Moose (*Alces alces andersoni*)

SPECIES NAME: Moose
SCIENTIFIC NAME: *Alces alces andersoni*
SPECIES CODE: M-ALAA
STATUS: Not at risk (MELP, 1997; COSEWIC, 1998)

DISTRIBUTION

Moose are found across northern Europe and Asia from Scandinavia to the Pacific coast and across northern North America from Alaska to Newfoundland and Maine (Banfield, 1974).

Provincial Range

Moose are widespread throughout the mainland of the province, excluding the coastal areas and the arid region centred in the Okanagan Valley. They are most abundant provincially in the central and northern portion of the province. Before 1900, moose were absent from most of the central and southern part of the province (Nagorsen, 1990).

Alces alces andersoni, one of three moose subspecies in the province (*A. a. americana*, *A. a. andersoni* and *A. a. shirasi*), ranges from northern Minnesota and Michigan to British Columbia, the Yukon Territory and NWT. It occupies regions east of the coastal mountain ranges except for the extreme northwest and southeast (Nagorsen 1990).

Provincial Benchmark

Ecoprovince: Boreal Plains
Ecoregion: Alberta Plateau
Ecosection: Peace Lowland (PEL)
Biogeoclimatic zone: BWBSmw2
Broad Ecosystem Units: Boreal White Spruce-Trembling Aspen in winter and White Spruce-Balsam Poplar Riparian in growing

Project Study Area

Ecoprovince: Northern Boreal Mountains
Ecoregion: Northern Canadian Rocky Mountains
Ecosection: Muskwa Foothills (MUF), Eastern Muskwa Ranges (EMR)
Biogeoclimatic zone: BWBSmw2, SWBmk, SWBmks, and AT.
Elevational range: Valley bottom to alpine tundra (~ 900m to 2100m in elevation).

ECOLOGY AND HABITAT REQUIREMENTS

Moose are generalist herbivores that feed on herbaceous plants, leaves and new growth of shrubs and trees in summer and twigs of woody vegetation during winter (Jackson *et al.*, 1991). They occupy a range of habitat types within forested communities, favouring immature forest shrubland for food and dense, woody forest areas for cover (Nietfeld *et al.*, 1985).

In winter, the most commonly consumed food is willow. Twigs of aspen, serviceberry, maple, birch, and red osier dogwood are also eaten in great quantities. Leaves and twigs of falsebox are a second favoured winter food, but this small shrub is usually buried deep under the snow. Conifers such as spruce and lodgepole pine will not sustain moose, although some types of fir and yew are eaten readily (Allen *et. al.,* 1987; Cushwa *et.al.,* 1976; Edwards, 1985; LeResche *et. al.,* 1974; Peterson, 1955; Pierce, 1984; Ritchie, 1978 and Spencer *et. al.*, 1964). Bark may be stripped off larger trees, especially in late winter and early spring when food is in short supply (Nietfeld *et al*., 1985).

Depth, density and hardness of snow is an important factor limiting suitability and availability of certain habitat for moose in the critical winter months (Franzmann, 1978). Nietfeld *et al*. (1985) reports that moose in Alberta tend to avoid areas with greater than 65-75 cm of snow. Eastman (1977) found that moose move into forested habitats in mid-winter when snow depths approached 80cm. Collins and Helm (1997) found that lower shrubs became unavailable when snow depths exceeded 110 cm. Some moose may remain at higher elevations in late winter where thermal cover is reduced and wind action or temperature inversions reduce snow depth.

Floodplains are the mainstay habitat for moose during severe winters, particularly in areas where lack of recent disturbance in upland forests has led to a decline in browse availability (Simkin, 1975; Bishop and Rausch, 1975). Moose are attracted to uplands disturbed by recent fires, homestead or subdivision clearing and right-of-way construction (Collins and Helm, 1997).

During summer, moose diet includes many aquatics, forbs, grasses, and the foliage of many of the trees eaten in winter (Banfield, 1974). Moose are attracted to weedy lakes, marshes and sluggish streams where they can feed on aquatic vegetation (Nietfeld *et al*., 1985). In aquatic feeding, they may feed on sedges or horsetails in shallow water or on bur-reeds that float on the surface and may dive deeply for pondweeds or water lilies (MELP, undated).

Disturbances, such as fire and clearcutting, return forests to earlier successional stages that usually provide abundant browse. Burn areas generally provide the most suitable moose browse after 10-15 years, the length of time varying with the time of year of the burn and its intensity. LeResche and Davis (1974) estimated that the beneficial effects of fire on moose habitat lasts than 50 years with moose density peaking 20 to 25 years following a fire. Wolf and Zasada (1979) reported that aspen provided the most browse for moose 1 to 5 years after fire, while birch and willow provided the most 10 to 16 years after fire. MacCracken and Vierek (1990) report that following a spring fire, moose browse was abundant within two months. Discontinuous forest mosaic created by fire or timber harvest enhance “edge effect” increasing diversity of plant species favoured by moose and staggers plant maturation rate of various seral stages.

