Establishing Ungulate Winter Range Objectives – Omineca Region

Prepared for
Ministry of Water, Land and Air Protection
Environmental Stewardship Division
Omineca Region
Prince George, BC.
V2L 3H9

Prepared by

TRITON
ENVIRONMENTAL CONSULTANTS LTD.

#201-1157 5th Avenue
Prince George, BC
V2L 3L2

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1.0 Introduction

The Environmental Stewardship Division, of the Ministry of Water, Land and Air Protection (WLAP) is charged with the task of developing *Ungulate Winter Range* (UWR) objectives to ensure winter survival for ungulate species in the Omineca Region. Ungulate Winter Ranges that meet certain biological and policy criteria must be confirmed under Section 69 of the *Operational Planning Regulations* (OPR) of the *Forest Practices Code* (FPC) to be considered in forest management activities regulated by the FPC. In accordance with the OPR, the term "ungulate winter range" means an area that is identified as being necessary for the winter survival of an ungulate species.

As such, UWR objectives need to consider key life requisites including thermal cover, security cover and forage sources as well as potential risk factors such as road access, and conflicts with other user groups (e.g., range management).

The primary purpose of this report is to critically review the existing information on ungulate winter habitat requirements and attempt to provide clear and defensible rationale for proposed management objectives for five species. The five ungulate species that require winter range objectives include:

1) Mule deer
2) Moose
3) Elk
4) Mountain goat
5) Stone Sheep

1.1 Background

Recent amendments to the *Operational Planning Regulation* (OPR) of the *Forest Practices Code* (FPC) have created a specific definition and regulations to provide the legal basis for management of ungulate winter ranges (UWR) on Provincial Forest land. A two-step process was approved for the establishment of UWR under the Regulation. Grandparenting of existing mapped winter ranges that had wildlife management plans and/or strategies, and were managed as UWR, was completed on October 15, 1998. The remaining candidate winter ranges include:

1) those that were previously mapped but not grandparented by October 15, 1998, and
2) those that were accounted for in TSR 1 but were not mapped.

All *Forest Practices Code* candidate and grandparented ungulate winter ranges are to be finalized as quickly as possible, and those meeting the conditions of the MOU confirmed by October 15, 2003. The overall intent is to: (1) identify the areas that are necessary for the winter survival of ungulates; (2) ensure that these areas are distributed in the most effective way for maintaining ungulates across their natural range; and (3) ensure that timber supply impacts do not exceed those included in Timber Supply Review 1 (TSR1) (Stewart Guy *pers. comm*).

2.0 Approach and Methods

Consistent with emerging policy direction, proposed management objectives for UWRs were based on the best scientific information available, and focused on criteria that were measurable, achievable and easily monitored[1]. Using the best information available, each objective was defined using measurable landscape as well as stand level attributes required to maintain the functional integrity of each winter range. This approach is consistent with the FPC intent of 'known ungulate winter range' as well as the anticipated framework of the Results-Based Forest Practices Code, which emphasizes results or 'specific measurable outcomes'.

As such, a concerted effort was made to ensure all UWR objectives were supported by explicit assumptions and cited literature. Regional information was used whenever possible; however, data from other parts of BC, the Pacific Northwest or Alberta were also used to fill in gaps. In addition, draft ungulate winter range objectives from other WLAP regions were also reviewed and suggested where appropriate. Despite these sources of information, knowledge gaps remain. Although our understanding of ungulate winter habitat is improving, there remains few empirical data on habitat thresholds (i.e., how much is enough?), efficacy of access control as well as the spatial and temporal effects of land use management activities (i.e., habitat supply). Therefore, there are instances where professional judgement was required to interpret the available information and propose a course of action. This is especially true for those objectives recommending forest cover constraints and access control. These objectives should be viewed as working hypotheses and implementing within an adaptive management framework.

To develop UWR objectives a number of biological as well as potential risk factors were considered including:

Biological Criteria

- Snow Interception (Thermal Cover)

[1] Monitoring is defined as a process to determine the extent to which a program, plan or activity achieves its specified goals and objectives

- ❖ Security Cover (screening)
- ❖ Forage production (Quality and Quantity)

<u>Potential Risk Factors</u>

- ❖ Access Management (e.g., access control points)
- ❖ Conflict between User Groups (e.g., agriculture-elk conflicts)
- ❖ Industrial Activities (e.g., timing of timber harvesting, commercial tourism)

The primary purpose of the biological criteria is to recognize that all winter ranges need to provide an adequate supply of habitat over time. As such, UWRs should ideally be managed as biological units designed to meet both landscape as well as stand level objectives. Management objectives need to minimize potential negative effects of forest harvesting activities (e.g., roads, timing of harvest) not only within the winter range but also outside the established winter range boundaries. That is, it is important to recognize that ungulates interact with their environment at both fine and coarse spatial scales (Pearson and Turner 1995). Because designated UWRs will be 'embedded' within the larger landscape matrix, they will be subject to wastershed processes and landscape level land management regimes. For example, Landscape Unit seral stage distributions as well as other management regimes outside the UWR have the potential to affect the suitability and overall integrity of the winter range. This may be especially true for UWRs that are relatively small (100-1000 ha)[2]. Regardless of UWR size, mature forest cover requirements should be met using area controlled harvesting regimes or forest cover constraints that apply over a set time period. The primary purpose of stand-level objectives is to explicitly state the desired or target outcome of stand structure habitat objectives.

Other potential risk factors or 'stressors' that can reduce habitat suitability (e.g., road access, human disturbance) need to be considered because they have the potential to result in habitat displacement and/or mortality. Within this context, each ungulate species was assessed according to their sensitivity to human disturbance in an effort to focus the UWR objectives. Other guiding principles used to develop draft objectives included:

- ❖ Consistency between proposed UWR objectives and Higher Level Plans (i.e., LRMPs)
- ❖ Ensure the objectives incorporate spatial and temporal factors (e.g., rotation length)

[2] Most proposed UWR boundaries in the Omineca will be relatively small. C. Ritchie. West Kootenays UWR range boundaries varied between 205-33,933 ha (average ~ 2137 ha, from Mowat et al. 2002).

- ❖ Ensure objectives reflect regional habitat suitability/capability and are consistent with natural disturbance patterns
- ❖ Recognize that not all of the desired information is currently available. Therefore, use the best information available, document assumptions and adapt over time as necessary (i.e., practice adaptive management).

