Appendix 5.4.10A
Moose Species Account

Project Name: Blackwater
Scientific Name: *Alces americanus*
Species Code: M-ALAL
Status: Yellow-listed species by the British Columbia Conservation Data Centre (2014); protected as big game under the BC *Wildlife Act* (1996).

1.0 DISTRIBUTION

Provincial Range

Moose is a year-round native resident of British Columbia. It has a widespread distribution throughout the provincial mainland but is absent from most coastal areas and from the arid interior of the province centred in the Okanagan Valley (Stevens and Lofts, 1988). Moose are most abundant in central and northern British Columbia.

Moose have greatly increased their range in North America over the past 100 years. In British Columbia, they have spread west and southwards from the northeast part of the province when fires eliminated much of the climax forests, which had acted as a barrier to dispersal.

Elevation Range

Sea level to alpine tundra.

Provincial Context

The 1997 moose population estimate for British Columbia was 170,000 (Hatter, 1997).

Project Area

Ecoprovince:	Central Interior
Ecoregions:	Fraser Plateau
Ecosections:	Nazko Upland (NU)
Biogeoclimatic Zones:	Sub-Boreal Spruce Dry Cool (SBSdk) Sub-Boreal Spruce Stuart Dry Warm (SBSdw3) Sub-Boreal Spruce Babine Moist Cold (SBSmc2) Sub-Boreal Spruce Kluskus Moist Cool (SBSmc3) Engelmann Spruce — Subalpine Fir Nechako Moist Very Cold (ESSFmv1) Engelmann Spruce — Subalpine Fir Moist Very Cold Parkland (ESSFmvp) Boreal Altai Fescue Alpine Undifferentiated (BAFAun)
Elevation Range in Study Area:	671 metres above sea level (masl) to 1,930 masl

2.0 ECOLOGY AND KEY HABITAT REQUIREMENTS

While moose inhabit many biogeoclimatic zones, the Sub-Boreal Spruce zone (SBS) represents the centre of moose abundance in British Columbia (Meidinger and Pojar, 1991). Moose will also use seral stands of lodgepole pine in the Montane Spruce (MS) zone in summer and fall, for thermal and hiding cover, within the dense thickets of regenerated forest. They will also use the forests of hybrid spruce and subalpine fir in MS zone for foraging. Forests of intermediate density may provide the optimum balance of locomotion ease and cover (Baker, 1990).

Moose select wetland and riparian areas of the MS, SBS, and Sub-Boreal Pine — Spruce (SBPS) zones for calving because of the abundant forage and dense security cover. However, much of the SBPS zone comprises extensive lodgepole pine forests, which, with the exception of terrestrial lichens for caribou, provide little in the way of forage for moose or other ungulates (Meidinger and Pojar, 1991).

Moose may occasionally winter in the drier regions of the Engelmann Spruce — Subalpine Fir (ESSF) zone, but usually leave during winter to escape the deep snows (Meidinger and Pojar, 1991).

Moose are mainly browsers but also forage on aquatic vegetation, grasses, sedges, and forbs. While browse is always an important component of their diet, the amount varies with the seasons, depending upon the availability, palatability, and nutritional values of other plant species. In summer, browsing is confined to the leaves and terminal tips of shrubs and trees, while woody browse is strictly a fall and winter diet (Hatter, 1950).

Important moose habitat types include mature / old-growth climax coniferous forests complexed with wetlands, ponds, and lakes and semi-open successional stages of forested habitats with abundant browse. Moose will occasionally forage in clear-cuts depending on the size of the opening cover characteristics surrounding the cutblock (Hamilton et al., 1980; Baker, 1990).

Sedge meadows may be heavily used in spring as the sedges are among the first plants to emerge from dormancy (Baker, 1990). Graminoids are highly palatable and nutritious in spring and early summer but they become less nutritious in fall and winter. Similarly, forbs quickly decline in protein and energy levels in late summer. During fall and winter seasons, the higher protein and mineral levels of woody forage encourage greater browsing (Stelfox and Stelfox, 1993). When snow conditions allow, moose will dig to forage on low shrubs such as dwarf birch. When snowpack is deep and/or crusted, tall shrubs and trees are usually the only forage that is available.

