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WILDLIFE MODELS FOR SLOCAN FOREST PRODUCTS SMITH/VENTS RIVERS TERRESTRIAL ECOSYSTEM MAPPING PROJECT
MOOSE SPECIES PROFILE DATA SHEET

1.0 INTRODUCTION

1.1 BACKGROUND

This species account provides background information used in preparing a model for rating habitat capability/suitability for moose in the Smith/Vents rivers TEM mapping project area within the Fort Nelson Forest District. The purpose of wildlife habitat capability/suitability modelling is to identify the relative importance of various habitats, or ecological units (site series) to wildlife populations (RIC, 1997) relative to a provincial standard.

Moose are a regionally important species in the Fort Nelson Forest District. Moose provide an important component of the large mammal fauna within much of the district and are a species of management concern. Despite their broad distribution in BC, moose have a high public profile and are an important resource for wildlife viewing and recreational hunting in the Peace Region. As both disturbed and undisturbed forest habitats are important for moose, habitat management for moose is of importance in planning forest development. As a species of management interest throughout their circumpolar distribution in northern latitudes, especially in North America, moose have been the subject of a great deal of habitat and management research (Franzmann and Swartz 1997). This information can be applied to the management of forest habitats in the Fort Nelson Forest District.

This species account summarizes known information on the status, ecology, habitat requirements, life requisites and seasonal use patterns of moose as applicable in the Fort Nelson Forest District (Goulet and Haddow, 1985; Resource Analysis Branch, 1978).

1.2 NOMENCLATURE

Species common name	Moose
Latin name	*Alces alces andersoni*
Species code	M-ALAL

1.3 STATUS

BC Status

Provincial Management List:	Yellow- listed
Conservation Data Centre Rank:	-
Identified Wildlife (Yes/No):	No

COSEWIC Status Not listed

2.0 DISTRIBUTION

2.1 PROVINCIAL DISTRIBUTION

Moose are widely distributed across the boreal regions of Eurasia and North America and occupy most of the province east of the coastal mountain ranges (Nagorsen 1990). Moose are absent from Vancouver Island, Queen Charlotte Islands, coastal islands, most of the southern coast, and Lower Mainland. Moose are relatively abundant and common in its habitat and have the widest distribution in the province, occurring from the 49th parallel to the Yukon border, west to the Coast Mountains, and east to Alberta.

2.2 STUDY AREA DISTRIBUTION

Occurs throughout most of study area in low to moderate numbers; sparse in upper elevations. Most abundant in Liard River valley and into Vents River/Fishing Creek watershed (associated with riparian habitats along streams, wetlands, shrubby sites). Low to moderately abundant along Smith River floodplain and associated main tributaries (riparian habitats along main streams, beaver ponds, wetlands) but uncommon in uplands.

2.3 DISTRIBUTION IN BIOGEOCLIMATIC ZONES OF STUDY AREA

Ecoprovinces:	Northern Boreal Mountains
Ecoregions:	Liard Basin, Northern Mountains and Plateaus, Northern Canadian Rocky Mountains
Ecosections:	Liard Plain, Hyland Highland, Eastern Muskwa Ranges, Muskwa Foothills
Biogeoclimatic Zones:	Expected to occur in the Dry Cool Boreal White and Black Spruce (BWBSdk2) and Spruce-Willow-Birch (SWBmk). Not expected in the SWBmks or AT.

2.4 ELEVATION RANGE

Within Study Area	throughout study area from main Liard River valley (425 m) to edge of alpine regions (1600 m).

3.0 POPULATION CHARACTERISTICS

Prior to 1996, there was little data on population size or parameters in study area. Moose were reported as common at Lower Liard Crossing (presently Liard River near hot springs) and along the upper Smith River by Rand (1944). An aerial winter survey flown by the Resource Analysis Branch in February 1978 (in area north and south of Liard River Hot springs and in Fishing Creek/Fishing Lake drainage), found low numbers along the Liard River and few moose and scattered tracks in the Smith River drainage.

In a review of previous population survey data for the Liard River area, the BC Wildlife Branch (1997) mentions population estimates of 0.76 and 0.73 moose per km^2 in 1978 and 1981, respectively. In a large block survey of the proposed BC Hydro impoundment area up to the Yukon border, densities were estimated at 0.70 moose per km^2 (Goulet and Haddow, 1985).