Dense, mature, coniferous forest is utilised as shelter from severe winter conditions, hot summer temperatures, as escape from harassment by insects and concealment from predators. Moose escape the summer heat by spending much of their time in the water, in cool timbered areas, or by retreating to high mountainous areas. Moose do not thrive in hot dry regions (MELP, undated). During summer, moose select tree muskegs and immature aspen stands greater than 10 m in height.

Boreal white spruce forests, white spruce-subalpine fir forests, wet interior white spruce forests, deciduous riparian forest, boreal spruce-trembling aspen mixed forests, trembling aspen forests, and birch-willow scrub parkland are important forest types. Other forested habitats such as Engelmann spruce-subalpine fir forests and Douglas fir-lodgepole pine forests are also used but mostly for cover. The mature forested habitats, wetland habitats, avalanche shrubland, and alpine/subalpine meadows with gentle terrain are important in the summer for food and general living (Stevens and Lofts, 1988). Eastman (1977) found that moose in north-central BC used partial cutovers and burns more than coniferous forest; deciduous forests and clearcuts were used least.

Moose generally make seasonal movements between winter and summer ranges, coinciding with spring thaw and freeze-up but they retain the same home range year after year (Nietfeld *et al*., 1985). In mountainous terrain, seasonal migrations are limited to up and down the mountain slopes and wintering in the valleys. Moose move into winter ranges before snow depths become limiting. Occasionally lone bulls winter high up on old avalanche slides where there has been thick regeneration of willows (Banfield, 1974).

Habitat sizes for the moose vary considerably with geographic location. On average, moose annual home range in northern Alberta and southern Alaska are approximately 568 – 638 km^2 (Novak *et al.*, 1987). In British Columbia, average seasonal moose ranges in summer are 218.9 ± 38 ha for males and 615.2 ±629.4 ha for females and in winter, 576.5 ± 365.8 ha for males and 596.2 ± 450.9 ha for females (Schwab, 1985, as cited in Stevens and Lofts, 1998).

LIFE REQUISITES/SEASONAL USE PATTERNS

In this model, moose life requisites are divided into food, security, thermal and living (Table 5.4.1).

Table 5.4.1 Moose seasonal life requisites.

Rank	Life Requisite	Season	Months
1.	Food	Winter	October to May
2.	Food	Growing	June to September
3.	Security/Thermal	Winter	October to May
4.	Security/Thermal	Growing	June to September
5.	Living	Winter, Growing	October to May, June to September

Food

Immature forest shrubland provides optimal food in winter. These areas, plus aquatic and wetland habitats provide optimal food in summer. Burn and clearcut areas generally provide high quality browse after 10-15 years. Young burned (70-year-old) aspen-white spruce-black spruce stands produce 10 times more forage than older stands (130 to 180 years old) (MacCracken and Viereck, 1990).

Security/Thermal

Security and thermal protection is provided by forest cover. In winter, dense, mature coniferous forest provides shelter from low temperatures and wind. Mature stands provide both thermal benefits and good snow interception because of their multi-layered structure and the deep, spreading crowns of the older trees. In summer, moose often use these thermal shelter areas to escape heat, although we assume that thermal habitat requirements are most important in winter. Ideal winter thermal habitat is composed of conifers taller than 6 m, with a canopy closure of 75 percent or greater (Allen *et. al.* 1987, Timmerman and McNichol, 1988, Krefting, 1974). Schwab and Pitt (1991) suggest that optimal canopy closure should be 70% in a mature forest and to escape winter wind chill factors and high summer temperatures.

Security may also be provided by concealing topography, such as that provided in gullied, ridged and hummocky terrain. We assume that water provides security for moose while feeding (i.e. open water and ponds).

Deep snow restricts movement and the availability of food, however, snow is not likely to be a limiting factor in the Study Area. Average maximum winter snowpacks for areas directly adjacent to the north of the Study Area are less the 80 cm with south aspects and windblown areas generally having less than 60 cm (Chilton, 1990).

Aerial surveys in the Study Area have shown moose utilising habitats with little or no nearby security in both summer and winter.

Living

Ideal moose habitat contains an interspersion of food and security/thermal habitat. We assume that food and security must be within 200m of each other.

HABITAT USE AND ECOSYSTEM ATTRIBUTES

Ecosection

Moose are abundant in both the EMR and MUF Ecosections. The MUF provides moose habitat equal to the provincial benchmark (RIC, 1998a). Overall, the EMR provides less moose habitat than the MUF, due, in part, to the absence of the BWBS zone and other high quality low elevation wintering habitats.

Biogeoclimatic Zone

Moose potentially occur in all of the BGC zones and sub-zones in the Study Area. AT represents habitat in the growing season only.

Site Series

In general, moister site series (soil moisture regimes from mesic to subhydric) provide better moose habitat than drier site series (very xeric to sub-mesic). Moister sites typically have a higher canopy closure and denser shrub and herb layers, which provides good food and security/thermal protection.

Structural Stage

Early successional forests provide feeding habitat whereas young to mature forests provide good security and thermal protection. Older forests are important for food in winter as their high snow interception allows for easy access to food. Shrub structural stages provide optimal food but low security/thermal protection. Young to mature forests provide optimal thermal protection. Old-growth forests usually have low crown closure which allows good shrub growth but intercepts snow poorly and provides poor thermal protection.