Bark-stripping of deciduous trees (predominantly aspen) by moose occurs mainly in late winter and early spring and is believed to be related to a scarcity of available twigs (Gruell and Loope, 1979) and possibly due to rising sap. In spring, cow moose remain close to their calves (Stringham, 1974), reducing their ability to search for forage resources. Intensive debarking has been observed near calving sites of radio-collared females in aspen/spruce forests (Miquelle and Van Ballenberghe, 1989).

Moose are easily heat-stressed even at winter temperatures as low as -5°C, while in the summer extreme panting and heat stress occurs at 14°C to 20°C (Renecker and Hudson, 1986). Areas with climates having temperatures exceeding 27°C for long periods and lacking shade do not support moose (Kelsall and Telfer, 1974).

Lakes, ponds, bogs, other wetlands, and shrub and forest cover associated with these sites are used in summer to alleviate heat stress and to provide succulent forage. The high sodium content of aquatic vegetation is believed to be important to moose nutrition (Jordan et al., 1973; Fraser et al., 1983).

Avalanche shrub areas and alpine/subalpine meadows with gentle to moderate terrain are important for moose in summer. These habitats provide good forage and a scarcity of predators. Cooling winds on alpine ridges can ease heat stress and provide relief from biting insects.

From late fall to early winter, moose movements towards winter range are triggered by snow depths of as little as 20 centimetres (cm) (LeResche 1974; Rolley and Keith, 1980). Moose are well adapted to life in temperate to cold climates with high snow pack. Their height and long legs enable them to move through snows of up to one metre deep, giving them access to browse above the snow. However, snow depths greater than 80 cm are believed to be limiting for moose.

In a study of winter habitat selection by moose along the Dean River in the west Chilcotin region, Baker (1990) found moose favoured spruce wetlands and mature spruce forest. They concentrated primarily within 100 metres of forest/wetland edge and virtually never used areas greater than 200 metres from the edge. Spruce wetlands provide both food and cover in one cover type. Sedge meadows were not usually utilized by moose in winter due to lack of shrubs and to sedges being covered with snow. Moose on the Kenai Peninsula in Alaska dug craters to feed on sedges when snow depths were less than 30 cm, but switched to feeding on birch stems when snow depths were greater than 30 cm (LeResche and Davis, 1973).

Thompson and Vukelich (1981) found that movements between sites were short and substantially reduced as the winter progressed. Moose usually foraged less than 60 metres (m) from cover in early winter in contrast to an average movement of 12 m after the snow reached 65 cm in depth. In late winter, cover and reduced exposure from wind may be as important as forage in the selection of sites (Polequin et al., 1977).

3.0 HABITAT USE – LIFE REQUISITES

Habitats for moose were rated separately for two seasons: growing and winter. The life requisites rated were: Feeding (FD) and Security/Thermal (ST) habitats for the specified season. They are described in detail below.

FEEDING HABITAT (FD)

Moose prefer semi-open successional stages of forested habitats with abundant browse. They will feed in many forest types including coniferous, deciduous, and mixed forests. Foraging

needs vary with the seasons. Browse is eaten at all seasons but is dominant in the winter diet. Shrub communities of willow (*Salix* spp.), birch, highbush-cranberry (*Viburnum edule*), red osier dogwood (*Cornus stolonifera)*, and aspen provide essential winter forage. In spring and summer, moose seek out succulent horsetails, grasses, sedges, forbs, and aquatic vegetation. Habitats that provide the forage needs of moose include riparian forests, structural stages 3a and 3b of moist forests, shrub-carrs, avalanche shrubland, subalpine parkland, wetlands, lakes, and ponds. Depending on the age of the area, moose will also feed in clearcuts and recent burns but usually will stay within 200 metres of cover.