In a 1996-97 CLIB moose survey of MU7-53 (north side of Liard River and including the Smith River drainage), the BC Wildlife Branch (1997) estimated moose density at 0.065 moose per km^2, which is only 10% of the estimate for a similar area surveyed for BC Hydro in 1985. (Note, however, that the 1996-97 survey did not include the Vents River/Fishing Creek drainage, which probably has the highest densities of moose in the present TEM study area.)

Results of the 1998 moose surveys flown by the Wildlife Branch (1998) determined that moose populations in the north part of MU7-51 and 7-52 were at a density of 0.35 moose per km^2. The conclusions of that survey were that the moose population in that area (including a part south of the Liard River with the present TEM study area) was still declining, due to poor juvenile recruitment. They also point out wolf predation as the primary factor in low calf numbers.

4.0 ECOLOGY AND LIFE REQUISITES

4.1 GENERAL

Moose prefer semi-open successional stages of forest habitat with an abundance of browse (Stevens and Lofts, 1988). Early successional stages with fine textured soils and abundant shrubs for moose browse are found on floodplains of major rivers, riparian communities along smaller streams and lakes, wetlands, regenerating burns and cut blocks, and avalanche chutes. Burns are often a major factor in local abundance of moose, with densities peaking 20-25 years after fire (Le Resche, 1974); this may occur sooner after fire on the east slopes.

Moose are primarily browsers and require an abundant food supply of shrubs in proximity to security cover. Suitable habitats are found in the BWBSdk2 and SWBmk, however, little use is expected of the SWBmks. Moose occur in upland basins and shrubby plateaus during the rut and often remain there into the early winter period. Little use is made of the AT. Migrations between summer/fall ranges and winter ranges likely occur to varying degrees in the study area.

Winter ranges are a critical limiting factor for moose populations, with moose winter ranges generally restricted to below 900 m. Several authors suggest that moose start to move once snow depths exceed 40 cm (Modaferri, 1992; Coady, 1974) and others suggest that depths of 65 cm and over restrict movements of cows and calves (per Romito et al., 1996). Movements of moose can be severely restricted when snow depths exceed 70 cm (Kelsall and Prescott, 1971) while others suggest 90 cm as critical (per Romito et al., 1996). Webster (pers. comm.) suggests that 90 to 110 cm is the determining snow depth in this general area.

Moose generally tend to stay at higher elevations until snow depth decreases mobility and food (browse) becomes difficult to find; some bulls will remain high up until late December. In mild winters with low snow loading, moose can remain at higher elevation winter ranges (e.g., regenerating burns); this type of distribution was noted by Wildlife Branch in the previous winter (Webster, pers. comm.).

Not all moose populations are migratory; some move to distinctly separate winter ranges while others live year round in the same area. The size of moose home ranges varies widely. Home range size for non-migratory populations have been estimated at 6 to 27 km^2 during winter and 2 to 35 km^2 during summer (Petticrew and Munro, 1979; Stevens and Lofts, 1988). Seasonal home ranges in the southern interior of the province have been estimated at 2.2 km^2 in summer, 10 km^2 in fall, and 5.8 km^2 in winter for males, while for females, the estimates are 6.2 km^2 in summer, 7.4 km^2 in fall, and 6 km^2 in winter (Stevens and Lofts, 1988).

4.2 SEASONAL HABITAT REQUIREMENTS

Generalised seasonal habitat requirements are outlined below.

Spring	Calving	In valley bottoms and lower slopes to calve and feed in the BWBSdk2
Summer	Rearing/Feeding	Dispersion through valleys and upper slopes of BWBSdk2 and SWBmk
Fall	Rutting/Feeding	Feeding throughout range; rut in October in BWBSdk2 and SWBmk
Winter	Movements to winter ranges	Winter in broad floodplains, regenerating burns on south and west aspects of the BWBSdk2 and shrubby upland plateaus of

the SWBmk

4.3 MIGRATIONS AND DISTRIBUTION

There is limited information on moose in the study area, except for studies by BC Hydro (Goulet and Haddow, 1985) and several surveys by the BC Wildlife Branch (1997) and Resource Analysis Branch (1978). Moose appear to occur throughout the Vents River drainage basin, except for the highest elevations and steepest slopes. They also occur along the Smith River riparian habitat and along tributary drainages, but are less common in the Smith River uplands.

