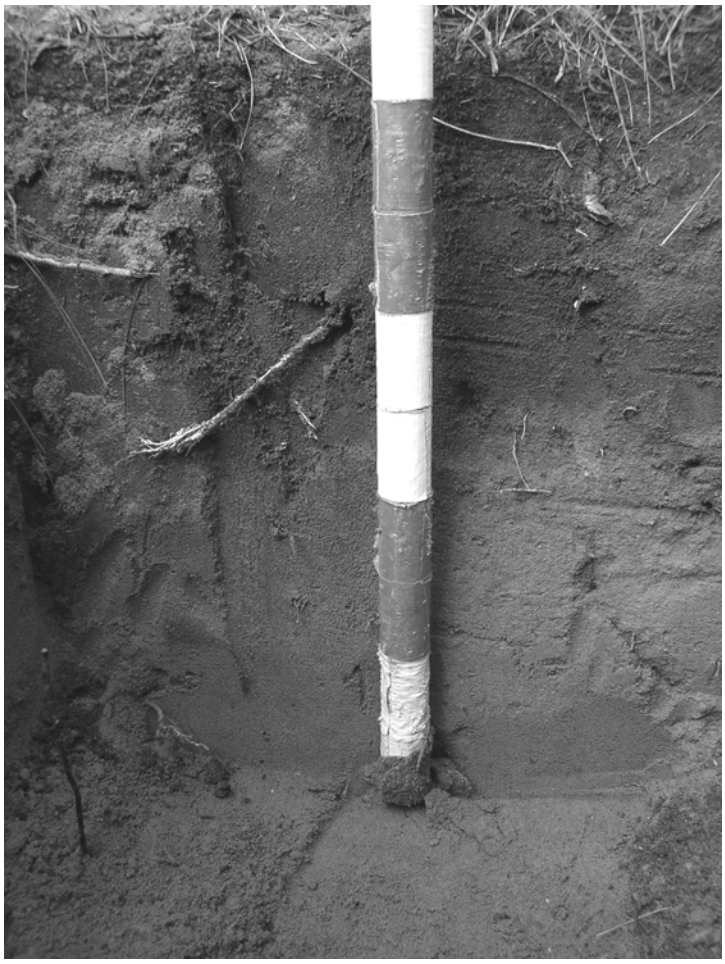
RECOMMENDED STOCKING RATES	AUM/ha	AUM/ac
conifer cover 10%	0.38	0.15
conifer cover 20%	0.35	0.14
conifer cover 30%	0.31	0.13
conifer cover 40%	0.28	0.11
conifer cover 50%	0.25	0.10
conifer cover 60%	0.22	0.09
conifer cover 70%	0.18	0.07

5.3 Aspen Parkland Ecoregion

5.3.1 Submesic Sand Ecosite

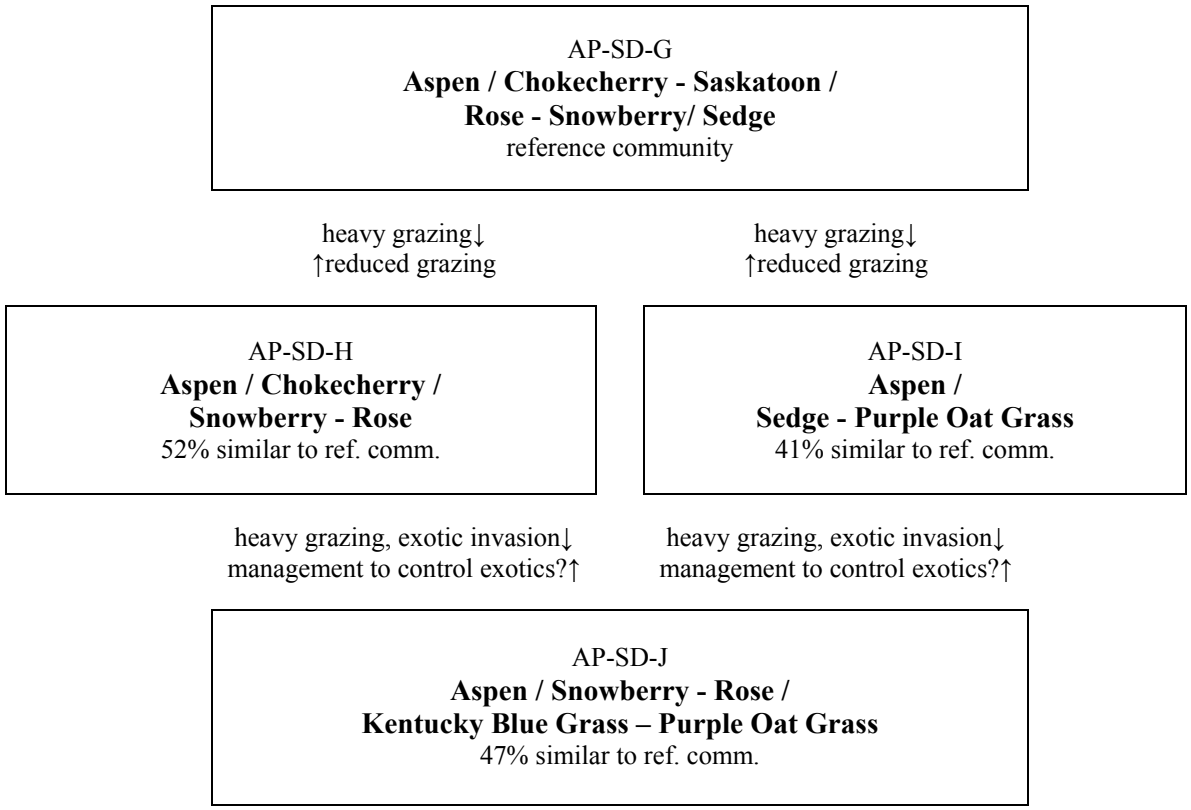
This ecosite includes coarse-textured soils with relatively little water-table influence. These soils occur mainly on glacio-fluvial or eolian landforms. Much of the data used to describe this type came from the Manito Sand Hills, the Battle River area, the Batoche area, and the Dundurn Sand Hills. Since only aspen stands were used in the classification, this ecosite includes mainly the subxeric to submesic areas on sand deposits, as opposed to the more xeric areas covered with grassland[3]. These subxeric to submesic areas may be on north-facing slopes or lower topographic positions, or have shallower depths of sand above impermeable materials.

Soils are predominantly Regosols. Common soil associations include Edam (Black Soil Zone) and Vera (Dark Brown Soil Zone), which develop on wind-worked fluvial material. The drainage class is usually rated as "rapidly drained" (LRRI 1983) because of the coarse-textured material. Some plots are rated as "well drained". Mottling and gleying are normally absent, although some rust-coloured mottles may occur in the lower part of soil profile. The moisture regime would be described as "subxeric to submesic" (AEP 1994, Beckingham et al. 1996), or as "moderately fresh to fresh" (SE 2004).



[3] Grasslands on sandy soils in the Aspen Parkland are described in Thorpe (2007c).

STATE-AND-TRANSITION DIAGRAM
Aspen Parkland: Submesic Sand Ecosite



AP-SD-G

Aspen / Chokecherry - Saskatoon / Rose - Snowberry / Sedge

Aspen Parkland: Submesic Sand Ecosite

GENERAL DESCRIPTION: **Reference community** for aspen stands on sandy soils in the Aspen Parkland. Both ungrazed and lightly grazed plots were used in describing this community. Note that this community includes Kentucky blue grass, which is exotic, as a major species. Stands that are totally free of exotics are hard to find in the Aspen Parkland, so this should be regarded as a "realistic" reference community, rather than an ideal one. This community, especially in open aspen stands, combines high grass production with significant yield from palatable shrubs and forbs, so recommended stocking rates are high. Recommended stocking rates are based on average yields in open stands of this community; rates for closed stands are estimated.

STRUCTURE

tree cover (n=13)	48% (38 – 63)	moss cover (n=8)	2% (0 – 6)
tall shrub cover (n=16)	26% (7 – 56)	lichen cover	?
short shrub cover (n=16)	19% (2 – 35)	LFH thickness (n=7)	2 cm (0 – 3)
prostrate shrub cover (n=16)	1% (0 – 4)	litter cover (n=5)	74% (56 – 93)
herbaceous cover (n=16)	23% (1 – 50)	bare soil (n=8)	0% (0 – 0)

SPECIES COMPOSITION	**% cover**
Major trees (n=13)	
trembling aspen (*Populus tremuloides*)	48% (38 - 63)
Major tall shrubs (n=16)	
chokecherry (*Prunus virginiana*)	12% (1 - 26)
saskatoon (*Amelanchier alnifolia*)	11% (0 - 23)
pincherry (*Prunus pensylvanica*)	3% (0 - 15)
beaked hazelnut (*Corylus cornuta*)	2% (0 - 8)
twining honeysuckle (*Lonicera dioica*)	1% (0 - 3)
Major short shrubs (n=16)	
rose (Rosa spp.)	8% (1 - 15)
snowberry (*Symphoricarpos spp*.)	6% (0 - 15)
wild red raspberry (*Rubus idaeus*)	1% (0 - 0)
Major prostrate shrubs (n=16)	
bearberry (*Arctostaphylos uva-ursi*)	1% (0 - 3)
Major graminoids (n=16)	
sedge (*Carex spp.*, especially *C. siccata and C. obtusata*)	5% (0 - 13)
Kentucky blue grass (*Poa pratensis*)	2% (0 - 6)
purple oat grass (*Schizachne purpurascens*)	2% (0 - 7)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	1% (0 - 2)
Hooker's oat grass (*Helictotrichon hookeri*)	1% (0 - 2)

Major forbs (n=16)	
vetchling (*Lathyrus spp*.)	2% (0 - 5)
northern bedstraw (*Galium boreale*)	2% (0 - 4)
wild sarsaparilla (*Aralia nudicaulis*)	1% (0 - 1)
star-flowered solomon's-seal (*Smilacina stellata*)	1% (0 - 2)
golden bean (*Thermopsis rhombifolia*)	1% (0 - 2)
two-leaved solomon's seal (*Maianthemum canadense*)	1% (0 - 2)
veiny meadow-rue (*Thalictrum venulosum*)	1% (0 - 2)
American vetch (*Vicia americana*)	1% (0 - 1)

Minor tall shrubs (n=16)	0%
wolf-willow (*Elaeagnus commutata*), Bebb willow (*Salix bebbiana*)	