Preferred Browse Species

By virtue of their great geographical range, moose have access to a wide variety of forage species. Although their diet preferences vary between regions, willows, being palatable and abundantly available, stand out as the most important winter food for moose in British Columbia (Hatter, 1950; Eastman, 1977). However, a variety of forage species can more adequately provide for the nutritional needs of moose than can a single species. Different species provide different nutrients and digestibility is often greatly enhanced by the addition of other forage to a single-species diet (LeResche and Davis, 1973; Oldemeyer et al., 1977). Diet preference depends on a number of factors such as nutritive quality, palatability, availability, and perhaps the individual animal's choice. There may also be an association between a preferred foraging site and cover aspects around that site. Forage growing in open habitats and on high elevation sites is typically more nutritious and digestible than the same species at lower elevations (Klein, 1970; Eastman, 1977; Dailey et al., 1984; Stelfox and Stelfox, 1993). Hatter (1950) reported that moose showed a strong preference for willows growing in upland versus lowland habitats.

Some browse species such as red-osier dogwood and highbush-cranberry are highly sought after wherever they occur but are rarely abundant enough in central British Columbia to be important winter forage for moose. Saskatoon berry (*Amelanchier alnifolia)* is also a highly palatable and widely distributed forage species. However, as it never attains tree proportions, Saskatoon is not a dominant species in any association and so has limited browse potential in most winter ranges (Hatter, 1950).

Soopolallie (*Shepherdia canadensis*) was reported to be an important food item for moose on the Kenai Peninsula, Alaska (Edwards, 1940), and in Montana (Hosley, 1949) but appears to be unpalatable to moose in British Columbia (Cowan et al., 1950; Hatter 1950). Other species used by moose elsewhere in their range but apparently not in British Columbia include snowberry (*Symphoricarpus racemosa*), dwarf juniper (*Juniperus communis*), flat-topped spirea (*Spirea lucida*), and black twinberry (*Lonicera involucrata*). However, heavy browsing on *Lonicera* has been observed in at least one site in the Charlotte Alplands of British Columbia (Power, pers. obs., 1999). Species that are only eaten in very small amounts include alder (*Alnus* spp.), kinnikinnick (*Arctostaphylus uva-ursi*), red elderberry (*Sambucus racemosa*), rose (*Rosa* spp.), and cow parsnip (*Heracleum lanatum*) (Hatter, 1950).

Subalpine fir (*Abies lasiocarpa*) is the conifer most commonly eaten by moose and can be an important forage species in late winter (Hatter, 1950; Eastman, 1977). Although lodgepole pine

(*Pinus contorta*) has rarely been reported as moose forage, Baker (1990) found this species comprised 10% to 30% of their winter diet along the Dean River. Hatter (1950) believed lodgepole pine to be unpalatable for moose and constituted a starvation diet when eaten in large quantities. Baker also found high use of dwarf birch (*Betula glandulosa),* although it is considered to be only of minor importance in other studies. Some researchers (LeResche and Davis, 1973; Eastman, 1977) have reported foliose lichens (*Peltigera* spp., *Lobaria* spp.) and mosses (*Hylocomium splendens, Sphagnum* spp.) in the diet of moose in late winter and spring. **Table 1** lists some important forage plants for moose.