Aerial survey results indicate that most moose winter in or near riparian habitats and lower slopes along Fishing Creek (and lake), at elevations less than 760 m. Smaller numbers winter along the Liard River valley (450 m elevation); in the uplands along Mould Creek and Teeter Creek (burn area, elevations of 600 to 100 m); and a few winter in lower drainages on the east side of the Smith River basin (760 to 900 m).

4.4 REPRODUCTION

Two major functions play a key role in the annual life cycle of moose: calving and rutting.

4.4.1 Calving

Calving occurs in late May-early June (Franzmann and Swartz 1997), likely in valley bottoms of the BWBSdk2. Specific calving locations have not been documented. Suitable habitats occurs along the Liard River, Fishing Creek and Lake, lower Vents River, and Smith River and its larger tributaries. Recent survey data by the Wildlife Branch (1998) suggests that calf recruitment is low in this area, likely the result of predation by wolves.

4.4.2 Rutting

Rutting occurs in basins and plateaus in the BWBSdk2 and SWBmk. Observations of cast antlers by the project team suggest that main rutting areas occur on upland plateaus between the Fishing Lake/Creek system and northward to the Liard River valley; these areas are used from late September to late-October during the rut, and from then onward into late-December or even January for the post-rut.

4.5 FEEDING

Utilisation of food resources varies considerably during the annual cycle. There is a general reliance on woody vegetation (branches and leaves) with lesser dependence on forbs (particularly semi-aquatic plants). A listing of key plants in the study area is provided below:

Willows (*Salix* spp.)
Black twinberry (*Lonicera involucrata*)
Red osier dogwood (*Cornus stolonifera*)

Highbush cranberry (*Viburnum edule*)
Saskatoon (*Amelanchier alnifolia*)
Poplar (*Populus balsamifera*)
Trembling aspen (*Populus tremuloides*)

4.5.1 Spring

Moose utilise valley bottoms and lower elevation valley slopes during the spring. At this time, browse is particularly important. Forbs and semi-aquatic plants are just starting to form new growth and will gain in importance as spring progresses. During calving in floodplain and riparian habitats, willows, twinberry, red-osier dogwood, and poplar are expected to be of particular importance in the study area.

4.5.2 Summer/Fall

Although they are not abundant in the study area, wetlands which provide semi-aquatic plants are utilized in summer and early fall as moose feed at lake edges, ponds, and backwater channels of rivers. At this time, plant species such as horsetail (*Equisetum* spp.), pond lily (*Nymphaea* spp.), burweed (*Sparganium* spp.), and pondweed (*Potamegeton* spp.) are important although shrubs remain a major component of the diet.

Browse species continue to be a major component of the summer/fall diet, with willows, red-osier dogwood, highbush cranberry, trembling aspen, Saskatoonberry, and twinberry of importance.

4.5.3 Winter

Habitat preferences in winter are for floodplain riparian habitats along major rivers, riparian shrub thickets along tributary streams, or on warm aspect regenerating burns at lower elevations. Moose are heavily dependent on key shrub species in winter; these include willows, red-osier dogwood, and black twinberry.

4.6 SECURITY COVER

Security cover for moose is most critical during spring calving when cow moose seek out islands and gravel bars on river floodplains for calving; landscape features adjacent to water provide for escape from predators. At calving time, dense growth of tall shrubs (e.g., willows) and mature stands of white spruce-poplar with at least a moderately dense understorey also provide cover for moose.

During summer/fall, security cover is provided by the same habitat types mentioned above. As well, moose at upper elevations (i.e., SWBmk) utilise coniferous and mixed forests, shrub thickets in riparian habitats, and willow thickets on plateaus as cover.

During winter, security cover is found in dense patches of coniferous trees adjacent to or interspersed with feeding habitat.