Stand Composition

In the growing season, optimal food is found in broadleaf and mixed stands.

Aspect

Estimated snowpacks for areas directly adjacent to the north of the Study Area report lowest snow depths on south-facing aspects, which is a function of Chinook winds and solar radiation (Chilton, 1990). Eastman (1977) found that moose chose bedding sites on the upper slopes that faced south particularly when snow depths became restrictive at lower levels (80cm). Therefore, warm aspects are rated higher for food and security/thermal in winter.

Terrain

Terrain that provides concealment, such as that provided by gullied, ridged or undulating topography, provides security. Therefore, non-forested areas that would normally provide no security, are rated higher than similar polygons lacking concealing topography.

Proximity Effects

Habitats that provide food must have security/thermal protection within 200m.

HABITAT RATINGS

Rating Scheme/Modelling Theme

A 6-class rating scheme is used to rate moose habitat. Food (FD), security/thermal (ST) and living (LI) are rated for use in the growing and winter seasons. LI encompasses all of the requirements necessary for survival and is a function of the spatial arrangement of FD and ST in the landscape.

Food (FD) and Security/Thermal (ST) Habitat Assumptions

The ratings table assigns a suitability rating for FD and ST to each ecosystem unit. An ecosystem unit is a combination of site series and structural stage. The relationship between moose life requisites and the ecosystem attributes are defined by a degrading score relative to the optimal value for the attribute (Table 5.4.2). For example, the optimal structural stage for food (low shrub) has a degrading score of “0”– no degrading effect. However, a sub-optimal structural stage (such as pole-sapling) has a degrading score of 4, which would result in a maximum rating of 5 on a scale of 1 to 6. By summing the degrading scores over all of the ecosystem attributes, a final rating is calculated. See Section 3.5 and Appendix F for a full description of the methodology used to generate the ratings table.

Table 5.4.2 Moose food and security/thermal habitat use assumptions. Each number represents a degradation score. A rating for an ecosystem unit is generated by summing the degradation scores over all attributes. See Section 3.5 and Appendix F for a full description of the ratings approach.

Attribute	Value	Degrading Score			
		G_FD	G_ST	W_FD	W_ST
1. Ecosection	EMR	0	0	0	0
	MUF	0	0	0	0
2. BEC Unit	BWBSmw2	0	0	0	0
	SWBmk	0	0	-1	-1
	SWBmks	0	-2	-1	-2
	AT	-1	-5	-4	-5
3a. Site Series (SMR)	Xeric	-2	-2	-2	-2
	Subxeric	-1	-1	-1	-1
	Submesic	0	0	0	0
	Mesic	0	0	0	0
	Subhygric	0	0	0	0
	Hygric	0	0	0	-1
	Subhydric	0	-1	0	-2
	Hydric	0	-2	0	-3
3b. Site Series (SNR)	Very poor- Poor	-1	-1	-1	-1
	Medium-very rich	0	0	0	0
4. Structural Stage	Sparse (1a)	-5	-5	-5	-5
	Bryoid (1b)	-5	-5	-5	-5
	Herb (2)	-2	-5	-4	-5
	Low shrub (3a)	0	-5	0	-5
	Tall shrub (3b)	0	-2	0	-2
	Pole/sapling (4)	-4	0	-4	0
	Young forest (5)	-4	0	-4	0
	Mature forest (6)	-4	0	-3	0
	Old forest (7)	-4	0	-3	0
5. Stand Composition	Coniferous (C)	-1	0	0	0
	Mixed (M)	0	0	0	0
	Broadleaf (B)	0	0	0	0

Polygon Food (FD) and Security/Thermal (ST) Adjustments

Adjustments are used to modify the ratings in order to account for moose habitat attributes that are not inherent features of the ecosystem unit.

Table 5.4.3 Polygon-specific food and security/thermal ratings adjustments for moose.

Topic	Description
A. Aspect	Cool aspects (285-135°) down 1 ST in winter.
B. Terrain surface expression	Polygons lacking forest cover (structural stages 1a, 1b, 2, 3a and 3b) are rated up 2 ST for growing and winter if the surface expression is ridged (r), undulating (u) or hummocky (h).

Living (LI) Habitat Assumptions/Adjustments

Moose require habitat for both food and security/thermal. The LI rating incorporates the FD and ST ratings within the target polygon and the ratings in adjacent polygons.

They are also adjusted depending on the primary use of the polygon:

- Habitats used primarily for food may only be rated as good as the best security/thermal within 200 m of the target polygon.
- Habitats used primarily for security/thermal may only be rated as good as the best food within 200 m of the target polygon.

Specifically:

- If the FD rating is better than the ST rating, LI is equal to the best ST within 200m (including any decile of the target polygon) but not exceeding the FD rating of the target polygon.
- If the SH rating is better than the FD rating, LI is equal to the best FD within 200m (including any decile of the target polygon) but not exceeding the ST rating of the target polygon.

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