Table 1 Preferred Forage Species for Moose

Shrubs	**Willow** *Salix* spp. **Red-osier dogwood** *Cornus stolonifera* **Highbush-cranberry** *Viburnum edule* **Sitka mountain ash** *Sorbus sitchensis* **Saskatoon** *Amelanchier alnifolia* False Box *Pachistima myrsinites* Dwarf Birch *Betula glandulosa*	Kinnikinnick *Arctostaphylos uva-ursi* Prickly rose *Rosa acicularis* *Vaccinium* spp. Thimbleberry *Rubus parviflorus* *Ribes* spp. Twinflower *Linnaea borealis* Red alder *Alnus rubra* Sitka alder *Alnus sitchensis* Devil's club *Oplopanax horridus* Trailing rubus *Rubus pedatus* **Saskatoon berry** *Amelanchier alnifolia*
Trees	**Black cottonwood** *Populus balsamifera* **Trembling aspen** *Populus tremuloides* Subalpine fir *Abies lasiocarpa* Lodgepole pine *Pinus contorta* Douglas-fir *Pseudotsuga menziesii*	
Aquatic and herbaceous plants	**Yellow pond-lily** *Nymphaea polysepala* Mare's tail *Hippurus vulgaris* Pondweed *Potamogeton* spp.	Sedges *Carex* spp. Grasses (*Poa, Festuca, Agrostis* spp.) Rushes *Juncus* spp. **Narrow-leaved cotton-grass** *Eriophorum angustifolium*
Forbs	**Lupine** *Lupinus* spp. **Fireweed** *Epilobium* spp. **Horsetail** *Equisetum* spp Goldenrod *Solid*ago spp. *Penstemon* spp Solomon's seal *Smilacina* spp. Broadleaf arnica *Arnica latifolia Aster* spp. Wild strawberry *Fragaria virginiana*	*Anemone* spp. Yarrow *Achillae* spp. Prince's pine *Chimaphila umbellata* Sitka valerian *Valeriana sitchensis* Bunchberry *Cornus canadensis* Clasping twistedstalk *Streptopus amplexifolius* Cow parsnip *Heracleum lanatum* Water hemlock *Cicuta occidentalis*
Ferns	Lady fern *Athyrium filix-femina* Oak fern *Gymnocarpium dryopteris* Sword fern *Blechnum spicant*	
Lichens	*Peltigera* spp. *Cladonia* spp. *Lobaria linita*	
Fungi	*Boletus* spp.	

Note: The most important or preferred species are in **bold** type.

SECURITY/THERMAL (ST)

Reproduction

Moose tend to rut in semi-open areas often adjacent to forest openings. Calving is usually in dense shrubby areas in forested or wetland and riparian habitats (Stevens and Lofts, 1988). Calving and rutting sites for moose were not rated separately because of their site-specific nature.

Special Habitat Needs

Moose require areas where settled snow depths do not exceed 80 cm. They will, therefore, generally winter in areas where snow depths are less than this (Franzmann, 1981). Mature forest may serve as winter and summer thermal cover or provide winter foraging areas in the shallow snow under the canopy. Dense forest stands may also provide escape cover. Bedding sites are usually in forests or near the forest edge but may be in more open areas close to foraging sites. Mineral licks are often used, especially in summer (Stevens and Lofts, 1988).

4.0 TERRITORY/HOME RANGE

Moose may live solitary lives where populations are at low densities but elsewhere small groups are common. They are non-territorial except during the rut. Moose generally have small seasonal home ranges, seldom exceeding 5 square kilometres (km^2) to 10 km^2 with bull home ranges being the largest (Van Ballenberghe and Peek, 1971; Phillips et al., 1973; LeResche, 1974). However, the average winter home range of six radio-collared cow moose within the survey area near Dean River was 22 km^2 over a two-year period (Baker, 1990). Ballard et al. (1980) reported that home ranges of cow-calf pairs in late spring and early summer in south central Alaska averaged 25 km^2. While some moose are year-round residents on a particular range, others may migrate along travel corridors of up to 50 km between summer and winter ranges depending on browse availability and snow depths (LeResche, 1974). Winter ranges are smaller than those of other seasons because deep snows limit moose movements from cover.

Security Habitat (SH)

Security habitat conceals moose from predators and is provided by a combination of vegetation and topography. Thomas (1979) defined hiding cover for ungulates as vegetation capable of hiding 90% of a standing adult animal from the view of a human at a distance of 61 m or less. With this definition in mind, we consider hiding cover for moose to be provided by any forest stand of adequate density and with trees taller than 2 m. Seral stages 3b, 4, 5, 6, and 7 generally provide these conditions. In open, non-forested habitats such as alpine slopes, undulating and broken topography with large boulders (more than 2 m tall) present can provide screening cover for moose. These sites are rated as security habitat, suitability class 5. Security habitat ratings in subalpine parkland depend on the tree heights, the density and distribution of tree islands, and the nature of the topography.