4.7 THERMAL COVER

Thermal protection is an important life requisite in winter, when moose congregate in mature, mixed forest habitat on the major floodplains. In these locations, mature stands of white spruce, poplar and trembling aspen with a moderately dense to dense shrub understorey are utilised; a significant component of mature coniferous trees is important for thermal cover. Those moose that winter higher up (at least for the early winter period), utilise dense, shrubby thickets of willows as thermal protection during cold periods. During certain periods, temperature inversions result in more stable, warmer temperatures at higher elevations (slopes and plateaus) when moose move to these zones.

Thermal protection during summer is found in mature mixed forest stands and coniferous forest at low to mid-elevations, including floodplain habitats. Mesic to subhygric mature stands are common in the lower valley slopes and provide cool habitats during the summer. Wetlands also afford thermal regulation and are locally important landscape features.

5.0 LIFE REQUISITES AND HABITAT ATTRIBUTES

5.1 SEASONS OF USE

Seasons of use for primary life requisites are outlined in the table below.

Life Requisites of Moose for Each Month of the Year:			
Life Requisite	**Specific Time Period**	**Month**	**Season**
Feeding, Security Habitat		January	Winter
Feeding, Security Habitat		February	Winter
Feeding, Security Habitat		March	Winter
Feeding, Security Habitat		April	Winter
Feeding, Security Habitat		May	Spring
Calving, Feeding, Security Habitat		June	Spring
Feeding, Security Habitat		July	Summer
Feeding, Security Habitat		August	Summer
Feeding, Security Habitat		September	Fall
Rutting, Feeding, Security Habitat		October	Fall
Feeding, Security Habitat		November	Winter
Feeding, Security Habitat		December	Winter

Data were collected for two seasons; growing (G) and winter (W). The primary life requisites that were rated are security habitat (SH) and feeding (FD), in conjunction with the secondary life requisite living (LI).

The two seasons for which ratings were applied to are:

Growing season	spring range use, calving, feeding in floodplain and early seral stages at lower elevations (late-April to early-June); summer and fall feeding on shrubs and aquatic plants in valleys and subalpine basins (mid-June to late-October);
Winter	feeding on shrubs in floodplain or early seral regeneration at low elevations (early-November to mid-April).

At a minimum, ratings were assigned for security cover (SH); and feeding (FD). When the thermal and security values could not be separated, the habitat was rated for both (i.e., code ST). Additional codes could be rated when warranted by special conditions (e.g., reproduction (RP); potential or confirmed birthing sites or rutting areas).

5.2 HIERARCHY OF LIFE REQUISITES

The following relates to a hierarchy of the most important life requisites, on a seasonal basis:

- winter food sources;
- winter thermal and security cover;
- spring calving areas in floodplain habitats with security habitat;
- rutting grounds in upper subalpine basins (BWBSdk2; SWBmk); and
- summer and fall feeding in the BWBSdk2 and SWBmk (with security cover nearby).

The selection of winter food source as the primary life requisite is based on the understanding that winter food source is the single most limiting factor for moose populations; this is followed closely by the requirement for winter thermal and security cover.

5.3 LIFE ATTRIBUTES AND RATINGS

Structural stages that have the most value for moose are ranked as follows:

Structural stage 2	herb in wetlands (FD, summer foraging)
Structural stage 3	shrubs (FD, year-round browsing and security habitat, SH)
Structural stage 5	young forest (SH, security habitat)
Structural stage 6	mature forest (SH and TH; year-round security habitat, thermal cover; FD, feeding particularly in winter)
Structural stage 7	old forest (SH and TH; year-round security habitat, thermal cover; FD, feeding, particularly in winter)

6.0 SUITABILITY/CAPABILITY RATING SYSTEM

6.1 RATING SCHEME

A six class/two season rating scheme (1=high; 2=moderately high; 3=moderate; 4=low; 5=very low; 6=nil) was used to rate habitat use by moose within the study area; this is explained in the table below. These ratings are based on the habitat's potential under optimal conditions (i.e., optimal structural stage) to support moose and reflects use relative to the best habitat in the province. Habitat use is evaluated as expected use and is based on a subjective estimate of number of animals that may use the habitat during a specified time period for a specified area of habitat.