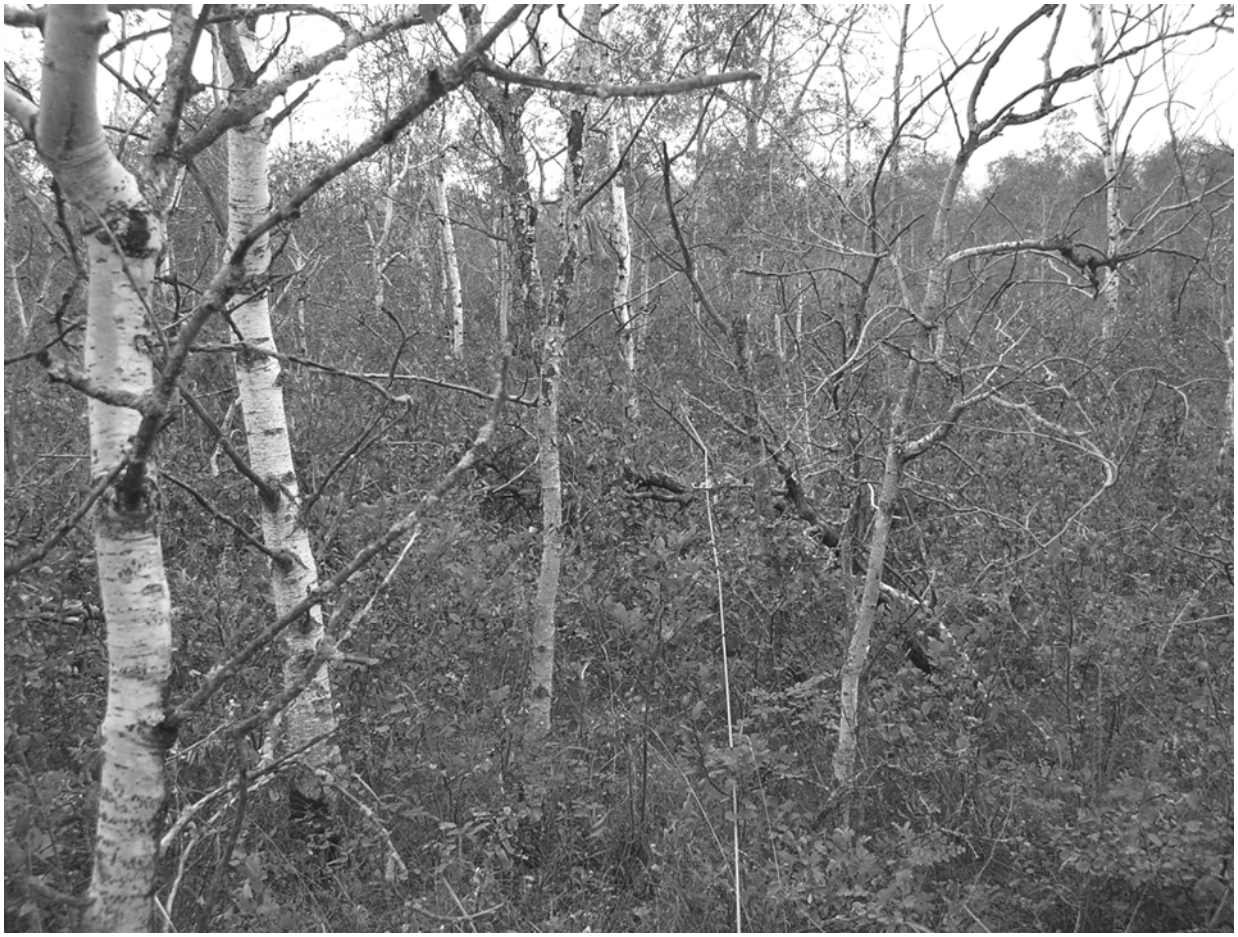
Minor short shrubs (n=16)	0%
currant (*Ribes spp*.), narrow-leaved meadowsweet (*Spiraea alba*)	

Minor graminoids (n=16)	1%
bearded wheat grass (*Agropyron trachycaulum var. unilaterale*), rough hair grass (*Agrostis scabra*), blue grama (*Bouteloua gracilis*), sand grass (*Calamovilfa longifolia*), plains rough fescue (*Festuca hallii*)	

Minor forbs and prostrate shrubs (n=16)	2%
woolly yarrow (*Achillea millefolium*), pasture sage (*Artemisia frigida*), Lindley's aster (*Aster ciliolatus*), narrow-leaved milk-vetch (*Astragalus pectinatus*), harebell (*Campanula rotundifolia*), field chickweed (*Cerastium arvense*), horsetail (*Equisetum spp*.), smooth wild strawberry (*Fragaria virginiana*), creeping juniper (*Juniperus horizontalis*), goldenrod (*Solidago spp*.), common dandelion (*Taraxacum officinale*), violet (*Viola spp*.)	

SIMILARITY TO REFERENCE COMMUNITY	ref. comm.

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
closed stands (>50% canopy closure)	(0.71)	(0.29)
open stands (<50% canopy closure)	1.05	0.43



AP-SD-H

Aspen / Chokecherry / Snowberry – Rose

Aspen Parkland: Submesic Sand Ecosite

GENERAL DESCRIPTION: Grazed community in aspen stands on the sandy soils in the Aspen Parkland. Interpreted as showing **minor to moderate alteration** from the reference community (AP-SD-G) as a result of grazing impact. This community includes grazed stands in which snowberry is the main increaser. It probably develops from AP-SD-G by decrease in chokecherry, saskatoon, and graminoids, and increase in snowberry. This community appears to develop in stands with a denser tree canopy, compared to the open, grassy stands included in AP-SD-I. Recommended stocking rates for closed stands are based on average yields in closed shrubby stands that have been altered by grazing; rates in open stands are estimated. The transition to a low shrub type results in lower recommended stocking rates compared to the reference community.

STRUCTURE

tree cover (n=9)	70% (40 – 90)	moss cover (n=5)	0% (0 – 1)
tall shrub cover (n=9)	12% (0 – 26)	lichen cover	?
short shrub cover (n=9)	28% (6 – 63)	LFH thickness	?
prostrate shrub cover (n=9)	1% (0 – 1)	litter cover (n=5)	87% (74 – 97)
herbaceous cover (n=9)	22% (1 – 48)	bare soil (n=5)	1% (0 – 3)

SPECIES COMPOSITION	**% cover**
Major trees (n=9)	
trembling aspen (*Populus tremuloides*)	69% (40 - 92)
balsam poplar (*Populus balsamifera*)	2% (0 - 3)
Major tall shrubs (n=9)	
chokecherry (*Prunus virginiana*)	5% (0 - 15)
saskatoon (*Amelanchier alnifolia*)	3% (0 - 7)
twining honeysuckle (*Lonicera dioica*)	2% (0 - 6)
wolf-willow (*Elaeagnus commutata*)	2% (0 - 3)
river birch (*Betula occidentalis*)	1% (0 - 2)
Major short shrubs (n=9)	
snowberry (*Symphoricarpos spp*.)	28% (4 - 63)
rose (*Rosa spp*.)	7% (0 - 16)
Major prostrate shrubs (n=9)	
bearberry (*Arctostaphylos uva-ursi*)	1% (0 - 1)
Major graminoids (n=9)	
sedge (*Carex spp*.)	3% (0 - 10)
bearded wheat grass (*Agropyron trachycaulum var. unilaterale*)	1% (0 - 3)
purple oat grass (*Schizachne purpurascens*)	1% (0 - 2)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	1% (0 - 1)

Major forbs (n=9)	
northern bedstraw (*Galium boreale*)	2% (0 - 5)
vetchling (*Lathyrus spp*.)	2% (0 - 6)
golden bean (*Thermopsis rhombifolia*)	2% (0 - 4)
violet (*Viola spp*.)	1% (0 - 4)
smooth wild strawberry (*Fragaria virginiana*)	1% (0 - 4)

Minor tall shrubs (n=9)	0%
red-osier dogwood (*Cornus stolonifera*), willow (*Salix spp*.)	

Minor short shrubs (n=9)	1%
poison-ivy (*Rhus radicans*), currant (*Ribes spp*.), wild red raspberry (*Rubus idaeus*), narrow-leaved meadowsweet (*Spiraea alba*)	

Minor graminoids (n=9)	1%
marsh reed grass (*Calamagrostis canadensis*), northern reed grass (*Calamagrostis inexpansa*), Hooker's oat grass (Helictotrichon hookeri), baltic rush (Juncus balticus), northern rice grass (*Oryzopsis pungens*), Kentucky blue grass (*Poa pratensis*)	

Minor forbs (n=9)	4%
woolly yarrow (*Achillea millefolium*), pygmy-flower (*Androsace septentrionalis*), prairie sage (*Artemisia ludoviciana*), smooth aster (*Aster laevis*), field chickweed (*Cerastium arvense*), pale comandra (*Comandra pallida*), horsetail (*Equisetum spp*.), three-flowered avens (*Geum triflorum*), blunt-leaved sandwort (*Moehringia lateriflora*), star-flowered solomon's-seal (*Smilacina stellata*), goldenrod (*Solidago spp*.), common dandelion (*Taraxacum officinale*), veiny meadow-rue (*Thalictrum venulosum*)	

SIMILARITY TO REFERENCE COMMUNITY	52%

RECOMMENDED STOCKING RATES	AUM/ha	AUM/ac
closed stands (>50% canopy closure)	0.22	0.09
open stands (<50% canopy closure)	(0.32)	(0.13)

AP-SD-I

Aspen / Sedge - Purple Oat Grass

Aspen Parkland: Submesic Sand Ecosite

GENERAL DESCRIPTION: Grazed community in aspen stands on sandy soils in the Aspen Parkland. Interpreted as showing **moderate alteration** from the reference community (AP-SD-G) as a result of grazing impact. This community includes the grassy stands that develop under grazing in some areas. It probably develops from AP-SD-G by decrease in shrubs and increase in graminoids. This community appears to develop in stands with a more open tree canopy, compared to AP-SD-H. The structure data show generally low tree cover, and the species composition includes several grassland species (e.g. rough fescue, Hooker's oat grass, golden bean, pasture sage) which would only be expected in open areas. The recommended stocking rates are based on average yields in open grassy stands that have been altered by grazing; rates for closed stands are estimated. While high grass yield leads to relatively high recommended stocking rates, these are somewhat lower than in the reference community because there is less palatable shrub and forb yield.