Thermal Habitat (TH)

Thermal habitat is used by moose to modify extremes in climate and thus assist them in maintaining a constant body temperature. Therefore, the thermal needs of moose may vary daily and seasonally. As with security habitat, vegetation and topography combine to produce thermal habitat. Although moose may use many pole-sapling stands for this purpose in winter and summer, older, closed-canopied, multi-layered coniferous forests on broken or rolling terrain provide optimum thermal cover. The forest canopy acts as a shield against solar radiation by day and radiated heat loss to the open sky, especially at night. The combination of vegetation, large diameter tree trunks (>24 cm), and topography reduces air movement through the stand, thereby minimizing the effects of windchill (Baker, 1990). In winter, these older seral stage forests also provide good snow interception, reducing snowpack levels and therefore the energy expenditures of moose (Baker, 1990). Eastman (1977) found that moose selection of winter bedding sites varied with snow depth. Moose chose south aspects on upper slopes, particularly when snow depths became restrictive (over 80 cm). As snow depths increased, moose bedded closer to larger than average trees in the denser canopied parts of forest stands. McNicol and Gilbert (1978) reported moose using residual islands of trees as wind breaks and benefiting from shallower snow depths on the lee sides of residual cover stands. To avoid heat stress in summer, moose will use forested habitats as shelter from solar radiation and ponds, wetlands, and subalpine/alpine ridges for cooling.

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to provide the life requisites of a species (Resources Information Standards Committee (RISC), 1999). In assigning a suitability rating for moose to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared to the best habitat in the province (i.e., the provincial benchmark) for the same season and life requisite. Each biogeoclimatic zone, site series, and structural stage (stages 2–7) is evaluated and assigned a suitability rating class based on its ability to provide the life requisites for moose for winter and growing seasons.

Seasons of Use

The thermal, security, and feeding habitat requirements of moose vary with the seasons. **Table 2** summarizes the life requisites for moose for each month of the year.

Table 2 Monthly Life Requisites for Moose

Life Requisites	Month	Season
Feeding, Security, Thermal	January	Winter
Feeding, Security, Thermal	February	Winter
Feeding, Security, Thermal	March	Winter
Feeding, Security, Thermal	April	Winter
Parturition/Feeding, Security, Thermal	May	Growing (Early Spring)
Parturition/Feeding, Security, Thermal	June	Growing (Spring)
Feeding, Security, Thermal	July	Growing (Summer)
Feeding, Security, Thermal	August	Growing (Summer)
Rutting/Feeding, Security, Thermal	September	Growing (Fall)
Rutting/Feeding, Security, Thermal	October	Growing (Fall)
Feeding, Security, Thermal	November	Winter
Feeding, Security, Thermal	December	Winter

Note: Seasons defined for Central Interior Ecoprovince per the Chart of Seasons by Ecoprovince (RICS, 1999).

Two seasons were rated for moose:

- Winter Season (November to April). Moose have specific thermal requirements (e.g., warm aspects, coniferous forest cover) and feeding requirements (e.g., abundant deciduous and coniferous browse, reduced snow depths) associated with cover during the winter season; and
- **Growing Season** (May to October). Moose require feeding and security habitat, taking advantage of plant phenology and food availability.

5.0 HABITAT USE AND ECOSYSTEM ATTRIBUTES

Table 3 outlines how each life requisite relates to specific ecosystem attributes (e.g., site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, terrain characteristics).

Table 3 Terrestrial Ecosystem Mapping (TEM) Relationships for Each Life Requisite for Moose

Life Requisite	TEM Attribute
Feeding Habitat	• site: site disturbance, elevation, slope, aspect, structural stage • soil/terrain: bedrock, terrain texture, flooding regime • vegetation: % cover by layer, species list by layer, cover for each species for each layer
Security Habitat	• site: elevation, slope, aspect, structural stage • soil/terrain: terrain texture • vegetation: % cover by layer • mensuration: tree species, dbh, height
Thermal Habitat	• site: elevation, slope, aspect, structural stage • soil/vegetation: terrain texture • vegetation: % cover by layer • mensuration: tree species, dbh, height

Note: dbh = diameter at breast height, % = percentage

6.0 RATINGS

There is a detailed level of knowledge of the habitat requirements of moose in British Columbia, and thus a six-class rating scheme was used (RISC, 1999).