Overall, the information reviewed attempts to focus on key winter habitat requirements and identifies any assumptions, especially those that are believed to affect functional aspects of ungulate winter range (e.g., crown closure, roads). This section explicitly identifies the rationale for the recommended UWR objective. As best as possible, UWR objectives reflected regional habitat suitability and capability. This required that objectives be tailored to ecological conditions and reflected biogeoclimatic subzone variants. Because of local TEM/PEM projects it was possible in certain instances to use information at the site series or ecosystem unit level to help guide stand-level objectives. These projects provided local information, which was useful in defining the range of stand attributes (e.g., crown closure, shrub cover, species composition) for high rated ungulate habitats.

In developing these draft objectives, we have assumed that winter range boundaries will be identified using appropriate algorithms developed to delineate high suitability winter habitat polygons. Other factors that influence ungulate population viability and survival that were not explicitly addressed in this report include, intra and inter-specific competition, predation risk, connectivity (among winter or other seasonal ranges including critical habitats); competing land use objectives and timber supply impact.

It is widely acknowledged that ungulate winter habitat requirements are associated with both topographic as well as vegetative features. Although topographic features (elevation, aspect slope) are a critical component of ungulate winter range, they are not discussed in detail here as they represent fixed variables that cannot be managed. The topographic features of ungulate winter range will be captured during the spatial analysis and identification of winter range boundaries. It should be emphasized that the objective contained in this report represent a first approximation and may need to be further refined according to reflect site specific locations.

3.0 Ungulate Winter Range Criteria

3.1 Mule Deer

3.1.1 Winter Ecology and Habitat Requirements – Biological Rationale

Thermal Cover

A review of the pertinent literature suggests that the ability for a forest stand to intercept snow and provide both thermal cover and accessible forage are the primary habitat variables influencing deer winter habitat selection in British Columbia and the Pacific Northwest (Hanley 1989, Nyberg *et al*. 1990, Kirchhoff and Schoen 1987, Armleder *et al* 1994, Terry and Simpson 1996). In particular, trees with large interlocking crowns help reduce snow accumulation and significantly reduce energy expenditures by deer, which increases their probability of survival (Parker et al. 1984, Armleder *et al.* 1986, Kirchhoff and Schoen 1987). Parker *et al*. (1984) reported deer energy expenditures increased by 50% in 25 cm of snow and more than doubled in 40 cm, which represented about 60% of brisket height. Most studies have cited critical snow depths > 40 cm restrict deer movement. In addition, to increased energy demands, deeper snow depths bury shrubs, which decreases forage availability (Waterhouse *et al*. 1994).

Therefore, the ability of forest stands to provide adequate snow interception cover should be a key component of mule deer winter range objectives. Because snow accumulation varies by biogeoclimatic subzone, all WLAP regions have stratified their mule deer winter ranges by snow pack zones using provincial climatic data. This appears to be a reasonable approach and therefore, it is recommended that the Omineca Region also stratify their objectives by deep and very deep snowpack zones as a first approximation (see below). It should be emphasized, however, that very deep snow pack zones (e.g., ICHwk, ICHvk2) also have limited capability to support mule deer populations even though canopy closures are typically greater in the ICH compared to the SBS (Safford 2001).

In order to provide snow interception cover, an easily measured stand attribute variable is required. Despite some of the methodological problems, percent crown closure is used most often to manage snow interception cover (Armleder and others). In B.C., typical crown closures recommended to retain mule deer winter range vary by biogeoclimatic subzone. Armleder et al. (1994) reported mule deer in the IDF biogeoclimatic zone used stands with moderate crown closures (36-65%) more often compared to their relative availability. The West

Kootenay UWR objectives suggest between 30-50% crown closure of trees >80 years old (Appendix 1). These objectives were developed from radio-telemetry studies and PEM projects. Other areas in the southern interior have recommended crown closures to be at least 46% post harvest (Appendix 1).

In order to provide objectives for snow interception cover in the Omineca Region, knowledge of local mule deer winter habitat use and specific stand structure attributes are required. A number of winter tracking studies (FRBC) have been conducted to identify the northern distribution of mule deer winter habitat use and movement patterns in the Omineca Region including the Prince George, Vanderhoof, Fort St. James and Robson Valley Forest Districts (D'Arcy and Storke 1998, Safford and D'Arcy 2000, Safford 2001). In addition, T*errestrial Ecosystem Mapping* (TEM) was completed for mule deer winter ranges in a portion of the Fort. St. James Forest District (TFL 42, Tanizul Timber), which provides additional information on regional habitat suitability and capability using provincial standards (Keystone 1998; RIC 1999). Radio-collared studies of deer are limited to the Robson Valley (Ingham 2000).

Overall, these studies have reported high suitability mule deer winter habitats occur on mesic, subxeric and xeric sites within the drier SBS subzone variants including the SBSdk, SBSdw2, SBSdw3 and SBSdh, (D'Arcy and Storke 1998, Keystone 1998). These ecosystems are represented by the mature and old structural stages of the 01, 02, 03 and 04 sites series all of which have a significant component of Douglas fir. Visual estimates of crown closure vary between 30-85% (D'Arcy and Storke 1998, Timberline 1998) for these site series. In the Robson Valley, mule deer preferred forests dominated by mature spruce and Douglas fir forest with canopy closures > 55% (Ingham 2000).

In addition to crown closure, basal area (m^2/ha) has also been recommended to manage stand structure on mule deer winter ranges in the IDF biogeoclimatic zone (MOF 1999). Basal area is easily measured and provides an effective means of monitoring both wildlife and timber objectives. Depending on stand-level objectives and crown closure class, this approach suggests retaining a total target stand basal area as well as basal area of large diameter (> 40 cm DBH) Douglas-fir trees. In a related study, these researchers have also reported that low volume partial-cutting (20% single tree selection) has not affected mule deer use, which suggests their basal area retention targets are adequate to maintain deer winter attributes (Armleder *et al*. 1998). Although these methods have been developed in the IDF (NDT 4), similar approaches could be developed for winter ranges in this region, which occur in NDT 3. Other studies have also found basal area to be a useful predictor of snow interception. In the Fort St. James and Vanderhoof Forest Districts, D'Arcy and Storke (1998) found a significant relationship between basal area and snow depth in

Douglas-fir stands in the SBSdw3. Forest stands with greater basal area (46-59 m^2/ha) resulted in significantly reduced snow depths (8-19 cm). Prescribing basal area retention targets to manage stand structure on winter ranges is useful because it is easily measured and focuses stand management on larger trees, which have better snow interception ability. However, site specific information on stand structure would be required to determine appropriate basal area retention targets.