Carrying Capacity (% of maximum capability)	Detailed Knowledge Level of Habitat Use (6-class)	
	Rating	Code
100 – 75%	High	1
75 – 50%	Moderately High	2
50 – 25%	Moderate	3
25 – 5%	Low	4
5 – 0%	Very Low	5
0%	Nil	6

6.2 BENCHMARK FOR CAPABILITY RATING

The provincial benchmark for moose has been established as the Peace Lowlands Ecosection. The Peace Lowland's major river valleys are assumed to have the best Class 1W winter range in the province. In comparison to this benchmark, a maximum rating of Class 3W was assigned for riparian habitats in the Fishing Lake/Creek system and floodplain habitats along the Liard River.

6.3 RATINGS ASSUMPTIONS

6.3.1 Model Assumptions

- Productive floodplains and their associated glaciofluvial benches as winter ranges in the BWBSdk2 are critical to maintenance of moose populations.
- Secondary winter ranges in riparian habitat and regenerating burns in the BWBSdk2 are also important for local moose populations.
- Habitats of high shrub density (structural stages 3a, 3b on willow benchlands) are generally regarded as having the highest suitability for moose.
- Wetlands are regarded as having a moderate to high suitability as summer/fall range.

- Calving areas with suitable security cover (late-May to early June) are important for moose population maintenance; these occur in the BWBSdk2 in valley bottoms and riparian edges of tributary streams.
- Secure rutting ranges in plateaus and basins of the BWBSdk2 and SWBmk are important to local moose populations.
- Summer and fall range (June through October) in the BWBSdk2 and SWBmk is not a limiting factor for moose populations.
- Use of the SWBmks as summer and fall range is expected to be minimal.
- The AT is not expected to constitute moose habitat.
- Habitat alteration from forest harvesting, mining, hydrocarbon exploration and linear access (roads, power lines, pipelines) associated with these activities, can have direct and negative impacts on moose habitat. Fragmentation of habitats, particularly between floodplain winter ranges and summer ranges may result in a deterioration of habitat suitability. Access can significantly impact moos populations and increase mobility of predators.

6.3.2 Ecosystem Unit Values and Assumptions

Ratings are assigned to ecosystem units within the study area based on habitat attributes and structural stages considered to be important. Habitat requirements for moose in the study area and related data requirements are summarized in Tables 1, 2 and 3.

6.4 CAPABILITY/SUITABILITY RATINGS TABLE

A suitability/capability ratings table is appended (capability=highest value of suitability). This is based on a listing of site series within BEC units of the study area, provided by the project ecologist (based on Banner et al, 1993 and newly developed site series information). New site series were developed through field work and approved by the Ministry of Forests project ecologist.

6.5 ADJUSTMENTS

It is anticipated that only a limited number of factors will contribute to an increase or decrease in ranking of suitability (an increase being for example, from Class 3 to Class 2). The following adjustments have been utilized for a decrease of one class, as based on site modifiers (singly or in combination) for ecosystem units:

- For all biogeoclimatic zones:
    - coarse-textured soils on a ridge position (cr) for SS 6 and 7; to a minimum of Class 5.
    - coarse-textured and shallow soils (cs) for SS 3a, 3b, 6, and 7; to a minimum of Class 5.
    - coarse-textured and very shallow soils (cv) for SS 3a, 3b, 6, and 7;to a minimum of Class 5.
    - cool aspect with very steep slope (kz) for SS 6 and 7; to a minimum of Class 5.
    - cool aspect with very steep slope (kz) for SS 3a and 3b; to Class 6.

- cool aspect with very shallow soils (kv) for all SS; to a minimum of Class 5.
- ridge position with very shallow soils (rv) for all SS; to a minimum of Class 5.
- ridge position with shallow soils (rs) for SS 3a, 3b, 6, and 7; to a minimum of Class 5.
- peaty material (p) on surface for all SS; maximum Class 4.

- In the SWBmk:

  - very steep slopes (z) for all SS; all reduced to Class 6 for winter.
  - very steep slope and shallow soil (sz) for all SS; all reduced to Class 6 for winter.
  - very steep slope and very shallow soil (vz) for all SS; all reduced to Class 6 for winter.

The rationale for these decreased adjustments is generally related to the physical characteristics of ecosystems, primarily rocky and dry conditions and/or very steep slopes which do not afford suitable habitat for moose.