Provincial Benchmark

Ecoprovince: Boreal Plains
Ecosection: Peace Lowlands (PEL)
Biogeoclimatic Zones: Winter— BWBSmw
Growing— BWBSmw
Broad Ecosystem: Boreal White Spruce Trembling
White Spruce-Balsam Poplar
Aspen
Riparian
Habitats: Riparian forests; structural stages 3a, 3b of moist forests; wetlands with emergent and submerged vegetation; floodplains with shrub communities.

Ratings Assumptions

- Sedge meadows have low to moderate (suitability <3) value for spring feeding.
- Meadows (wetlands and riparian areas) and fens of structural stage 3, when dominated by deciduous shrubs (>15%) and adjacent to forest cover, should provide abundant forage and be rated high (suitability <1) for feeding for both winter and growing seasons.
- All habitats that have snow depths greater than 1 m have little value (suitability 5) for winter use.

- Forage habitats lacking cover and more than 200 m from forest cover have minimal value (suitability 5) for feeding.
- Riparian forests and floodplains with well-developed shrub communities have high values (suitability <1) for feeding and security.
- Wetlands, ponds, and lakes with emergent and submerged plants (e.g., water lilies, pondweed, horsetails) provide high value (suitability <1) habitat for summer feeding.

Ratings Adjustments

Final habitat suitability map products should incorporate:

- landscape heterogeneity and connectivity;
- habitats adjacent to significant anthropogenic disturbance regimes (e.g. roads, settlements); and
- interspersion of different structural stages within the landscape. Adjustments will typically increase or decrease suitability value by a single class.

7.0 REFERENCES AND BIBLIOGRAPHY

Baker, B.G. 1990. Winter habitat selection and use by moose in the west Chilcotin region of British Columbia. M.Sc. Thesis, University of British Columbia.

Ballard, W.B., C.L. Gardner, and S.D. Miller. 1980. Influence of predators on summer movements of moose in south-central Alaska. Proc. North Am. Moose Conf. Workshop 16: 339-359.

British Columbia Conservation Data Centre. 2014. BC Species and Ecosystem Explorer. BC Ministry of Environment, Victoria, BC. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed March 2014.

Cowan, I.M., W.S. Hoar, and J. Hatter. 1950. The effects of forest succession upon the quantity and upon the nutritive values of weedy plants used as food by moose. Can. Journ. Res. Sec. D 28: 249-271.

Dailey, T.V., N.T. Hobbs, and T.N. Woodward. 1984. Experimental comparisons of diet selection by mountain goats and mountain sheep in Colorado. J. Wildl. Manage. 48: 799-806.

Eastman, D.S. 1977. Habitat selection and use in winter by moose in sub-boreal forests of north-central British Columbia and relationships to forestry. PhD. Thesis, University of British Columbia, Vancouver. 554p.

Edwards, O.T. 1940. Preliminary inspection report on the Kenai River moose winter range. Unpublished report. U.S. Forest Service, Juneau, Alaska.

Franzmann, A.W. 1981. *Alces alces.* Mammal. Species 154: 1-7.

Fraser, D., E.R Chavez, and J.E. Paloheimo. 1983. Aquatic feeding by moose: selection of plant species and feeding areas in relation to plant chemical composition and characteristics of lakes. Can. Jour. Zool. 62: 80-87.

Government of British Columbia. 1996. *Wildlife Act.* RSBC 1996. c 488. Available at http://www.bclaws.ca/Recon/document/ID/freeside/00_96488_01. Accessed March 2014.

Gruell, G.E., and L.L. Loope. 1979. Relationships among aspen, fire, and ungulate browsing in Jackson Hole, Wyoming. U.S. For. Serv. Intermt. Reg. 33 pp.

Hamilton, G.D., P.D. Drysdale, and D.L. Euler. 1980. Moose winter browsing patterns on clear cuttings in northern Ontario. Can Jour. Zool. 58: 1412–1426.

Hatter, J. 1950. Moose of Central BC. Master's Thesis, University of Washington.