Winter Forage

To maintain mule deer winter range, adequate supplies of forage are also required. Mule deer browse occurs in a variety of forested as well as non-forested ecosystems including cutblocks and cultivated fields. The dry Douglas-fir ecosystems mentioned previously, provide adequate amounts of forage, however, some ecosystem units provide more abundant browse than others (D'Arcy and Storke 1998, Keystone 1999). Stands with canopy gaps, for example, provide better developed shrub layers and preferred browse species including saskatoon, Douglas maple, and common snowberry. Habitat suitability in these ecosystems is often enhanced by the close proximity of natural non-forested ecosystems (openings), which provide higher shrub cover (>30%) of preferred browse species (Keystone 1998, Keystone 1999). Although mule deer browse primarily on shrubs, they also will feed on arboreal lichen litterfall (Stevenson 1985, Waterhouse et al. 1991, Waterhouse et al. 1994).

Overall, the best available information indicates mule deer winter range objectives should focus on the following stand-level features:

(1) Tree Species Composition (Overstory)
(2) Crown Closure and/or Basal Area
(3) Age Class and Stand Structure
(4) Shrub Species Composition and Abundance

Interspersion of Thermal Cover and Foraging Areas

In addition to these stand level features, an estimate of the total area retained in mature forest is required. The optimum mix of thermal cover, security cover and foraging areas have not been studied locally. However, extensive research in the Pacific Northwest has documented that a 60:40 ratio of forage: cover is considered optimal for winter mule deer habitat (Thomas et al. 1979).

In the West Kootenays, deer management guidelines recommend increasing forest retention targets in wetter biogeoclimatic subzones. In drier and shallow snow subzones, a minimum of 20% forest retention in age class ≥ 80 years is recommended with a minimum forage requirement of 15% ≤20 years old (Mowat *et al*. 2002, see Appendix 1). Their maximum retention level for mule deer is 40% in age ≥ 100 years old and a minimum of 5% ≤20 years to maintain foraging habitat. In these habitats, crown closure requirements are ≥50%.

<u>Access Management and Human Disturbance</u>

Roads generally decrease the value of habitat for mule deer (Towry 1984). The estimated zone of influence extends for 100 m from the road into adjacent habitat. As such, it is recommended that roads be located away from UWR. In particular, avoid dry south facing slopes. If roads are required ensure visual screen buffers and deactivate as soon as possible.

Harper and Eastman (2000) reviewed the potential impacts of recreation activities on various wildlife species. In general, the availability of information suggests that human disturbances on winter ranges (e.g., snowmobile) can results in deer habitat displacement. However, the severity of response appears to vary with the intensity of human use (Dorrance *et al*. 1975, Freddy *et al*. 1986.) Freddy suggested persons afoot including snowmobiles should remain >190 m from deer to prevent overt movement responses.

3.1.2 Ungulate Winter Range Objectives

Given the above rationale, the following ungulate winter range management objectives are proposed:

Within the UWR identified on Map xx: Maintain mule deer winter range to provide high suitability snow interception cover and foraging opportunities (shrubs, conifer and arboreal lichen litterfall) at both landscape and stand-levels . This will be accomplished by:

Deep Snowpack Subzones (annual snow fall >150-200 cm); SBSdw2, SBSdw3, SBSmh, SBSdh		
Objective	Assumptions	Supporting Evidence
Maintaining a minimum of 40% of winter range area in age class 8 (>140 years) or greater at all times. Maintain a crown closure of >56%	• Assumes the 60:40 ratio of forage to cover is adequate. • Stands have at least 40% Douglas fir. • Mature trees (>140 years) have larger deeper crowns,	✧ Thomas et al 1979. ✧ Armleder et al. 1994 ✧ Stevenson 1985 ✧ Waterhouse et al. 1991 ✧ D'Arcy and Storke 1998 ✧ DeLong et al. 1993

	abundant arboreal lichens (Bryoria spp,) • Crown closure is within range of site series capability 36-85%.	
Maintaining 10—40% shrub cover of preferred deciduous forage species. This may include a combination or a dominance of the following species: saskatoon, prickly rose, Douglas maple, common snowberry,)	• Reported literature reflects diet selection • Suggested % shrub cover within capability of sites and contains high value deer habitat.	✧ Waterhouse et al 1994 ✧ Keystone 1998 ✧ D'Arcy and Storke 1998 ✧ Safford 2001
Timber harvesting openings within UWR: should be irregular in shape and < 1 ha in size and < 250 m wide.	• Assumes natural disturbance pattern leaves remnant patches of Douglas-fir with small openings on relatively dry site series (grassland/shrub-steppe). • Distance to mature forest cover within reported range of deer use and FPC regulation	✧ DeLong 2000 ✧ Simpson (TFL 5)
Minimizing new road or access development.	Roads and human use reduce habitat effectiveness	✧ Towry 1984
Avoid promoting winter recreational activity (snowmobiling) on winter ranges	Human presence and noise results in increased stress and habitat displacement	Freddy et al. 1986 Dorrance et al. 1975
Very Deep Snowpack Subzones (annual snow fall >200 cm): SBSmk1, ICHvk2, SBSwk1, SBSwk3 *		
Objective	Assumptions	Supporting Evidence
Maintaining a minimum of 50% of stands in age class 8 (>140 years) or greater. Maintain crown closure of mature forests >66% (cedar, hemlock, Douglas fir, spruce)	• Assumes slightly higher requirements and canopy closure due to very deep snow pack. Mature trees (>140 years) have larger deeper crowns, abundant arboreal lichens (*Alectoria sarmentosa*; *Bryoria* spp.) • Deeper snows require increased snow interception cover*. Range of site series capability 50-85%	✧ Safford 2001 ✧ Stevenson 1985 ✧ DeLong et al. 1993
In all subzones, allow salvage		

harvesting within the ungulate winter range if the recovery of damaged timber is necessary (i.e., forest health) and the quality of the winter range is not reduced.		

* Mule deer winter habitat capability is limited in these subzones due to deep snow accumulations

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3.2 Moose

3.2.1 Winter Ecology and Habitat Requirements – Biological Rationale

Thermal Cover

Moose have developed morphological as well as physiological adaptations to survive cold winters and deep snow conditions (Telfer and Kelsall 1984). These adaptations include: (i) large body size, which helps retain heat (thermal inertia); (ii) long legs, which allow movement through deep snow; (iii) dark coloration, which helps absorb solar radiation and (iv) a highly insulative winter coat that provides an estimated lower critical temperature[3] of <-30^{0} C (Renecker and Hudson 1986). Although these adaptations suggest moose are less dependent on snow interception cover compared to other ungulates such as mule deer, snow interception cover can become important especially during late winter when deeper snowpacks occur (Eastman and Ritcey 1987).