STRUCTURE

tree cover (n=13)	35% (15 – 59)	moss cover (n=25)	4% (0 – 14)
tall shrub cover (n=30)	4% (0 – 13)	lichen cover	?
short shrub cover (n=30)	5% (0 – 15)	LFH thickness (n=6)	2 cm (0 – 5)
prostrate shrub cover (n=30)	1% (0 – 5)	litter cover (n=24)	41% (4 – 89)
herbaceous cover (n=30)	53% (21 – 87)	bare soil (n=25)	2% (0 – 3)

SPECIES COMPOSITION	**% cover**
Major trees (n=13)	
trembling aspen (*Populus tremuloides*)	34% (15 - 59)
Major tall shrubs (n=30)	
twining honeysuckle (*Lonicera dioica*)	1% (0 - 5)
river birch (*Betula occidentalis*)	1% (0 - 0)
chokecherry (*Prunus virginiana*)	1% (0 - 2)
wolf-willow (*Elaeagnus commutata*)	1% (0 - 0)
Major short shrubs (n=30)	
rose (*Rosa spp*.)	3% (0 - 15)
snowberry (*Symphoricarpos spp*.)	2% (0 - 2)
Major prostrate shrubs (n=30)	
bearberry (*Arctostaphylos uva-ursi*)	1% (0 - 1)
creeping juniper (*Juniperus horizontalis*)	1% (0 - 1)

Major graminoids (n=30)	
sedge (*Carex spp.*, especially *C. siccata*)	15% (1 - 33)
purple oat grass (*Schizachne purpurascens*)	8% (0 - 19)
northern bedstraw (*Galium boreale*)	4% (0 - 9)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 - 8)
bearded wheat grass (*Agropyron trachycaulum var. unilaterale*)	2% (0 - 7)
plains rough fescue (*Festuca hallii*)	1% (0 - 6)
Kentucky blue grass (*Poa pratensis*)	1% (0 - 3)
northern rice grass (*Oryzopsis pungens*)	1% (0 - 3)
baltic rush (*Juncus balticus*)	1% (0 - 1)
Hooker's oat grass (*Helictotrichon hookeri*)	1% (0 - 0)

Major forbs (n=30)	
vetchling (*Lathyrus spp.*)	2% (0 - 7)
American vetch (*Vicia americana*)	1% (0 - 1)
golden bean (*Thermopsis rhombifolia*)	1% (0 - 2)
smooth wild strawberry (*Fragaria virginiana*)	1% (0 - 3)
goldenrod (*Solidago spp.*)	1% (0 - 2)
veiny meadow-rue (*Thalictrum venulosum*)	1% (0 - 0)
pasture sage (*Artemisia frigida*)	1% (0 - 1)
woolly yarrow (*Achillea millefolium*)	1% (0 - 1)

Minor tall shrubs (n=30)	1%
saskatoon (*Amelanchier alnifolia*), willow (*Salix spp.*)	

Minor short shrubs (n=30)	0%
wild red raspberry (*Rubus idaeus*), narrow-leaved meadowsweet (*Spiraea alba*)	

Minor graminoids (n=30)	2%
northern wheat grass (*Agropyron dasystachyum*), western wheat grass (*Agropyron smithii*), blue grama (*Bouteloua gracilis*), smooth brome (*Bromus inermis*), northern reed grass (*Calamagrostis inexpansa*), plains reed grass (*Calamagrostis montanensis*), sand grass (*Calamovilfa longifolia*), sheep fescue (*Festuca saximontana*), june grass (*Koeleria macrantha*), sand dropseed (*Sporobolus cryptandrus*), needle-and-thread (*Stipa comata*), western porcupine grass (*Stipa curtiseta*)	

Minor forbs (n=30)	7%
pygmy-flower (*Androsace septentrionalis*), crocus anemone (*Anemone patens*), everlasting (*Antennaria spp.*), plains wormwood (*Artemisia campestris*), prairie sage (*Artemisia ludoviciana*), aster (*Aster spp.*), field chickweed (*Cerastium arvense*), pale comandra (*Comandra pallida*), horsetail (*Equisetum spp.*), three-flowered avens (*Geum triflorum*), two-leaved solomon's seal (*Maianthemum canadense*), wild bergamot (*Monarda fistulosa*), common plantain (*Plantago major*), wintergreen (*Pyrola spp.*), dock (*Rumex spp.*), star-flowered solomon's-seal (*Smilacina stellata*), violet (*Viola spp.*)	

SIMILARITY TO REFERENCE COMMUNITY	41%

RECOMMENDED STOCKING RATES	AUM/ha	AUM/ac
closed stands (>50% canopy closure)	(0.50)	(0.20)
open stands (<50% canopy closure)	0.74	0.30

AP-SD-J

Aspen / Snowberry - Rose / Kentucky Blue Grass – Purple Oat Grass

Aspen Parkland: Submesic Sand Ecosite

GENERAL DESCRIPTION: Grazed community in aspen stands on sandy soils in the Aspen Parkland. Interpreted as showing **significant alteration** from the reference community (AP-SD-G) as a result of grazing impact coupled with exotic invasion. Kentucky blue grass, as well as forbs such as dandelion, invade stands in which the native shrubs and herbs have been weakened by grazing. Recommended stocking rates are based on average yields in open grassy stands that have been altered by grazing; rates for closed stands are estimated. While high grass yield leads to relatively high recommended stocking rates, these are somewhat lower than in the reference community because there is less yield of palatable shrubs and forbs.

STRUCTURE

tree cover (n=8)	59% (46 – 73)	moss cover (n=12)	1% (0 – 1)
tall shrub cover (n=12)	7% (0 – 22)	lichen cover	?
short shrub cover (n=12)	9% (0 – 20)	LFH thickness	?
prostrate shrub cover (n=12)	1% (0 – 4)	litter cover (n=10)	66% (2 – 98)
herbaceous cover (n=12)	48% (38 – 58)	bare soil (n=12)	2% (0 – 3)

SPECIES COMPOSITION	**% cover**
Major trees (n=8)	
trembling aspen (*Populus tremuloides*)	59% (46 - 73)
Major tall shrubs (n=12)	
chokecherry (*Prunus virginiana*)	3% (0 - 10)
saskatoon (*Amelanchier alnifolia*)	3% (0 - 5)
wolf-willow (*Elaeagnus commutata*)	1% (0 - 5)
willow (*Salix spp*.)	1% (0 - 1)
Major short shrubs (n=12)	
snowberry (*Symphoricarpos spp*.)	15% (0 - 49)
rose (*Rosa spp*.)	5% (0 - 10)
wild red raspberry (*Rubus idaeus*)	1% (0 - 1)
Major prostrate shrubs (n=12)	
bearberry (*Arctostaphylos uva-ursi*)	1% (0 - 4)
Major graminoids (n=12)	
Kentucky blue grass (*Poa pratensis*)	16% (5 - 27)
purple oat grass (*Schizachne purpurascens*)	6% (0 - 12)
sedge (*Carex spp.*, especially *C. siccata*)	4% (0 - 12)
bearded wheat grass (*Agropyron trachycaulum var. unilaterale*)	4% (0 - 9)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 - 6)
baltic rush (*Juncus balticus*)	1% (0 - 1)

Major forbs (n=12)	
northern bedstraw (Galium boreale)	4% (0 - 8)
golden bean (Thermopsis rhombifolia)	2% (0 - 4)
vetchling (Lathyrus spp.)	2% (0 - 4)
violet (*Viola spp*.)	1% (0 - 2)
common dandelion (*Taraxacum officinale*)	1% (0 - 3)
American vetch (*Vicia americana*)	1% (0 - 2)
smooth wild strawberry (*Fragaria virginiana*)	1% (0 - 2)

Minor tall shrubs (n=12)	0%
pincherry (*Prunus pensylvanica*)	

Minor short shrubs (n=12)	0%
currant (*Ribes spp*.)	

Minor graminoids (n=12) 2%

blue grama (*Bouteloua gracilis*), fringed brome (*Bromus ciliatus*), smooth brome (*Bromus inermis*), plains reed grass (*Calamagrostis montanensis*), plains rough fescue (*Festuca hallii*), june grass (*Koeleria macrantha*), northern rice grass (*Oryzopsis pungens*)

Minor forbs (n=12) 5%

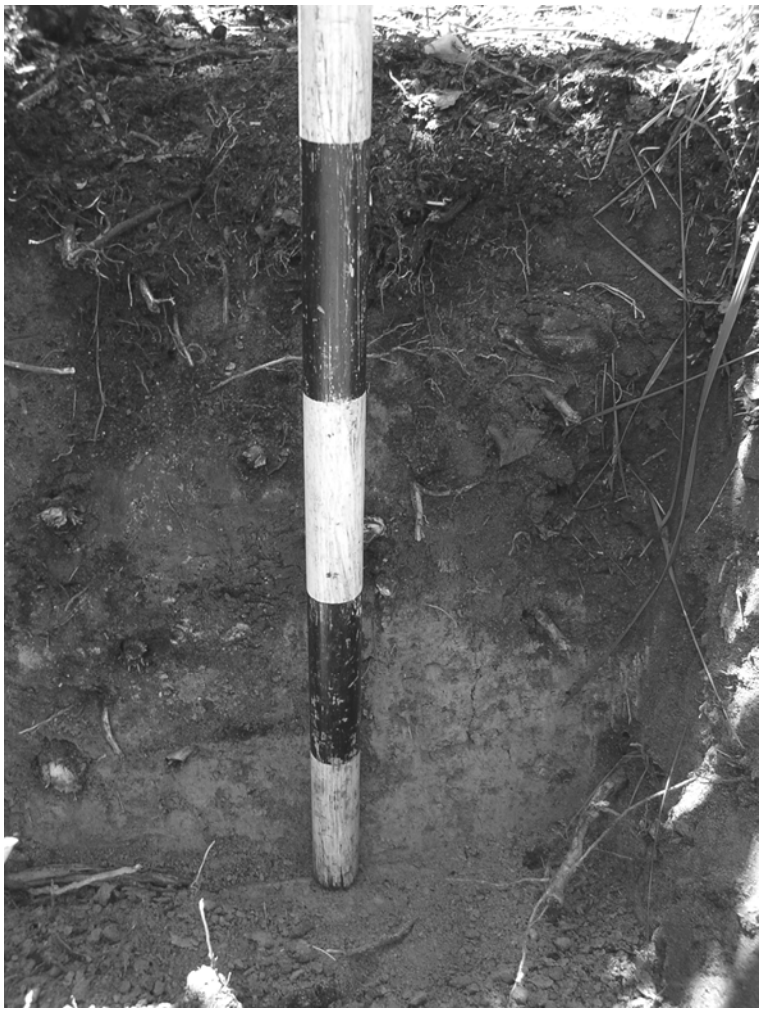
woolly yarrow (*Achillea millefolium*), everlasting (*Antennaria spp*.), prairie sage (*Artemisia ludoviciana*), Lindley's aster (*Aster ciliolatus*), smooth aster (*Aster laevis*), harebell (*Campanula rotundifolia*), field chickweed (*Cerastium arvense*), pale comandra (*Comandra pallida*), wild licorice (*Glycyrrhiza lepidota*), two-leaved solomon's seal (*Maianthemum canadense*), blunt-leaved sandwort (*Moehringia lateriflora*), wintergreen (*Pyrola spp*.), star-flowered solomon's-seal (*Smilacina stellata*), goldenrod (*Solidago spp*.), veiny meadow-rue (*Thalictrum venulosum*)

SIMILARITY TO REFERENCE COMMUNITY	47%

RECOMMENDED STOCKING RATES	AUM/ha	AUM/ac
closed stands (>50% canopy closure)	(0.50)	(0.20)
open stands (<50% canopy closure)	0.74	0.30