TABLE 1
SUMMARY OF HABITAT REQUIREMENTS
FOR MOOSE IN THE SMITH/VENTS RIVERS STUDY AREA

LIFE REQUISITE	SEASON	STRUCTURAL STAGE	REQUIREMENTS
Calving	Spring	3,6,7	Islands or gravel bars on major river or larger tributary stream with security cover in form of dense and tall shrubs (e.g., willows) and/or mature stands of white spruce or poplar (BWBSdk2). These must be remote from roads or highway.
Feeding	Spring	3, 6,7	Spring feeding on early green-up vegetation and willows in riparian habitats. BWBSdk2 (and possibly SWBmk) in floodplains and on lower valley slopes are important in spring.
	Summer/Fall	2,3,6,7	Feeding on shrubs (willows, red-osier dogwood, twinberry, trembling aspen), forbs and semi-aquatic plants. Much broader distribution than in spring or winter; found throughout much of BWBSdk2 and into SWBmk.
	Winter	3, 6,7	Two types of winter ranges are used. In floodplain winter ranges in the BWBSdk2, shrubs such as willows, red-osier dogwood, elderberry, and twinberry are major food sources; such winter ranges occur along the Liard River floodplain. The secondary riparian and seral burn winter ranges occur in the BWBSdk2 and into the SWBmk, usually with a south or west aspect. On these, willows are the most important browse.
Security/ Thermal Cover	Spring	3,5,6,7	Thermal and security cover is provided in dense shrub thickets (e.g., willows) and mature stands of mixed spruce, poplar or trembling aspen on floodplains or riparian habitats along major tributary drainages in the BWBSdk2 and SWBmk.
	Summer/Fall	3,5,6,7	Thermal and security cover is provided in dense shrub thickets (e.g., willows) in riparian habitats and basins, and also in mature stands of mixed spruce, poplar or trembling aspen on floodplains. Moose are much more widely distributed at this time and can occur throughout much of the BWBSdk2 and SWBmk.
	Winter	3,6,7	Clumps of dense shrubs (e.g., willows) on floodplains and mature stands of mixed white spruce, poplar, and trembling aspen, with at least a moderately dense understorey of shrubs, in the BWBSdk2. Dense clumps of shrubs in early regenerating growth of burns in the BWBSdk2 and SWBmk.

TABLE 2 SUMMARY OF CRITICAL HABITAT REQUIREMENTS MEASURED		
SEASON/ACTIVITY	**MEASURABLE ATTRIBUTE**	**HABITAT FEATURES**
Spring/Summer/Fall Feeding (FD/G)	Shrub cover Herb cover Tree cover	Species and percent cover of shrubs and herbs as food Species and percent cover of trees.
Winter Feeding (FD/W)	Shrub cover Tree cover	Species and percent cover of shrubs and trees.
Spring/Summer/Fall Thermal Cover (TH/G)	Elevation	Valley bottoms and lower slopes are first to warm up and loose snow cover; more productive growth.
	Aspect	South and west aspects are first to clear of snow and warm up.
	Tree cover	Species, crown cover, age, diameter of trees.
Winter Thermal Cover (TH/W)	Tree cover Shrub cover	Species and age, diameter of trees Species and density of shrubs Crown cover to intercept snow
Spring/Summer/Fall Security Cover (SH/G)	Tree cover Shrub cover	Species and percent cover of trees and shrubs on islands, gravel bars or riparian edges.
Winter Security Cover (SH/W)	Tree species, crown cover	Species and percent cover of trees in canopy

TABLE 3 SUMMARY OF DATA COLLECTION METHODOLOGY		
HABITAT FEATURES	**FORM USED**	**METHOD**
Tree Species	V	Field Manual for Describing Terrestrial Ecosystems (FMDTE)
Tree Cover	V	FMDTE
Tree Height, Diameter	CWD	FMDTE
Shrub layer	V	FMDTE
Herb Layer	V	FMDTE
Leading Species	V	FMDTE
Crown Closure	V	FMDTE
Aspect	S	FMDTE
Slope	S	FMDTE
Elevation	S	FMDTE

S – Site Description Form
V – Vegetation Form
CWD – Coarse Woody Debris Form

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