During early winter (Nov-Jan), moose surveys in the Omineca have reported moose primarily use open areas such as cutblocks (10-20 years old) (Eastman 1977, G. Watts pers. comm) suggesting snow interception cover does not play a dominant role during this snow accumulation period. However, as winter progresses and snow depths increase, moose tend to move to forested areas that provide greater canopy closure and snow interception (Eastman 1977). These areas typically include forested riparian areas near wetlands and floodplain forests that support mature conifers such as spruce and subalpine fir. Overall, cited literature report snow depths greater than 65 cm hinder movements of moose, but critical snow depths that begin to restrict movement have been reported around 90 cm (Timmerman and McNicol 1988).

[3] Lower and upper critical temperatures represent the range of temperatures where animals feel 'comfortable' and do not expend metabolic energy trying to warm up or cool down respectively (i.e., their thermal neutral zone).

Some researchers have suggested moose require at least 30% canopy closure in boreal mixed-wood forests (Romito *et al*. 1995) while others have suggested a considerably higher canopy closure (70%) (Costain 1989). Recent moose guidelines in the West Kootenays recommend ≥30% crown closure in all ICH zones (Mowat et al. 2002, see Appendix 1).

Clearly, the amount of canopy closure required by moose will vary according to local snow conditions and weather patterns. Moose winter habitat in the Omineca Region can be found in a variety of biogeoclimatic subzones. However, the majority of high suitability moose winter habitats are found predominately in lower elevation forests of the BWBSdk1 (Mackenzie Forest District), SBSmk (McGregor Plateau and Parsnip River) as well as drier SBS subzones that occur in the Nechako Lowlands. Within these subzones, ecosystems that occur in riparian valley bottoms (e.g., mature spruce stands, willow dominated wetlands), burns, upland shrub communities and south facing slopes dominated by aspen receive heavy use during winter and spring (Terry and Handler 1998, Keystone 1999). In the Wet Trench NDU (DeLong 2000), the SBSwk1, SBSvk and ICHvk2 contain moose winter range whereas in the Moist Trench NDU (Robson Valley), the ICHmm and SBSdh provide the highest suitability moose winter habitats (EBA 2002, Safford 2001).

Keystone (1999) reported moose near Morrison Lake, B.C. (SBSmc2) used mature ecosystems that had crown closures between 15-40%. Overall, mature and old growth stands with canopy closures >30% likely provide adequate snow interception for moose during late winter. This assumes however, that snow depths become limiting to initiate a movement to conifer dominated sites. These areas would most likely include floodplain ecosystems that contain mature conifers (spruce, subalpine fir) as well as forested edges adjacent to riparian wetlands and/or shrub carr communities. In years where snow accumulations are normal or below average, moose may continue to use more open mixed deciduous-coniferous areas throughout the winter (Keystone 1999).

<u>Winter Forage</u>

Although thermal and security cover are important, moose winter habitat selection is strongly influenced by foraging opportunities. Because of their large size moose need to consume a large amount of browse to meet energetic needs. As a result, moose choose feeding areas that are dominated by abundant preferred shrub species that allow a high intake rate.

In the boreal forest, moose browse primarily on shrubs, deciduous trees as well as coniferous tree species. Browse species include willow (*Salix* spp.), aspen

(*Populus tremuloides*), balsam poplar (*Populus balsamifera*), saskatoon (*Amelanchier alnifolia*), red-osier dogwood (*Cornus stolonifera*), chokecherry (*Prunus pennsylvanica*), subalpine fir (*Abies lasiocarpa*), hazelnut (*Corylus cornuta*), highbush cranberries (*Viburnum edule*), prickly rose (*Rosa acicularis*), mountain ash (*Sorbus americana*)and gooseberry (*Ribes* spp) (Westworth et al. 1989, Renecker and Hudson 1992, Keystone 1998).

Van Dyke (1995) suggested high value winter feeding areas have 30% shrub cover, relatively low mature tree density (< 200 stems/ha) and gentle slopes (7%). Romito *et al*. (1995) suggested a minimum of 50% shrub cover to provide optimal moose browse. Local studies in the SBSmc2 have documented high suitability moose winter foraging areas supported 15-40% cover of preferred browse species (willows, saskatoon) (Keystone 1999). Setting realistic shrub cover targets is difficult at this time because shrub cover varies by ecosystem and site. Although abundant browse is often available in clearcuts, herbicide treatments can reduce browse availability. Many moose foraging areas also occur in non-forested sites such as willow dominated wetlands where shrub cover is very high (>60%) (Madrone, Bio-Geo Dynamics). Considering the shrub cover capability of high value ecosystems in the SBS, ICH and BWBS (Delong 1993,1996, Madrone, Bio-Geo Dynamics, Keystone 1998), maintaining a minimum of 20% cover of preferred forage species over the entire winter range (i.e., openings, non-forested, forested) seems reasonable.

Interspersion of Thermal Cover and Foraging Areas

Similar to other members of the deer family, moose prefer a mosaic of well interspersed patches of young seral foraging habitat and mature thermal and security cover (Thompson and Stewart 1987). Eastman and Ritcey (1987) recommended that cutbocks be < 100 ha and maximum distance between blocks be 300m. Few studies have explicitly documented minimum forest retention levels required by moose during winter. Hence most jurisdictions appear to use professional judgement when defining minimum forest retention levels. In the Cariboo Region, moose guidelines along the Caribou River (ICH) state that 85% of the moose management area has to be > 3m tall at all times (i.e., max 15% <3 m). In the Okanagan-Shuswap, a least 33% of the forested area must be at least 16 m tall with canopy closures between 56-65%. A total of 40% of the forested area must be greater than 16 m tall. In the West Kootenays, moose winter range objectives include 10% forest cover retention > 60 years old and a 10% forage area < 20 years old (See Appendix 1).

Access Management

Several studies have demonstrated that increase road access can increase hunter success, and reduce moose densities (Lynch 1973, Eason 1985, Boer 1990, and Rempel *et al*. 1997 all cited in Sopuck *et al*. 1997). Therefore, an inverse relationship between habitat quality and open road density (i.e. habitat quality declines as road density increases) is often assumed to be a significant risk factor to moose survival and should be considered during the development of ungulate winter range objectives. Although increased road access into ungulate winter range can increase legal and illegal hunting pressures, it may also provide increased predator access for wolves. However, recent research in southeastern B.C. reported that moose are less likely to be killed by wolves if they were at higher elevations, farther from trails, away from other moose, nearer to or within areas sheltered by large trees and in areas with higher road density (Kunkel and Pletscher 2000).