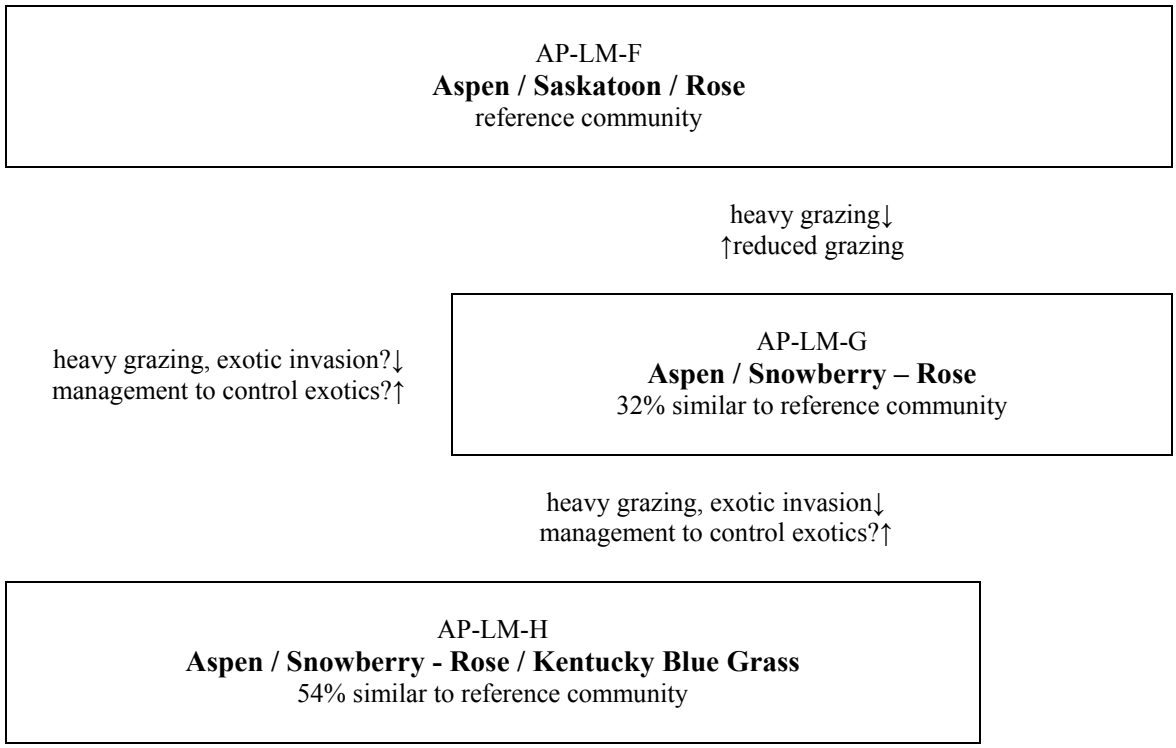
5.3.2 Mesic Loam Ecosite

This ecosite includes mesic sites (i.e. sites with intermediate moisture availability) on medium to moderately fine-textured soils that support aspen stands. These sites occur mainly on morainal landforms, with textures of loam to clay loam, or occasionally clay. Soils range from Dark Brown to Black to Dark Gray Chernozems, or even Gray Luvisols in some areas. Common soil associations include Weyburn, Oxbow, Whitewood, and Waitville. The drainage class is usually rated as "well drained" or "moderately well drained". Gleying is absent, while mottling is either absent or restricted to the lower part of the soil profile (moderately well drained soils). The moisture regime would be rated as "mesic" (AEP 1994, Beckingham et al. 1996) or "very fresh" (SE 2004). On rolling moraines in the Aspen Parkland, grasslands[4] occur on warmer and drier slope positions (crests and south-facing slopes), while the forests of the Mesic Loam Ecosite are found on cooler and moister positions such as north-facing slopes and depressions. However depressional slope positions are often moist enough to belong in the Moist Ecosite (see below) rather than the Mesic Loam Ecosite.



[4] Grasslands of loamy soils in the Aspen Parkland are described in Thorpe (2007b).

STATE-AND-TRANSITION DIAGRAM
Aspen Parkland: Mesic Loam Ecosite



AP-LM-F

Aspen / Saskatoon / Rose

Aspen Parkland: Mesic Loam Ecosite

GENERAL DESCRIPTION: **Reference community** for aspen stands on the Mesic Loam Ecosite in the Aspen Parkland. This reference community is **tentative** because of the small number of plots available for characterizing it. Note that AP-LM-F includes Kentucky blue grass and dandelion, which are exotic, as major species. Stands that are totally free of exotics are hard to find in the Aspen Parkland, so this should be regarded as a "realistic" reference community, rather than an ideal one. Stands with a dense hazelnut understory are also found on this ecosite, especially in the moister parts of the Aspen Parkland, but data were insufficient to describe a community of this type. Recommended stocking rates are based on average yields in open and closed hardwood stands. Recommended stocking rates would be lower in stands with a dense hazelnut layer (approximately 0.12 AUM/ac).

STRUCTURE

tree cover	?	moss cover (n=5)	0% (0 – 1)
tall shrub cover (n=6)	13% (3 – 24)	lichen cover	?
short shrub cover (n=6)	22% (7 – 46)	LFH thickness (n=4)	6 cm (4 – 8)
prostrate shrub cover (n=6)	0% (0 – 0)	litter cover	?
herbaceous cover (n=6)	38% (7 – 62)	bare soil (n=5)	0% (0 – 0)

SPECIES COMPOSITION	percent cover
Major trees (n=3)	
trembling aspen (Populus tremuloides)	41% (12 - 72)
balsam poplar (Populus balsamifera)	13% (0 - 32)
Major tall shrubs (n=6)	
saskatoon (Amelanchier alnifolia)	9% (2 - 18)
beaked hazelnut (Corylus cornuta)	3% (0 - 9)
chokecherry (Prunus virginiana)	2% (0 - 4)
willow (Salix spp.)	2% (0 - 5)
red-osier dogwood (Cornus stolonifera)	1% (0 - 4)
Major short shrubs (n=6)	
rose (Rosa spp.)	9% (3 - 19)
western snowberry (Symphoricarpos occidentalis)	4% (0 - 10)
wild red raspberry (Rubus idaeus)	2% (0 - 7)
currant (Ribes spp.)	1% (0 - 2)
Major graminoids (n=6)	
white-grained mountain rice grass (Oryzopsis asperifolia)	4% (0 - 12)
hay sedge (Carex siccata)	2% (0 - 6)
Kentucky blue grass (Poa pratensis)	2% (0 - 6)
bearded wheat grass (Agropyron trachycaulum var. unilaterale)	1% (0 - 3)
hairy wild rye (Elymus innovatus)	1% (0 - 2)
purple oat grass (Schizachne purpurascens)	1% (0 - 2)

Major forbs (n=6)	
violet (Viola spp.)	4% (0 - 9)
smooth wild strawberry (Fragaria virginiana)	4% (0 - 8)
spreading dogbane (Apocynum androsaemifolium)	2% (0 - 7)
wild sarsaparilla (Aralia nudicaulis)	2% (0 - 7)
wild peavine (Lathyrus venosus)	2% (0 - 4)
Lindley's aster (Aster ciliolatus)	1% (0 - 4)
common dandelion (Taraxacum officinale)	1% (0 - 3)
fireweed (Epilobium angustifolium)	1% (0 - 3)
cream-colored vetchling (Lathyrus ochroleucus)	1% (0 - 3)
showy aster (Aster conspicuus)	1% (0 - 2)
American vetch (Vicia americana)	1% (0 - 2)
two-leaved solomon's seal (Maianthemum canadense)	1% (0 - 2)
star-flowered solomon's-seal (Smilacina stellata)	1% (0 - 2)
fairybells (Disporum trachycarpum)	1% (0 - 2)
veiny meadow-rue (Thalictrum venulosum)	1% (0 - 1)
northern bedstraw (Galium boreale)	1% (0 - 1)

Minor tall shrubs (n=6)	1%
twining honeysuckle (Lonicera dioica), pincherry (Prunus pensylvanica), low bush-cranberry (Viburnum edule)	

Minor short shrubs (n=6)	0%
Canada buffaloberry (Shepherdia canadensis), few-flowered snowberry (Symphoricarpos albus)	

Minor graminoids (n=6)	1%
slender wheat grass (Agropyron trachycaulum var. trachycaulum), redtop (Agrostis stolonifera), smooth brome (Bromus inermis), blunt sedge (Carex obtusata)	

Minor forbs (n=6)	2%
baneberry (Actaea rubra), Canada anemone (Anemone canadensis), smooth aster (Aster laevis), milk-vetch (Astragalus spp.), bunchberry (Cornus canadensis), fringed loosestrife (Lysimachia ciliata), one-sided wintergreen (Orthilia secunda), common plantain (Plantago major), pink wintergreen (Pyrola asarifolia), dewberry (Rubus pubescens), Canada goldenrod (Solidago canadensis), long-leaved stitchwort (Stellaria longifolia)	

SIMILARITY TO REFERENCE COMMUNITY	ref. comm.

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
closed stands (>50% canopy closure)	0.42	0.17
open stands (<50% canopy closure)	0.62	0.25

AP-LM-G

Aspen / Snowberry – Rose

Aspen Parkland: Mesic Loam Ecosite

GENERAL DESCRIPTION: Grazed community occurring in aspen stands on the Mesic Loam Ecosite in the Aspen Parkland. This community is interpreted as showing **significant alteration** from the reference community (AP-LM-A) as a result of grazing impact. The main changes are decreases in tall shrubs, including the palatable saskatoon, chokecherry, pincherry, and dogwood, and a large increase in snowberry. Data were limited for this ecosite. One anomaly is the appearance of European buckthorn as a major tall shrub. This is an uncommon exotic invader, which happened to appear in a few of the plots for which data were available. However, it should not be expected in most areas. Recommended stocking rates are based on averaged yields in closed shrubby stands that have been altered by grazing; rates in open stands are estimated. The transition to a low shrub type results in lower recommended stocking rates compared to the reference community.

STRUCTURE

tree cover (n=9)	47% (15 – 69)	moss cover (n=)	?
tall shrub cover (n=9)	4% (0 – 7)	lichen cover (n=)	?
short shrub cover (n=9)	58% (34 – 76)	LFH thickness	?
prostrate shrub cover (n=9)	0% (0 – 0)	litter cover (n=)	?
herbaceous cover (n=9)	11% (2 – 22)	bare soil (n=)	?