Hatter, J. 1997. British Columbia ungulate species regional population estimates and status, preseason 1997. Min. of Environ. Williams Lake, BC.

Hosley, N.W. 1949. The moose and its ecology. Wildlife Leaflet 312. U.S. Dept. Int., Fish and Wildlife Service. pp. 1-51.

Jordan, P.A., D.B. Botkan, A.S. Dominski, H.S. Lowendorf, and G.E. Belovsky. 1973. Sodium as a critical nutrient of moose on Isle Royale. North Am. Moose Conf. Workshop. 9: 3–42.

Kelsall, J.P., and E.S. Telfer. 1974. Biogeography of moose with particular reference to western North America. Nat. Can. (PQ) 101:117-130.

Klein, D.R. 1970. Food selection by North American deer and their response to over-utilization of preferred plant species. Pp. 25-44. In: A. Watson, ed. Animal populations in relation to their food resources. Symp. Br. Ecol. Soc. 10. Blackwell Sci. Publ., Oxford, UK.

LeResche, R.E., and J.L. Davis. 1973. Importance of nonbrowse foods to moose on the Kenai Peninsula, Alaska. Jour. Wild. Management. 37 (3): 279 - 287.

LeResche, R.E. 1974. Moose migrations in North America. Nat. Can. (PQ.) 100: 393-415.

McNicol, J.G., and F.F. Gilbert. 1978. Late winter bedding practices of moose in mixed upland cutovers. Can Field-Nat. 92: 189–192.

Meidinger, D. and J. Pojar (editors). 1991. Ecosystems of BC. BC Ministry of Forests.

Miquelle, D.G. and V. Van Ballenberghe. 1989. Impact of bark stripping by moose on aspen-spruce communities. Jour. Wild. Manage. 53(3): 577-586.

Oldemeyer, J.L., A.W. Franzmann, A.L. Brundage, P.D. Arneson, and A.Flynn. 1977. Browse quality and the Kenai moose population. Jour. Wild. Management 41 (3): 533 - 542.

Phillips, R.L., W.E. Berg, and D.B. Siniff. 1973. Moose movement patterns and range use in northwestern Minnesota. Jour. Wild. Management. 37(3): 266 -278.

Polequin, A., B. Scherner, and R. Joyal. 1977. Characteristics of winter browsing areas of moose in western Quebec as determined by multivariate analysis. North Am. Moose Conf. 13: 128-143.

Power, D. 1999. Wolfhound Wildlife Services, Vancouver, British Columbia.

Resources Information Standards Committee (RISC). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual.

Renecker, L.A., and R.J. Hudson. 1986. Seasonal energy expenditures and thermoregulatory responses of moose. Can. Jour. Zool. 64: 322-327.

Rolley, R.E., and L.B. Keith. 1980. Moose population dynamics and winter habitat use at Rochester, Alberta, 1965-1979. Canadian Field-Naturalist 94(1): 9-18.

Stelfox, J.B., and J.G Stelfox. 1993. Distribution. pp. 45-61 In: Hoofed mammals of Alberta. J.B Stelfox (editor). Lone Pine Publishing 1993.

Stevens, V. and S. Lofts. 1988. Wildlife habitat handbooks for the southern interior ecoprovince. Vol. 1: Species notes for mammals. Wildlife Habitat Research WHR-28, Wildlife Report No. R-15. Wildlife Branch, Ministry of Environment, Victoria, BC.

Stringham, S.F. 1974. Mother-infant relations in moose. Nat. Can.(PQ.) 101: 325-369.

Thomas, J.W. (editor). 1979. Wildlife habitat in managed forests. U.S. Dept. of Agric., For. Serv. Agriculture Handbook No. 553.

Thompson, I.D., and M.F. Vukelich. 1981. Use of logged habitats by moose cows with calves in northeastern Ontario. Can. Jour. Zool. 59: 2103-2114.

Van Ballenberghe, V., and J. M. Peek. 1971. Radiotelemetry studies of moose in northeastern Minnesota. Jour. Wild. Management. 35(1): 63 - 71.