3.2.2 Ungulate Winter Range Objectives

Based on the literature cited above as well as professional judgement the following moose winter range objectives are recommended.

Within the UWR identified on Map xx: Maintain moose winter range to provide high suitability foraging opportunities (cutblocks, burns, floodplain forests, riparian shrub communities) and snow interception cover by:

Objective	Assumptions	Supporting Evidence
Maintaining a minimum of 25% of winter range area stands in age class 6 (>101 years) or greater at all times (throughout rotation). Maintain crown closure of mature forests >30%	Increased interspersion of mature forest and cutblocks expected to improve cover and forage availability.	Professional Judgement
Adjacent to non-forested feeding areas (i.e., natural openings, wetlands, cutblocks) maintain crown closure of mature forests >25%	Within range of site series capability 25-40%	DeLong 1993
On forested site series, maintain >20% cover of preferred forage species	Within range of site series capability 10-40% % cover meets the needs of moose	Professional Judgement
Limit vehicular road access to reduce human disturbance and illegal harvest (access	Open road density results in increased mortality risk and habitat displacement	From Rempel et al, 1997 and Others. See other ungulate studies

restrictions, gates, deactivation)		(see Cole et al 1997)

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3.3 Elk

3.3.1 Winter Ecology and Habitat Requirements- Biological Rationale

Thermal Cover

A number of studies have concluded that snow depth strongly influences elk distribution and movement. Elk movements begin to be restricted by snow depths in excess of 40-50 cm (Irwin and Peek 1983, Parker *et al*. 1984). Snow depth limits forage availability in winter, and at depths > 61 cm, browsing will replace grazing (Skovlin, 1982). Periods of deep snow (> 40 cm) result in elk moving to habitats of high forage availability and low snow cover such as south-facing slopes (Irwin and Peek 1983, Sweeney and Sweeny 1984).

The degree to which elk require winter thermal cover varies with regional climatic conditions (temperature, snow depths). Some researchers have recommended elk require thermal protection from low temperatures and is best provided in conifer stands with continuous closed canopies (Thomas, et al. 1979, Skovlin, 1982). Closely stocked stands of coniferous forest, 12 m or greater with high stem densities and an average canopy closure exceeding 70%, are used in winters characterized by very deep snow cover (Black *et al*. 1979; Skovlin, 1982). In contrast, Cook et al. (1998) found no significant positive effect of thermal cover on body condition of elk during winter and cautioned against using habitat selection studies to infer thermal cover requirements. These researchers also stressed that solar radiation is an important factor determining winter severity and is typically not included in ungulate winter range models.

Thus, it is clear that there is disagreement in the literature regarding thermal cover requirements for elk. Nonetheless, a pragmatic approach would be to focus on local studies that have documented elk habitat use recognizing that elk may be using forest cover for other reasons (i.e., security cover, predator avoidance). For example, ungulate winter range guidelines recently developed in the West Kootenays recommended the same forest cover objectives as mule deer because of similar habitat use patterns (20-40% mature forest retention and 30-50% crown closure, see Appendix 1).

Although small numbers of elk can be found in all five Forest Districts of the Omineca Region, the majority of elk winter range occurs in the Robson Valley, Stuart River, Blackwater River, and the Ingenika Valley. These areas fall within the Moist Trench, Moist Interior and Omineca Natural Disturbance Units respectively, (DeLong unpub. 2002). Within these broad units, elk winter range occurs in ecosystem units represented by the BWBSdk1, SBSdw2, SBSdw3 and the SBSdh biogeoclimatic subzone variants.

Backmeyer (1994) found elk used predominately open shrub/grassland communities as well as deciduous and mixed stands near the Peace Arm of the Williston Reservoir. Conifer dominated stands were not used during winter. Simpson (1992) also reported elk used relatively open habitats on south-facing river escarpments and cultivated fields. Safford and D'Arcy (2000) and Safford (2001) identified potential elk winter range in the Prince George area and suggested elk winter range may include a variety of habitat types including, south facing slopes with a Douglas fir component, river banks and cedar-hemlock forests.

In addition to thermal protection, forest attributes also provides security cover. Thomas *et al*. (1979) characterized escape cover for elk as vegetation over 2 m with a stem density of between 50 and 2000 stems/ha while Black *et al.* (1976) states that vegetation capable of hiding 90% of an elk from a human at 61m as preferred.

Winter Forage

Studies in western North America have shown that the diets of elk vary seasonally, spatially, and in response to forage availability, palatability, plant phenology, plant species diversity, and habitat type. These studies have concluded that elk are primarily grazers with grass and grass-like species composing up to 90% of their diets. They are particularly reliant on grasses throughout the year though they tend to shift to a mixture of grasses and shrubs in fall and winter. During fall and winter, elk consume greater amounts of forbs and shrubs (Skovlin 1982, Smith 1985), but prefer grass when available (Morgantini and Russel 1983). Overall, elk in boreal mixedwood forests rely more heavily on browse, especially during winter, than elk in the boreal foothills and mountain regions where semi-open forest cover provided accessible grassland during most times of the year (Nietfeld *et al*. 1985).

In winter, snow cover limits ground level forage and elk are forced to browse on deciduous trees and shrubs. Preferred winter browse species include saskatoon (*Amelanchier alnifolia*), water birch (*Betula occidentalis*) and trembling aspen (*Populus tremuloides*) (Nietfeld *et al.*, 1985). Conifers, with the exception of spruce, are also utilized. Snow-free areas associated with southerly aspects and periodic chinook weather provides the greatest access to forage in winter and spring (Smith 1985). In agricultural areas, cultivated crops may provide significant amounts of forage in fall and winter.

<u>Interspersion of Forest Cover and Foraging Areas</u>

Similar to mule deer, interspersion of forest cover and openings is a desirable management objective on elk winter ranges (Thomas et al. 1979; 60:40 ratio), primarily because elk are typically associated with forest edges (Thomas et al. 1979) and foraging usually occurs within 200 m of cover (Thomas et al. 1979, Smith 1985).