SPECIES COMPOSITION	**% cover**
Major trees (n=9)	
trembling aspen (*Populus tremuloides*)	46% (15 - 67)
balsam poplar (*Populus balsamifera*)	1% (0 - 2)
Major tall shrubs (n=9)	
willow (*Salix spp*.)	3% (0 - 5)
European buckthorn (*Rhamnus cathartica*)	1% (0 - 3)
Major short shrubs (n=9)	
western snowberry (*Symphoricarpos occidentalis*)	48% (32 - 63)
rose (*Rosa spp*.)	8% (0 - 20)
narrow-leaved meadowsweet (*Spiraea alba*)	1% (0 - 3)
Major graminoids (n=9)	
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 - 4)
hay sedge (*Carex siccata*)	2% (0 - 3)
Kentucky blue grass (*Poa pratensis*)	1% (0 - 3)
Major forbs (n=9)	
nodding stickseed (*Hackelia americana*)	3% (0 - 5)
smooth wild strawberry (*Fragaria virginiana*)	1% (0 - 2)
star-flowered solomon's-seal (*Smilacina stellata*)	1% (0 - 2)
veiny meadow-rue (*Thalictrum venulosum*)	1% (0 - 1)
Minor tall shrubs (n=9)	0%
saskatoon (*Amelanchier alnifolia*)	

Minor short shrubs (n=9)	1%
currant (*Ribes spp.*), wild red raspberry (*Rubus idaeus*)	

Minor forbs (n=9)	2%
Canada anemone (*Anemone canadensis*), field chickweed (*Cerastium arvense*), northern bedstraw (*Galium boreale*), wild peavine (*Lathyrus venosus*), stinging nettle (*Urtica dioica*), American vetch (*Vicia americana*)	

SIMILARITY TO REFERENCE COMMUNITY	32%

RECOMMENDED STOCKING RATES	AUM/ha	AUM/ac
closed stands (>50% canopy closure)	0.22	0.09
open stands (<50% canopy closure)	(0.32)	(0.13)

AP-LM-H

Aspen / Snowberry - Rose / Kentucky Blue Grass

Aspen Parkland: Mesic Loam Ecosite

GENERAL DESCRIPTION: Grazed community occurring in aspen stands on the Mesic Loam Ecosite in the Aspen Parkland. Interpreted as showing **significant alteration** from the reference community (AP-LM-A) as a result of grazing impact. This community includes stands in which exotic herbs have become dominant. Kentucky blue grass and other exotics invade stands in which the native species have been weakened by heavy grazing. Production of palatable forage appears to be higher than in the reference community, mainly because of the increased proportion of grass. Recommended stocking rates are based on average yields in open grassy stands that have been altered by grazing; rates in closed stands are estimated. While the ecological status of this community is low, reducing stocking rates will probably not reverse the invasion of exotic herbs. Therefore, recommended stocking rates are higher than for the reference community. Fire may kill exotic herbs and encourage resprouting of native shrubs, so may aid the transition back to a native community.

STRUCTURE

tree cover (n=10)	64% (7 – 100)	moss cover (n=10)	0% (0 – 0)
tall shrub cover (n=12)	11% (1 – 21)	lichen cover	?
short shrub cover (n=12)	24% (8 – 40)	LFH thickness	?
prostrate shrub cover (n=12)	0% (0 – 0)	litter cover (n=8)	58% (35 – 95)
herbaceous cover (n=12)	54% (29 – 79)	bare soil (n=10)	1% (0 – 1)

SPECIES COMPOSITION	**% cover**
Major trees (n=10)	
trembling aspen (*Populus tremuloides*)	54% (6 - 86)
balsam poplar (*Populus balsamifera*)	13% (0 - 31)
Major tall shrubs (n=12)	
willow (*Salix spp*.)	6% (0 - 19)
beaked hazelnut (*Corylus cornuta*)	2% (0 - 4)
saskatoon (*Amelanchier alnifolia*)	1% (0 - 4)
chokecherry (*Prunus virginiana*)	1% (0 - 1)
red-osier dogwood (*Cornus stolonifera*)	1% (0 - 2)
Major short shrubs (n=12)	
western snowberry (*Symphoricarpos occidentalis*)	12% (2 - 28)
rose (*Rosa spp*.)	9% (0 - 20)
currant (*Ribes spp*.)	1% (0 - 2)
wild red raspberry (*Rubus idaeus*)	1% (0 - 1)
Major graminoids (n=12)	
Kentucky blue grass (*Poa pratensis*)	17% (8 - 32)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	6% (0 - 16)

Major forbs (n=12)	
common dandelion (*Taraxacum officinale*)	4% (0 - 7)
smooth wild strawberry (*Fragaria virginiana*)	3% (0 - 9)
wild peavine (Lathyrus venosus)	3% (0 - 7)
star-flowered solomon's-seal (*Smilacina stellata*)	2% (0 - 8)
violet (*Viola spp*.)	2% (0 - 12)
veiny meadow-rue (*Thalictrum venulosum*)	2% (0 - 3)
northern bedstraw (*Galium boreale*)	2% (0 - 4)
tall meadow-rue (*Thalictrum dasycarpum*)	1% (0 - 5)
American vetch (*Vicia americana*)	1% (0 - 3)
Canada anemone (*Anemone canadensis*)	1% (0 - 2)

Minor tall shrubs (n=12)	0%
European buckthorn (*Rhamnus cathartica*)	

Minor short shrubs (n=12)	1%
narrow-leaved meadowsweet (*Spiraea alba*)	

Minor graminoids (n=12)	2%
quack grass (*Agropyron repens*), bearded wheat grass (*Agropyron trachycaulum var. unilaterale*), fringed brome (*Bromus ciliatus*), smooth brome (*Bromus inermis*), marsh reed grass (*Calamagrostis canadensis*), blunt sedge (*Carex obtusata*), hay sedge (*Carex siccata*), Canby's blue grass (*Poa canbyi*), purple oat grass (*Schizachne purpurascens*)	

Minor forbs (n=12)	5%
woolly yarrow (*Achillea millefolium*), rayless aster (*Aster brachyactis*), Lindley's aster (*Aster ciliolatus*), bunchberry (*Cornus canadensis*), hemp-nettle (*Galeopsis tetrahit*), sweet-scented bedstraw (*Galium triflorum*), northern hedysarum (*Hedysarum boreale*), cream-colored vetchling (*Lathyrus ochroleucus*), two-leaved solomon's seal (*Maianthemum canadense*), alfalfa (*Medicago sativa*), wild mint (*Mentha arvensis*), wild bergamot (*Monarda fistulosa*), common plantain (*Plantago major*), common shinleaf (*Pyrola elliptica*) ,wintergreen (*Pyrola spp*.), dewberry (*Rubus pubescens*), Canada goldenrod (*Solidago canadensis*), perennial sow-thistle (*Sonchus arvensis*), golden bean (*Thermopsis rhombifolia*), red clover (*Trifolium pratense*), white clover (*Trifolium repens*)	

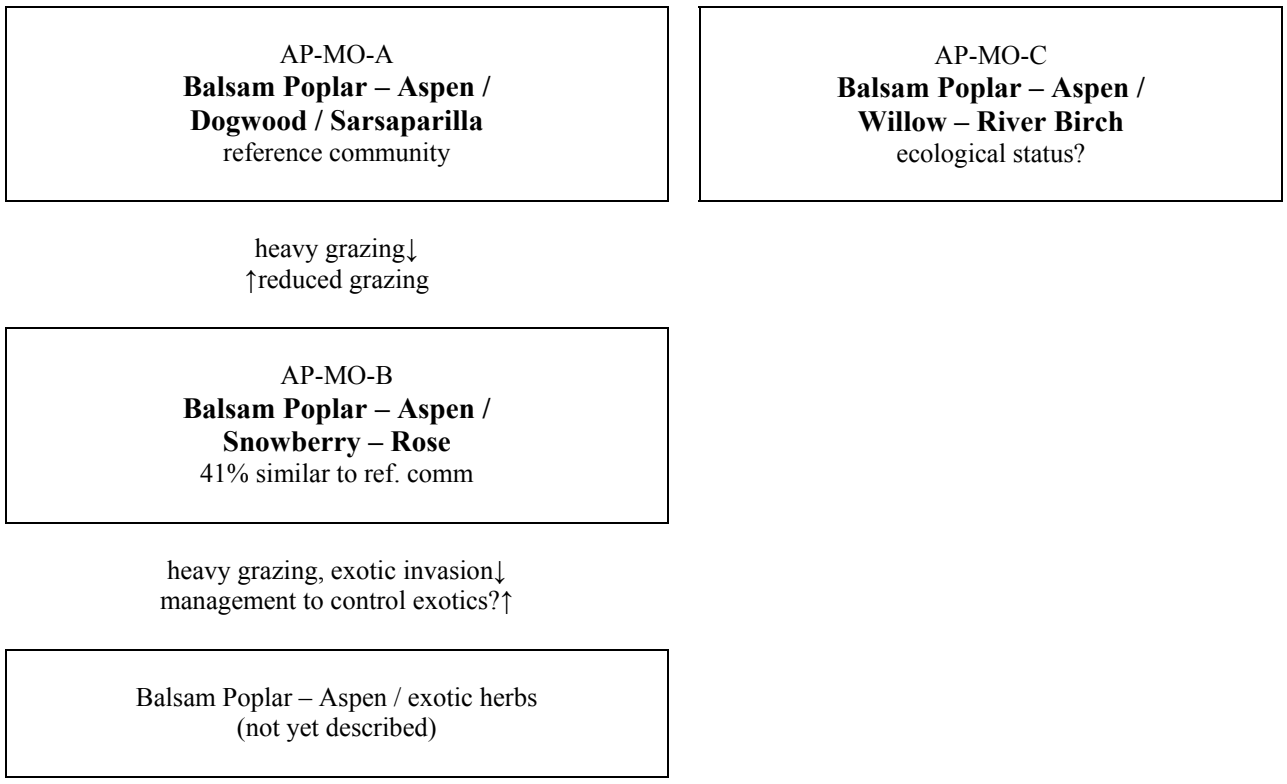
SIMILARITY TO REFERENCE COMMUNITY	54%

RECOMMENDED STOCKING RATES	AUM/ha	AUM/ac
closed stands (>50% canopy closure)	(0.50)	(0.20)
open stands (<50% canopy closure)	0.74	0.30

5.3.3 Moist Ecosite

This ecosite includes moist sites that support forests in which balsam poplar is usually part of the tree canopy. These sites may occur on a variety of landforms, on level or depressional slope positions that are kept moist either by a high water table or by runoff from upper slopes. Soil texture is variable, from sand to clay, because the high water table overrides the effect of texture. Soils are Gleyed Regosols, Gleyed Chernozems, or Gleysols. The drainage class is usually rated as "imperfectly drained", although some plots are rated as "poorly drained" (LRRI 1983). Prominent mottling usually occurs in the top 50 cm of soil, and gray gley colours may appear in the soil profile. The moisture regime is described as "subhygric to hygric" (AEP 1994, Beckingham et al. 1996) or as "moist to very moist" (SE 2004).

STATE-AND-TRANSITION DIAGRAM
Aspen Parkland: Moist Ecosite



AP-MO-A

Balsam Poplar - Aspen / Dogwood / Sarsaparilla

Aspen Parkland: Moist Ecosite

GENERAL DESCRIPTION: **Reference community** for poplar forests on the Moist Ecosite in the Aspen Parkland. Note that AP-MO-A includes Kentucky blue grass as a major species. Stands that are totally free of exotics are hard to find in the Aspen Parkland, so this should be regarded as a "realistic" reference community, rather than an ideal one. This community provides a mix of palatable graminoids, forbs, and shrubs, and recommended stocking rates are similar to comparable stands on the Mesic Loam Ecosite. Recommended stocking rates are based on average yields in open and closed stands of reference communities.