<u>Access Management</u>

A number of studies have shown elk are sensitive to human disturbances including the presence of roads and skiing (Morrison *et al*. 1995, Cole *et al.* 1997). Cole *et al*. (1997) found that limited vehicular access (using gates) reduced human disturbances, which resulted in increased survival of elk by reduced poaching and elk movement. Habitat effectiveness was reduced by the presence of open roads used by motorized vehicles (Wisdom et al. 1986, Thomas and Bryant 1987). Roads through forage areas could reduce elk use by up to 90% for 500 m when hiding cover is unavailable (Lyon 1979). When roadside hiding cover is present the zone of influence may be reduced to approximately 100 m. Lyon (1982) also observed habitat suitability declined by 40% when open road densities were greater than 0.62/km2. Cow elk responded similarly to disturbances by cross-country skiers (Cassirer *et al*. 1992). Ferguson and Keith (1982) noted elk moved away from heavily used ski trails.

<u>Range and Agricultural Conflicts</u>

Elk challenges managers in all areas of North America where agriculture and range conflicts occur. In the Omineca Region, elk winter range objectives should largely focus on the Ingenika Valley where transplants have taken place and elk habitat use is not confounded by agriculture and cultivated fields.

3.3.2 *Ungulate Winter Range Objectives*

Within the UWR identified on Map xx: Maintain elk winter ranges to provide high suitability foraging opportunities (burns, south-facing slopes dominated by grasses, riparian shrub communities), screening and snow interception cover by:

All Subzones		
Objective	Assumptions	Supporting Evidence
Maintaining a minimum of 40% of winter range area stands in age class 6 (>100 years) or greater. Crown closure >40%	60:40 ratio adequate Crown closure within range of site series capability (BWBS, ICH, SBS)	Thomas 1979 DeLong 1993
Maintaining at least 15% in High suitability foraging habitat - grazing/browsing habitat (grasses, saskatoon etc) Enhancing forage productivity through prescribed burns	Elk require a constant supply of early seral foraging habitat	Professional judgement
Limit vehicular road access to reduce human disturbance and illegal harvest (access restrictions, gates, deactivation)	Open road density results in increased mortality risk and habitat displacement	Cole, E.K., M.D. Pope and R.G. Anthony. 1997. Lyon 1983

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3.4 Mountain Goat

3.4.1 Winter Ecology and Habitat Requirements – Biological Rationale

Thermal Cover

The overriding factor influencing mountain goat habitat suitability is the presence of adequate escape terrain. Although some terrain features such as forested bluffs and timbered areas adjacent to avalanche chutes are used during winter, overall, the extent to which mountain goats use forested areas specifically for thermal cover varies with regional climate and mountain goat ecotype (Hebert and Turnbull 1977). Both coastal and interior ecotypes will use lower elevations to escape heavy snows and cold temperatures but interior populations may also move upslope to wind swept ridges to find exposed herbs and grasses if the snow is dry enough (Hebert and Turnbull 1977, Fox and Smith 1988). Smith (1986) suggests that 50% of winter foraging occurs in commercial old growth forests in southeastern Alaska primarily because of their snow interception characteristics. However, these areas are only used if adjacent to escape terrain (Foster and Rahs 1985 and Fox and Smith 1988). Recent GPS studies in the Robson Valley found mountain goats used forested areas infrequently, and when they did were primarily steep and inoperable forest types (Poole and Heard 1999).

Although mountain goats have minimal direct conflict with forest harvesting activities, maintaining forested corridors between alpine areas is important to avoid isolation of sub-populations. Therefore, minimizing fragmentation and maintaining landscape-level connectivity during land use management planning is recommended.

Other regions in B.C. have chosen to provide guidelines on forest harvesting activities (see Appendix 1). If some mountain goat winter ranges are found to include operable timber in close proximity to escape terrain, providing a forest cover objective may be warranted.

Winter Forage

Winter diets include conifers such as subalpine fir, mosses (such as *Hylocomium* spp., *Rhytidiadelphus* spp.), lichens (especially *Lobaria* sp.), and forbs (goldthread, bunchberry, trailing bramble) (Province of BC 1999; Fox and Smith 1988).

Access Management and Human Disturbance

Although mountain goats use alpine and subalpine habitats extensively (i.e., grassy alpine slopes, cliffs, avalanche chutes) forest harvesting and mining activities provide access into remote areas, which increases the risks to local populations through increased legal and illegal hunting pressures. Mountain goats are also vulnerable to helicopter activity used for mineral exploration and development, commercial backcountry recreation (e.g., heli-skiing) and wildlife surveys. The potential impact helicopters and other human disturbances (aircraft, blasting) have on mountain ungulates will vary with the timing (season), frequency and duration of disturbance. Although some ungulate species may show a greater degree of habituation and tolerance to human activity, mountain goats appear more susceptible to human disturbances than other species (Foster and Rahs 1983, Cote 1996, extensive review in Wilson and Shackleton 2001).

3.4.2 Ungulate Winter Range Objectives

Maintain mountain goat winter range by minimizing human disturbances and access, This will be accomplished by.

Objective	Assumptions	Supporting Evidence
Limiting helicopter flights to > 2 km from mountain goat herds Where appropriate, maintain forested corridors between winter ranges	• Mineral exploration/development and commercial recreation (e.g., heli-skiing) can increase risks to goat populations through disturbance and habitat displacement. Degree of impacts will vary with frequency and duration of activity. • Noise from aircraft results in habitat displacement and increased stress levels at the individual level. No population response	✧ Côté, S. 1996 ✧ Foster and Rahs (1983)
Maintaining a mature forested buffer (200 m no harvest zone) adjacent to critical escape terrain.	• Forested areas near adjacent escape terrain (bluffs, cliffs) considered limiting (thermal/security cover; kidding areas).	✧ Professional judgement

Limiting road access in close proximity to winter ranges (1-2 km) to reduce human disturbance and illegal harvest (access restrictions, gates, deactivation)	• Increased road access poses high risks to goat populations over the long term.	Professional Judgement

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3.5 Stone Sheep

3.5.1 Winter Ecology and Habitat Requirements – Biological Rationale

Thermal Cover

Stone sheep (blue-listed) are mountain ungulates that utilize alpine and subalpine habitats. Stone sheep have very specific requirements for key and limited habitat types. They need windblown, grassy slopes as winter range; steep, secure natal areas where ewes can safely bear their lambs; steep rugged cliffs where they can escape from predators; and access to mineral licks. Thus, in order to maintain Stone sheep populations, escape terrain, winter forage and migration routes need to be maintained. Given the available information, thermal cover is not considered limiting to thinhorn sheep populations and therefore should not be included in the ungulate winter range objectives at this time.

Although mountain sheep have minimal direct conflict with forest harvesting activities, maintaining forested corridors between alpine areas is also important to avoid isolation of sub-populations. Therefore, minimizing fragmentation and maintaining landscape-level connectivity during land use planning is recommended.

Winter Forage

Stone sheep forage on windswept ridges where they feed predominantly on grasses and sedges. Seip (1983) reported Stone sheep near Fort Nelson preferred forage grasses include *Poa* spp. Backmeyer (1995) found radio-collared transplanted Stone sheep (Peace Arm) used primarily alpine habitats as well as shrub/grass communities and conifer bluffs (escape terrain/thermal cover) during winter.

Potential risk factors to Stone sheep include fire suppression, which has resulted in the loss of grazing habitat due to encroachment of woodlands/shrubs. In addition, wild sheep easily catch diseases carried by domestic sheep. Therefore, every effort must be made to avoid any contact between wild and domestic sheep.

Access Management and Human Disturbance

Increased road access, poaching, and all-terrain vehicle (ATV) use are potential risk factors that need to be addressed near sheep winter ranges
Similar to mountain goats, the potential impact helicopters and other human disturbances (aircraft, blasting) have on Stone sheep varies with the timing (season), frequency and duration of disturbance (Stockwell, 1991, Bleich et al. 1994. Frid 1996).

3.5.2 Ungulate Winter Range Objectives

Maintain or enhance current Stone sheep population levels by minimizing human disturbances and providing high suitability foraging habitat. This will be accomplished by.

ESSF, ESSFp and AT BEC zones		
Objective	Assumptions	Supporting Evidence
Limiting helicopter and fixed-wing flights to > 2 km horizontal distance from Stone's sheep winter ranges Limit helicopter and fixed-wing flight altitudes to a minimum of 500 m over designated sheep habitats	Noise from aircraft results in habitat displacement and increased stress levels at the individual level. However, no demographic response reported	Frid (1996) Stockwell et al. (1991) Bleich et al. (1994) See Wilson and Shackleton (2001) and Harper and Eastman 2000
Minimizing the amount of shrub encroachment on grazing areas	Maintain seral grass communities	Seip 1983
Limit road access in close proximity to winter ranges (1-2 km) to reduce human disturbance and illegal harvest (access restrictions, gates, deactivation)	• Increased road access poses high risks to sheep populations over the long term.	Professional Judgement

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Appendix 1.0 Summary of Ungulate Winter Range Objective from other Regions in B.C.

Deer	Elk	Moose	Mountain Goat
Note: Kamloops TSA Guidelines call for **25%** of deer winter ranges in stands > 75 years or 20 m tall **Okanagan-Shuswap UWR:** Deep snowpack zone: 60%of snow interception cover retained; minimum rotation age 100 years or 40 cm DBH. Allow harvest in snow interception areas– max 20% volume removal, crown closure must be at least 46% post harvest Open road densities not to exceed 3km/km2 **Invermere TSA, 40%** of stands on THLB > 120 years. **Cariboo TSA–** selective harvest only; 50-80% volume retained with during harvest entry (30-50 years). **West Kootenay UWR:** **BEC specific:** **IDFun, ICHxw** – minimum **20%** forest cover retention > 80 years old and >15% < 20 years old (forage). Crown closure >30%.	West Kootenay UWR – same as mule deer BEC specific: IDFun, ICHxw – minimum 20% forest cover retention > 80 years old and >15% < 20 years old (forage). Crown closure >30%. ICHdw – minimum 30% forest cover retention > 80 years old and > 10% < 20 years old (forage). Crown closure >40%. ICHmw - 40% forest cover retention >100 years old and minimum 5% <20 years (forage). Crown closure >50%. Okanagan-Shuswap UWR: Retain 30-50% of forest cover in patches >= 10 ha Okanagan-Shuswap UWR: Maintain a 100 m forested buffer adjacent to special habitats (wallows, rutting areas). Selective harvest allowed – 40% of preharvest stems must > 100 years old	**West Kootenay UWR** 10% forest cover retention > 60 years old: 10% forage area < 20 years old. Crown closure > 30%. **Cariboo River Moose Area:** 85% has to be > 3 tall at all times (i.e., max 15% <3 m) ? **Okanagan Shuswap UWR:** minimum 33% of the forested area in stands at least 16 m tall and canopy closure of 6 (56-65%). Maintain 40% of forested area > 16 m tall. **Lillooet LRMP: 33% of** wetland riparian edges may be opened up in single pass. Maximum exposure is 200 mm wide **Okanagan-Shuswap UWR** Minimum of 15% of forested land base in young forest (<25 (IDF/ICH), < 35 years old (MS/ESSF). Retain a mature deciduous component >=40% of pre-harvest composition in cutblocks.	**Okanagan-Shuswap UWR**:Avoid logging activities within 500 m of winter range **KBLUP: 70**% basal area retention within a 100 to 200 metre strip on either side of the avalanche track comprised of 120 year old trees with an ave. crown closure of 60%. **Okanagan-Shuswap UWR**: Selection systems - retain 50% preharvest basal area. Clearcut – openings must be < 5 ha and < 200 m in one dimension Max. 33% of forested area < 33 years old

ICHdw – minimum **30%** forest cover retention > 80 years old and > 10% < 20 years old (forage). Crown closure >40% **ICHmw - 40%** forest cover retention >100 years old and minimum 5% <20 years (forage). Crown Closure >50% **KBLUP** On steep (>50%) south facing slopes - **15%** forest cover comprised of 101 + yr. old trees, with an ave. crown closure of 50% in units >10 ha. every 250 or suitable multiples up to planning cell	Okanagan-Shuswap UWR: Locate roads a minimum 100 m from wallows, rutting areas and cover areas > 10 ha		

WLAP. Draft Ungulate Winter Range Objectives– Okanagan- Shuswap (courtesy of Grant Furness)
WLAP. Lillooet LRMP. Draft 4 (Courtesy of Phil Belliveau)

Appendix 2: Kootenay Boundary Land Use Plan Implementation Strategy (1997) – UWR Guidelines

These guidelines represented current practices but have been recently revised. The new UWR objectives for the West Kootenay are presented Appendix 1. New East Kootenay UWR objectives are almost completed.