STRUCTURE

tree cover (n=19)	54% (27 – 79)	moss cover	?
tall shrub cover (n=22)	28% (15 – 54)	lichen cover	?
short shrub cover (n=22)	17% (1 – 39)	LFH thickness (n=10)	12 cm (2 – 21)
prostrate shrub cover (n=22)	2% (0 – 0)	litter cover	?
herbaceous cover (n=22)	24% (1 – 41)	bare soil	?

SPECIES COMPOSITION	**percent cover**
Major trees (n=19)	
balsam poplar (*Populus balsamifera*)	31% (0 - 63)
trembling aspen (*Populus tremuloides*)	20% (0 - 63)
white birch (*Betula papyrifera*)	2% (0 - 0)
jack poplar (*Populus X jackii*)	2% (0 - 0)
Manitoba maple (*Acer negundo*)	1% (0 - 0)
Major tall shrubs (n=22)	
red-osier dogwood (*Cornus stolonifera*)	14% (0 - 20)
chokecherry (*Prunus virginiana*)	4% (0 - 15)
saskatoon (*Amelanchier alnifolia*)	3% (0 - 15)
beaked hazelnut (*Corylus cornuta*)	3% (0 - 15)
pincherry (*Prunus pensylvanica*)	2% (0 - 14)
high bush-cranberry (*Viburnum opulus*)	2% (0 - 3)
willow (*Salix spp.*, especially *S. bebbiana and S. monticolia*)	1% (0 - 5)
European buckthorn (*Rhamnus cathartica*)	1% (0 - 0)
Major short shrubs (n=22)	
rose (Rosa spp.)	5% (0 - 15)
wild red raspberry (*Rubus idaeus*)	3% (0 - 15)
western snowberry (*Symphoricarpos occidentalis*)	2% (0 - 6)
Canada buffaloberry (*Shepherdia canadensis*)	1% (0 - 0)
few-flowered snowberry (*Symphoricarpos albus*)	1% (0 - 3)
poison-ivy (*Rhus radicans*)	1% (0 - 0)
Major prostrate shrubs (n=22)	
bearberry (*Arctostaphylos uva-ursi*)	1% (0 - 0)
creeping juniper (*Juniperus horizontalis*)	1% (0 - 0)

Major graminoids (n=22)	
white-grained mountain rice grass (*Oryzopsis asperifolia*)	2% (0 - 2)
sedge (*Carex spp.*, especially *C. siccata*)	1% (0 - 0)
Kentucky blue grass (*Poa pratensis*)	1% (0 - 0)
purple oat grass (*Schizachne purpurascens*)	1% (0 - 1)

Major forbs (n=22)	
wild sarsaparilla (*Aralia nudicaulis*)	11% (0 - 38)
dewberry (*Rubus pubescens*)	1% (0 - 3)
violet (*Viola spp.*)	1% (0 - 2)
raspberry (*Rubus spp.*)	1% (0 - 0)
meadow horsetail (*Equisetum pratense*)	1% (0 - 0)
Canada thistle (*Cirsium arvense*)	1% (0 - 0)
two-leaved solomon's seal (*Maianthemum canadense*)	1% (0 - 2)

Minor tall shrubs (n=22)	1%
river birch (*Betula occidentalis*), wolf-willow (*Elaeagnus commutata*), twining honeysuckle (*Lonicera dioica*), low bush-cranberry (*Viburnum edule*)	

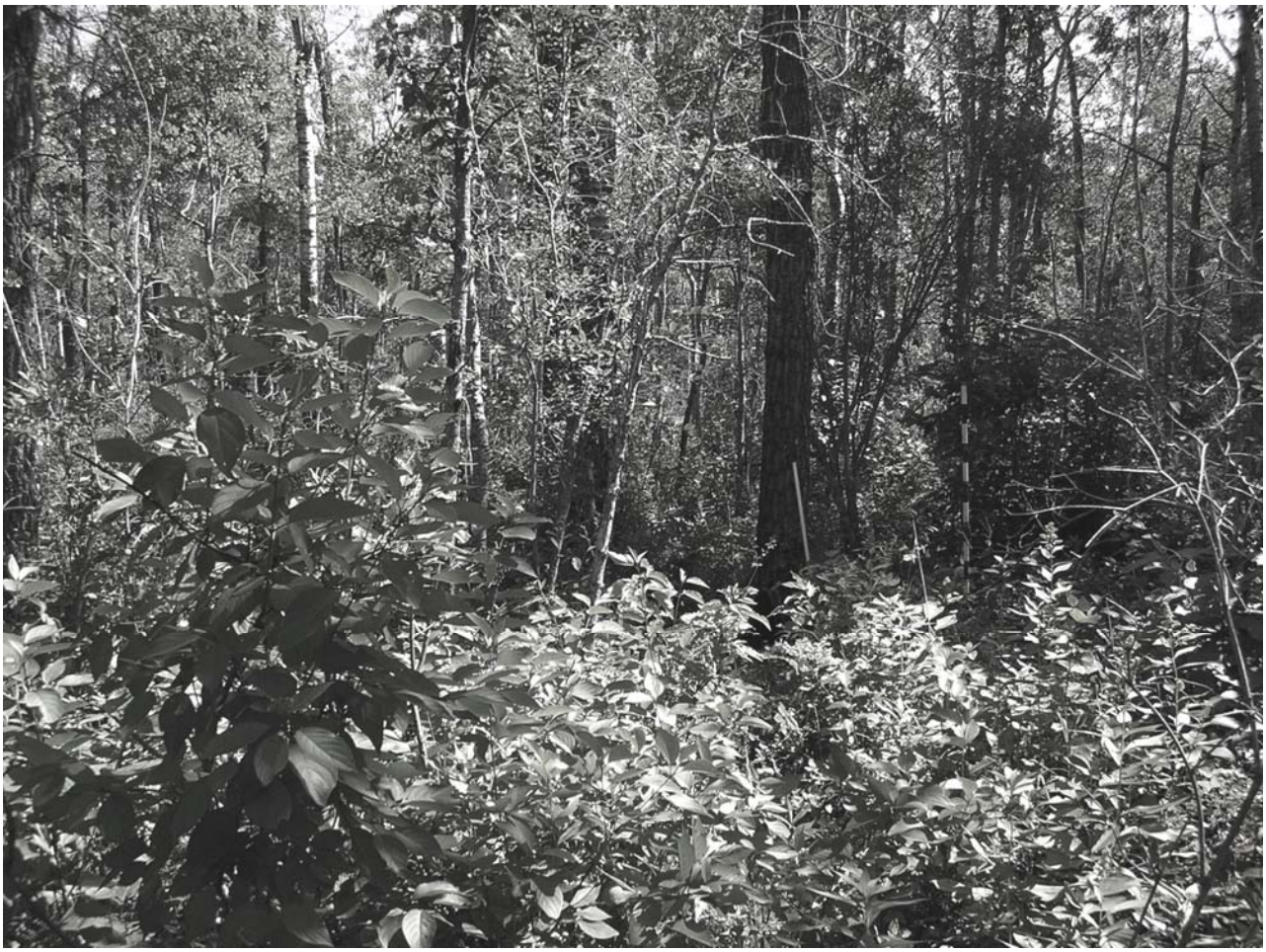
Minor short shrubs (n=22)	1%
low juniper (*Juniperus communis*), alder-leaved buckthorn (*Rhamnus alnifolia*), northern gooseberry (*Ribes oxyacanthoides*), swamp red currant (*Ribes triste*)	

Minor graminoids (n=22)	1%
fringed brome (*Bromus ciliatus*), smooth brome (*Bromus inermis*), marsh reed grass (*Calamagrostis canadensis*), timber oat grass (*Danthonia intermedia*), fowl manna grass (*Glyceria striata*)	

Minor forbs and prostrate shrubs (n=22)	5%
baneberry (*Actaea rubra*), Canada anemone (*Anemone canadensis*), spreading dogbane (*Apocynum androsaemifolium*), Lindley's aster (*Aster ciliolatus*), bunchberry (*Cornus canadensis*), fairybells (*Disporum trachycarpum*), smooth wild strawberry (*Fragaria virginiana*), northern bedstraw (*Galium boreale*), sweet-scented bedstraw (*Galium triflorum*), cream-colored vetchling (*Lathyrus ochroleucus*), wild peavine (*Lathyrus venosus*), fringed loosestrife (*Lysimachia ciliata*), lungwort (*Mertensia paniculata*), palmate-leaved colt's-foot (*Petasites palmatus*), pink wintergreen (*Pyrola asarifolia*), snakeroot (*Sanicula marilandica*), star-flowered solomon's-seal (*Smilacina stellata*), Canada goldenrod (*Solidago canadensis*), giant goldenrod (*Solidago* gigantea), common dandelion (*Taraxacum officinale*), veiny meadow-rue (*Thalictrum venulosum*), American vetch (*Vicia americana*)	

SIMILARITY TO REFERENCE COMMUNITY	ref. comm.

RECOMMENDED STOCKING RATES	**AUM/ha**	**AUM/ac**
closed stands (>50% canopy closure)	0.42	0.17
open stands (<50% canopy closure)	0.62	0.25



AP-MO-B

Balsam Poplar - Aspen / Snowberry – Rose

Aspen Parkland: Moist Ecosite

GENERAL DESCRIPTION: Grazed community occurring in poplar stands on the Moist Ecosite in the Aspen Parkland. Interpreted as showing **moderate alteration** from the reference community (AP-MO-B) as a result of grazing impact. Palatable tall shrubs such as red-osier dogwood, chokecherry, and saskatoon have decreased, while the low shrub layer of snowberry and rose has increased. Recommended stocking rates are based on average yields in closed shrubby stands that have been altered by grazing; rates in open stands are estimated. The transition to a low shrub type results in lower recommended stocking rates compared to the reference community.

STRUCTURE

tree cover (n=5)	37% (19 – 53)	moss cover	?
tall shrub cover (n=8)	4% (0 – 9)	lichen cover	?
short shrub cover (n=8)	28% (15 – 39)	LFH thickness (n=5)	16 cm (5 – 32)
prostrate shrub cover (n=8)	0% (0 – 0)	litter cover	?
herbaceous cover (n=8)	17% (4 – 29)	bare soil	?