Species	Guideline Set	Biogeoclimatic Ecosystem Classification Subzone Variants	Minimum Amount of Mature Forest Cover Retention Over the Managed Forest Land Base	Habitat Management Objective	Rationale/Comments
Elk Mule Deer	**1a** slopes <50%	PPdh1, PPdh2, IDFdm1, IDFdm2, IDFun, IDFxh1, ICHxw, MSdk (only on site series 2 & 3 on slopes >50%)	**25%** forest cover comprised of 101 + yr. old trees, with an ave. crown closure of 50% in units >10 ha. every 250 or suitable multiples up to planning cell scale.	• Maintain a relatively high component of forest cover to support foraging, security, snow interception cover and connectivity requirements. • Maintain mature forest cover at the optimum distance to forage sites.	Slopes <50% usually retain deeper snow than slopes >50%. Mature trees, particularly Fd, frequently have the structural attributes which optimize foraging, cover and movement opportunities on these sites.
Elk Mule deer	**1b** southern aspects >50%)	PPdh1, PPdh2, IDFdm1, IDFdm2, IDFun, IDFxh1, ICHxw, MSdk (only on site series 2 & 3 on slopes >50%)	**15%** forest cover comprised of 101 + yr. old trees, with an ave. crown closure of 50% in units >10 ha. every 250 or suitable multiples up to planning cell scale.	• Maintain thermal cover and litterfall opportunities. • Contribute to habitat diversity management objectives. • Maintain a high forage to cover differentiation.	Steeper slopes, on southern aspects, receive a higher degree of solar radiation, have less snow and consequently can be managed to a wider spacing and a lower retention component of mature trees.
Elk	**1c**	MSdm1, MSdk, except site series 2 &	**30%** forest cover comprised of 101+ yr. old trees, with	Maintain a relatively high component of forest cover to	Deep snow is often prevalent on these winter range habitats. Dense

		3, ICHdw, ICHmk1, ICHmw1,2 & 3. ICHvk1, ICHwk1, ESSFdk	an ave. crown closure of 60% in units >20 ha. every 250 or suitable multiples up to planning cell scale	support foraging, security snow interception cover and connectivity requirements.	stands with interlocking crowns provide the required attributes to facilitate foraging and movement opportunities
Whitetail deer	**2a** except beside avalanche tracks	PPdh1, PPdh2, IDFdm1, IDFdm2, IDFun, IDFxh1, ICHxw, MSdk (only on site series 2 & 3)	**30%** forest cover comprised of 101 + yr. old trees, with an ave. crown closure of 50% in units >20 ha. every 250 or suitable multiples up to planning cell scale **15%** forest cover for whitetail deer late winter range on slopes >50%	• Maintain suitable security, snow interception cover and connectivity habitat values. • Maintain mature forest cover at the optimum distance to forage sites. • Maintain a high forage to cover differentiation..	Retention of mature trees, particularly Fd, provide the most suitable structural attributes required to optimize the habitat management objectives for whitetail deer. See 1a and 1b for forest cover retention variation.

Species	**GuidelineSet**	**Biogeoclimatic Ecosystem Classification Subzone Variants**	**Forest Cover Retention Over the Managed Forest Land Base Minimum Amount of Mature**	**Habitat Management Objective**	**Rationale/comments**
Whitetail deer	2b	MSdm1, MSdk, except as noted in 1a & 1b, ICHdw, ICHmk1, ICHmw1,2 & 3	**40%** forest cover comprised of 101+ yr. old trees, with an ave. crown closure of 60% in units >20 ha. every 250 or suitable multiples up to planning cell scale	• Maintain snow interception , security, thermal cover,litterfall and connectivity • Maintain mature forest cover in close proximity to forage sites	Deep snow is often prevalent on these winter range habitats. Dense stands with interlocking crowns provide the required attributes to facilitate foraging

Whitetail deer Elk Moose Mule deer	3 adjacent to avalanche tracks	All B.E.C.'s	**70**% basal area retention within a 100 to 200 metre strip on either side of the track comprised of 120 year old trees with an ave. crown closure of 60%.	- Maintain mature forest cover in close proximity to forage sites. - Maintain connectivity, security cover, snow interception cover, thermal cover and litterfall	Deep snow is often prevalent on these winter range habitats. Dense stands with interlocking crowns provide the required attributes to facilitate foraging and movement opportunities.
Mule deer	**4**	MSdm1, MSdk, except as noted in 1a & 1b, ICHdw, ICHmk1, ICHmw1,2 & 3 ICHvk1, ICHwk1,ESSFdk	**35 - 55%** forest cover comprised of 101+ yr. old trees. In the Boundary F.D. , 121+ trees, with an ave. c.c. of 60%. in units >20 ha. every 250 or suitable multiples up to planning cell scale	• Maintain snow interception, security cover and litterfall • Maintain mature forest cover in close proximity to early spring forage sites. • In the Boundary F.D., snow interception is the principle management objective	Deep snow is often prevalent on these winter ranges. Dense mature Fd stands with interlocking crowns provide the required attributes to facilitate foraging and movement opportunities.
Rocky Mountain Bighorn Sheep	**5** (subalpine/ alpine grassland)	ICHvk1, ICHwk1,ESSFdk	**70%** basal area retention within a 300 m radius of grassland. Forest cover comprised of 121 to140+ year old trees with an ave. crown closure of	• Maintain 100% retention of Pa parkland. • Maintain thermal cover	Mature trees, with a high crown closure or interlocking limb component provide the structural attribute required to meet this objective.

	300 m. area adjacent to grassland habitat.		60%. Distribution units should be established within a 300 m. radius of grassland habitat.	retention adjacent to foraging habitats	
Moose	**6**	PPdh1, PPdh2, IDFdm1, IDFdm2, IDFun, IDFxh1, ICHxw, MSdk (only on site series 2 & 3 on slopes >50%)	**40%** forest cover comprised of 82 to 100+ year old trees, with an ave. crown closure of 50% in units >20 ha. every 500 or suitable multiples up to planning cell scale	• Maintain snow interception, security cover, and connectivity • Maintain mature forest cover in close proximity to forage sites.	In the drier subzones, snow depth is usually not an issue. However, deep snow is often prevalent on the moister subzones. Dense stands with interlocking crowns provide the required attributes to facilitate foraging and movement opportunities.
Moose	**7**	ICHvk1, ICHwk1,ESSFdk MSdm1, MSdk, except as noted in 1a & 1b, ICHdw, ICHmk1, ICHmw1,2 & 3	**50%** forest cover comprised of 121 to 140+ year old trees, with an ave. crown closure of 70% in units >20 ha. every 500 or suitable multiples up to planning cell scale	• Maintain snow interception, security cover, and connectivity • Maintain mature forest cover in close proximity to forage sites.	Deep snow is often prevalent in these subzones. Dense, mature stands with interlocking crowns provide the required attributes to facilitate foraging and movement opportunities