SPECIES COMPOSITION	**percent cover**
Major trees (n=5)	
balsam poplar (*Populus balsamifera*)	27% (10 - 38)
trembling aspen (*Populus tremuloides*)	11% (0 - 29)
Major tall shrubs (n=8)	
beaked hazelnut (*Corylus cornuta*)	3% (0 - 9)
saskatoon (*Amelanchier alnifolia*)	1% (0 - 2)
chokecherry (*Prunus virginiana*)	1% (0 - 1)
Major short shrubs (n=8)	
western snowberry (*Symphoricarpos occidentalis*)	12% (4 - 18)
rose (*Rosa spp*.)	10% (3 - 16)
Canada buffaloberry (*Shepherdia canadensis*)	2% (0 - 5)
northern gooseberry (*Ribes oxyacanthoides*)	2% (0 - 5)
wild red raspberry (*Rubus idaeus*)	1% (0 - 2)
Major graminoids (n=8)	
Kentucky blue grass (*Poa pratensis*)	2% (0 - 5)
white-grained mountain rice grass (*Oryzopsis asperifolia*)	1% (0 - 1)
Major forbs (n=8)	
wild sarsaparilla (*Aralia nudicaulis*)	6% (0 - 15)
wild peavine (*Lathyrus venosus*)	1% (0 - 2)
smooth wild strawberry (*Fragaria virginiana*)	1% (0 - 2)
northern bedstraw (*Galium boreale*)	1% (0 - 2)

Minor tall shrubs (n=8) 1%
red-osier dogwood (*Cornus stolonifera*), wolf-willow (*Elaeagnus commutata*), twining honeysuckle (*Lonicera dioica*), Bebb willow (*Salix bebbiana*)

Minor short shrubs (n=8) 1%
alder-leaved buckthorn (*Rhamnus alnifolia*), skunk currant (*Ribes glandulosum*), narrow-leaved meadowsweet (*Spiraea alba*)

Minor graminoids (n=8) 1%
quack grass (*Agropyron repens*), marsh reed grass (*Calamagrostis canadensis*), sedge (*Carex spp.*), purple oat grass (*Schizachne purpurascens*)

Minor forbs and prostrate shrubs (n=8) 4%
woolly yarrow (*Achillea millefolium*), Canada anemone (*Anemone canadensis*), sweet-scented bedstraw (*Galium triflorum*), creeping juniper (*Juniperus horizontalis*), cream-colored vetchling (*Lathyrus ochroleucus*), fringed loosestrife (*Lysimachia ciliata*), two-leaved solomon's seal (*Maianthemum canadense*), blunt-leaved sandwort (*Moehringia lateriflora*), one-sided wintergreen (*Orthilia secunda*), common plantain (*Plantago major*), pink wintergreen (*Pyrola asarifolia*), marsh skullcap (*Scutellaria galericulata*), star-flowered solomon's-seal (*Smilacina stellata*), Canada goldenrod (*Solidago canadensis*), perennial sow-thistle (*Sonchus arvensis*), common dandelion (*Taraxacum officinale*), tall meadow-rue (Thalictrum dasycarpum), veiny meadow-rue (*Thalictrum venulosum*), stinging nettle (*Urtica dioica*), violet (*Viola spp.*)

SIMILARITY TO REFERENCE COMMUNITY 41%

RECOMMENDED STOCKING RATES	AUM/ha	AUM/ac
closed stands (>50% canopy closure)	0.22	0.09
open stands (<50% canopy closure)	(0.32)	(0.13)

AP-MO-C

Balsam Poplar - Aspen / Willow - River Birch

Aspen Parkland: Moist Ecosite

GENERAL DESCRIPTION: Grazed community found in open poplar stands with a distinct tall shrub layer on the Moist Ecosite in the Aspen Parkland. More research is needed on the ecological differences between this community and AP-MO-A (Balsam Poplar – Aspen / Dogwood / Sarsaparilla). The prominence of river birch and willow in AP-MO-C may indicate a site difference. Many of the plots in this type are on moist sandy soils, so the difference may be texture-related. While the relatively low abundance of decreaser species suggests a grazing impact, the ecological status of this community is unclear. While no yield data were available, the cover of palatable species suggests that recommended stocking rates should be lower than in the reference community, so they were set at half of the reference value for open stands.

STRUCTURE

tree cover (n=10)	39% (15 – 54)	moss cover	?
tall shrub cover (n=10)	34% (15 – 54)	lichen cover	?
short shrub cover (n=10)	10% (0 – 18)	LFH thickness	?
prostrate shrub cover (n=10)	0% (0 – 0)	litter cover	?
herbaceous cover (n=10)	15% (1 – 34)	bare soil	?

SPECIES COMPOSITION	**percent cover**
Major trees (n=10)	
balsam poplar (*Populus balsamifera*)	28% (14 - 39)
trembling aspen (*Populus tremuloides*)	11% (0 - 20)
Major tall shrubs (n=10)	
willow (*Salix spp.*)	15% (0 - 38)
river birch (*Betula occidentalis*)	15% (0 - 38)
wolf-willow (*Elaeagnus commutata*)	2% (0 - 2)
saskatoon (*Amelanchier alnifolia*)	2% (0 - 2)
red-osier dogwood (*Cornus stolonifera*)	1% (0 - 3)
Major short shrubs (n=10)	
rose (*Rosa spp.*)	5% (0 - 15)
western snowberry (*Symphoricarpos occidentalis*)	4% (0 - 8)
Major graminoids (n=10)	
sedge (*Carex spp.*)	2% (0 - 3)
smooth brome (*Bromus inermis*)	2% (0 - 1)
fowl manna grass (*Glyceria striata*)	2% (0 - 1)
Major forbs (n=10)	
wild sarsaparilla (*Aralia nudicaulis*)	4% (0 - 4)
smooth wild strawberry (*Fragaria virginiana*)	1% (0 - 1)

Minor tall shrubs (n=10)	0%
chokecherry (*Prunus virginiana*)	

Minor short shrubs (n=10)	0%
wild red raspberry (*Rubus idaeus*), Canada buffaloberry (*Shepherdia canadensis*)	

Minor graminoids (n=10)	1%
quack grass (*Agropyron repens*), baltic rush (*Juncus balticus*), bog muhly (*Muhlenbergia glomerata*), northern rice grass (*Oryzopsis pungens*)	

Minor forbs and prostrate shrubs (n=10)	4%
false dandelion (*Agoseris glauca*), rush aster (*Aster borealis*), smooth aster (*Aster laevis*), thistle (*Cirsium spp.*), swamp horsetail (*Equisetum fluviatile*), meadow horsetail (*Equisetum pratense*), northern bedstraw (*Galium boreale*), sweet-scented bedstraw (*Galium triflorum*), fringed loosestrife (*Lysimachia ciliata*), knotweed (*Polygonum spp.*), pink wintergreen (*Pyrola asarifolia*), marsh skullcap (*Scutellaria galericulata*), giant goldenrod (*Solidago gigantea*), common dandelion (*Taraxacum officinale*), veiny meadow-rue (*Thalictrum venulosum*), violet (*Viola spp.*)	

SIMILARITY TO REFERENCE COMMUNITY	28%

RECOMMENDED STOCKING RATE

RECOMMENDED STOCKING RATES	0.31 AUM/ha	0.31 AUM/ac

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Appendix 1 Locations of production monitoring plots

UNGRAZED PLOTS

Plot	Region	Site	Canopy	Stand	UTM Coordinates (NAD83)			Legal Location					Near to
					Zone	Easting	Northing	Quar	Sec	Twp	Rge	Mer	
1	Aspen Parkland	Sand		tA	13	427221	5834806	SW	15	42	1	W3	St Julien
2	Aspen Parkland	Moist		tA bPo	13	427259	5835002	SW	15	42	1	W3	St Julien
3	Boreal Forest	Sand	Closed	tA	13	414719	5875301	SW	5	47	2	W3	Wingard
4	Boreal Forest	Sand	Open	tA	13	419353	5876010	NE	3	47	2	W3	Wingard
5	Boreal Forest	Sand	Open	tA	12	593691	5971833	NE	36	56	25	W3	Peck L
6	Boreal Forest	Sand	Closed	tA	12	593395	5971406	SE	36	56	25	W3	Peck L
7	Boreal Forest	Loam	Closed	tA	12	595355	5968047	SE	19	56	24	W3	Little Fishing L
8	Boreal Forest	Loam	Open	tA	12	594251	5967188	NW	18	56	24	W3	Little Fishing L
9	Boreal Forest	Moist	Closed	bPo	12	659949	5941975	SW	27	53	18	W3	Turtle L
10	Aspen Parkland	Loam		tA	13	308967	5796025	SW	21	38	13	W3	Sonningdale
11	Aspen Parkland	Sand		tA	13	667274	5699046	SW	13	28	5	W2	Whitesand R
12	Boreal Forest	Loam	Closed	tA	14	304846	5773135	SE	8	36	31	W1	Whitebeech
13	Boreal Forest	Moist	Closed	bPo tA	13	678607	5782696	SE	8	37	3	W2	Endeavour
14	Aspen Parkland	Loam		tA	13	681665	5585802	NE	35	16	4	W2	Broadview
15	Boreal Forest	Sand	Open	tA	13	680479	5736384	NE	17	32	3	W2	Fulton L
16	Aspen Parkland	Sand		tA	12	573788	5832754	SW	25	42	28	W3	Suffern L
17	Aspen Parkland	Moist		bPo tA	12	566710	5825957	NE	36	42	1	W4	Dilberry L
18	Boreal Forest	Loam	Closed	tA	13	307018	5806686	NE	20	39	13	W3	Sonningdale
19	Boreal Forest	Loam	Open	tA	13	428315	5938257	SE	21	53	1	W3	PANP
20	Boreal Forest	Moist	Open	bPo	13	434343	5911090	NE	14	50	28	W2	Sturgeon R
21	Aspen Parkland	Loam		tA	13	354065	5854398	SE	25	44	9	W3	Krydor
22	Aspen Parkland	Moist		tA bPo	13	661987	5708082	NW	9	29	5	W2	Good Spirit L
23	Boreal Forest	Loam	Open	tA	13	594057	5820640	SW	13	47	12	W2	Greenwater Park
24	Boreal Forest	Moist	Open	bPo tA	13	594045	5820593	SW	13	47	12	W2	Greenwater Park

GRAZED PLOTS

Plot	Region	Site	Canopy	Stand	UTM Coordinates (NAD83)			Legal Location					Near to
					Zone	Easting	Northing	Quar	Sec	Twp	Rge	Mer	
25	Boreal Forest	Loam	Closed	tA	12	588288	5967489	SW	21	56	25	W3	Bronson Lake
26	Boreal Forest	Loam	Open	tA	12	589233	5967128	NW	14	56	25	W3	Bronson Lake
27	Boreal Forest	Sand	Open	tA	12	627079	6015298	SW	14	61	21	W3	Meadow Lake
28	Boreal Forest	Sand	Open	tA	12	627360	6015245	SW	14	61	21	W3	Meadow Lake
29	Aspen Parkland	Sand		tA	12	574607	5828958	NW	8	43	27	W3	Manitou Lake
30	Aspen Parkland	Moist		bPo	12	569295	5820760	NW	16	41	28	W3	Dilberry Lake
31	Boreal Forest	Moist	Closed	bPo	12	659884	5938805	NW	10	53	18	W3	Turtle Lake
32	Aspen Parkland	Loam		tA	13	308367	5798338	NW	28	38	13	W3	Sonningdale
33	Boreal Forest	Loam	Closed	tA	13	312286	5800928	NW	6	39	12	W3	Sonningdale
34	Boreal Forest	Moist	Closed	bPo	13	436218	5909581	NE	18	50	28	W2	Sturgeon R
35	Boreal Forest	Loam	Open	tA	13	402375	5937577	NE	14	53	4	W3	Cookson
36	Aspen Parkland	Moist		bPo	13	427190	5835061	SE	16	42	1	W3	St Julien
37	Aspen Parkland	Sand		tA	13	427231	5835272	NW	15	42	1	W3	St Julien
38	Boreal Forest	Sand	Open	tA	13	442352	5906875	SE	15	50	27	W3	Prince Albert
39	Boreal Forest	Sand	Closed	tA	13	414633	5875232	SE	6	47	2	W3	MacDowall
40	Boreal Forest	Loam	Closed	tA	13	593392	5819605	NE	11	41	12	W2	Marean Lake
41	Boreal Forest	Moist	Closed	bPo tA	13	593902	5819582	NE	11	41	12	W2	Marean Lake
42	Boreal Forest	Moist	Closed	bPo tA	13	679122	5774513	SW	16	36	3	W2	Endeavor
43	Aspen Parkland	Loam		tA	13	676950	5583860	NE	29	16	4	W2	Broadview
44	Aspen Parkland	Sand		tA	13	667603	5698835	NW	12	28	5	W2	Whitesand R
45	Boreal Forest	Loam	Closed	tA	14	304920	5772270	NW	4	36	31	W1	Whitebeech
46	Aspen Parkland	Moist		tA bPo	13	655013	5717275	SE	10	30	6	W2	Good Spirit
47	Boreal Forest	Sand	Open	tA	13	680316	5737899	NE	20	32	3	W2	Fulton Lake
48	Boreal Forest	Loam	Open	tA	14	307351	5771090	SE	3	36	31	W1	Whitebeech
49	Aspen Parkland	Loam		tA	13	352380	5854018	SE	26	44	9	W3	Krydor

Appendix 2 Production monitoring plots: forage yields from clipped quadrats for three years

UNGRAZED PLOTS

				oven-dry weight (kg/ha)								
				2005			2006			2007		
Plot	Region	Site	Canopy	graminoid	forb	browse	graminoid	forb	browse	graminoid	forb	browse
1	Aspen Parkland	Sand		615	477	694	772	375	803	739	351	419
2	Aspen Parkland	Moist		117	181	465	36	227	933	105	456	668
3	Boreal Forest	Sand	Closed	280	355	376	386	255	657	212	239	313
4	Boreal Forest	Sand	Open	167	543	244	254	620	376	257	674	576
5	Boreal Forest	Sand	Open	290	565	1102	154	728	1240	254	492	736
6	Boreal Forest	Sand	Closed	122	324	356	224	524	973	102	326	480
7	Boreal Forest	Loam	Closed	93	254	708	149	339	444	116	334	608
8	Boreal Forest	Loam	Open	184	994	707	91	469	967	234	664	449
9	Boreal Forest	Moist	Closed	61	128	659	214	201	552	92	232	644
10	Aspen Parkland	Loam		108	585	1260	81	421	1158	51	499	1082
11	Aspen Parkland	Sand		482	245	664	535	120	516	418	288	677
12	Boreal Forest	Loam	Closed	33	277	586	27	238	722	94	224	562
13	Boreal Forest	Moist	Closed	9	370	583	19	177	547	40	433	434
14	Aspen Parkland	Loam		15	326	607	31	162	491	52	93	831
15	Boreal Forest	Sand	Open	92	79	488	286	80	352	101	102	548
16	Aspen Parkland	Sand		507	376	511	758	392	736	863	253	740
17	Aspen Parkland	Moist		47	55	717	47	136	1053	373	140	1237
18	Boreal Forest	Loam	Closed	20	107	1009	97	323	979	103	383	748
19	Boreal Forest	Loam	Open	30	95	977	67	89	1072	111	125	714
20	Boreal Forest	Moist	Open	82	321	1377	183	1205	752	63	742	817
21	Aspen Parkland	Loam		105	167	501	123	265	661	144	289	753
22	Aspen Parkland	Moist		166	795	764	472	490	396	298	601	355
23	Boreal Forest	Loam	Open	8	377	312	1	154	614	30	297	309
24	Boreal Forest	Moist	Open	252	514	296	178	363	514	24	461	403

GRAZED PLOTS

				oven-dry weight (kg/ha)										
				2005			2006				2007			
Plot	Region	Site	Canopy	graminoid	forb	browse	graminoid	forb	browse		graminoid	forb	browse	
25	Boreal Forest	Loam	Closed				86	227	182	*	225	546	179	*
26	Boreal Forest	Loam	Open				467	377	286	*	463	588	142	*
27	Boreal Forest	Sand	Open				115	356	1041		140	139	589	
28	Boreal Forest	Sand	Open				95	107	675		75	200	461	
29	Aspen Parkland	Sand					671	187	230		471	82	129	
30	Aspen Parkland	Moist					17	52	520	*	41	43	776	*
31	Boreal Forest	Moist	Closed				20	309	492	*	41	158	609	*
32	Aspen Parkland	Loam					286	226	147	*	311	151	562	
33	Boreal Forest	Loam	Closed				36	110	371	*	58	120	789	*
34	Boreal Forest	Moist	Closed				163	174	641		100	299	574	
35	Boreal Forest	Loam	Open				137	235	1178	*	163	140	985	*
36	Aspen Parkland	Moist					72	78	370	*	156	86	617	*
37	Aspen Parkland	Sand					992	177	560		1060	312	339	
38	Boreal Forest	Sand	Open				714	61	138		524	55	46	
39	Boreal Forest	Sand	Closed				601	328	444	*	530	494	631	
40	Boreal Forest	Loam	Closed				305	217	381	*	495	469	338	
41	Boreal Forest	Moist	Closed				442	157	240	*	314	341	256	
42	Boreal Forest	Moist	Closed				33	165	498	*	10	97	341	
43	Aspen Parkland	Loam					619	111	372		700	155	445	
44	Aspen Parkland	Sand					730	249	376		581	363	408	
45	Boreal Forest	Loam	Closed				93	309	165		171	415	109	
46	Aspen Parkland	Moist					142	120	495	*	78	61	441	*
47	Boreal Forest	Sand	Open				197	40	387	*	126	70	388	*
48	Boreal Forest	Loam	Open				93	301	185	*	82	388	415	
49	Aspen Parkland	Loam					114	45	229	*	94	149	317	*

*may be less than actual yield because of current utilization by cattle.

Appendix 3 **Mean yield in the monitoring plots, and the proportion of yield used for calculating recommended stocking rates. Mean yields are averaged over the years of measurement.**

UNGRAZED PLOTS

				mean yield (kg/ha)			percent palatable			palatable yield (kg/ha)		
				graminoid	forb	browse	graminoid	forb	browse	graminoid	forb	browse
1	Aspen Parkland	Sand		709	401	639	100	93	53	709	372	337
2	Aspen Parkland	Moist		86	288	689	100	96	40	86	277	275
3	Boreal Forest	Sand	Closed	293	283	449	100	92	25	293	259	114
4	Boreal Forest	Sand	Open	226	612	399	100	72	49	226	439	196
5	Boreal Forest	Sand	Open	232	595	1026	100	84	11	232	497	115
6	Boreal Forest	Sand	Closed	149	391	603	100	39	8	149	154	50
7	Boreal Forest	Loam	Closed	119	309	587	100	68	14	119	211	81
8	Boreal Forest	Loam	Open	170	709	708	100	93	44	170	658	315
9	Boreal Forest	Moist	Closed	123	187	618	100	76	30	123	142	185
10	Aspen Parkland	Loam		80	502	1166	100	67	37	80	335	434
11	Aspen Parkland	Sand		478	218	619	100	96	63	478	209	389
12	Boreal Forest	Loam	Closed	51	246	623	100	32	13	51	80	82
13	Boreal Forest	Moist	Closed	23	327	522	100	20	36	23	64	187
14	Aspen Parkland	Loam		33	194	643	100	49	5	33	96	30
15	Boreal Forest	Sand	Open	160	87	463	100	76	12	160	67	54
16	Aspen Parkland	Sand		709	340	662	100	85	51	709	288	335
17	Aspen Parkland	Moist		156	110	1002	100	27	40	156	30	400
18	Boreal Forest	Loam	Closed	73	271	912	100	38	7	73	102	64
19	Boreal Forest	Loam	Open	70	103	921	100	73	6	70	75	53
20	Boreal Forest	Moist	Open	110	756	982	100	22	45	110	163	446
21	Aspen Parkland	Loam		124	240	638	100	87	27	124	209	173
22	Aspen Parkland	Moist		312	629	505	100	40	41	312	249	207
23	Boreal Forest	Loam	Open	13	276	412	100	34	25	13	93	103
24	Boreal Forest	Moist	Open	151	446	404	100	30	41	151	134	166

GRAZED PLOTS

				mean yield (kg/ha)				percent palatable			palatable yield (kg/ha)			
				graminoid	forb	browse		graminoid	forb	browse	graminoid	forb	browse	
25	Boreal Forest	Loam	Closed	155	386	181	*	100	32	0	155	123	0	*
26	Boreal Forest	Loam	Open	465	483	214	*	100	41	23	465	198	50	*
27	Boreal Forest	Sand	Open	127	248	815		100	42	8	127	105	68	
28	Boreal Forest	Sand	Open	85	154	568		100	22	5	85	34	30	
29	Aspen Parkland	Sand		571	135	179		100	74	88	571	99	158	
30	Aspen Parkland	Moist		29	47	648	*	100	76	9	29	36	56	*
31	Boreal Forest	Moist	Closed	30	234	551	*	100	39	51	30	91	283	*
32	Aspen Parkland	Loam		311	151	562		100	83	26	311	125	146	
33	Boreal Forest	Loam	Closed	47	115	580	*	100	89	6	47	103	38	*
34	Boreal Forest	Moist	Closed	132	236	608		100	54	59	132	128	360	
35	Boreal Forest	Loam	Open	150	188	1081	*	100	40	5	150	75	59	*
36	Aspen Parkland	Moist		156	86	617	*	100	93	18	156	81	113	*
37	Aspen Parkland	Sand		1026	244	449		100	58	72	1026	141	322	
38	Boreal Forest	Sand	Open	619	58	92		100	64	34	619	37	31	
39	Boreal Forest	Sand	Closed	530	494	631		100	83	61	530	409	385	
40	Boreal Forest	Loam	Closed	495	469	338		100	71	10	495	331	34	
41	Boreal Forest	Moist	Closed	314	341	256		100	76	19	314	261	47	
42	Boreal Forest	Moist	Closed	10	97	341		100	44	39	10	43	134	
43	Aspen Parkland	Loam		659	133	408		100	76	28	659	101	116	
44	Aspen Parkland	Sand		656	306	392		100	72	45	656	220	178	
45	Boreal Forest	Loam	Closed	132	362	137		100	56	14	132	202	19	
46	Aspen Parkland	Moist		142	120	495	*	100	57	16	142	69	78	*
47	Boreal Forest	Sand	Open	161	55	387	*	100	82	9	161	45	36	*
48	Boreal Forest	Loam	Open	82	388	415		100	46	14	82	178	58	
49	Aspen Parkland	Loam		104	97	273	*	100	91	44	104	88	119	*

*may be less than actual yield because of current utilization by cattle.