MULE DEER WINTER RANGE:
MANAGING FOR A BROADER RANGE OF VALUES

By
ANTHONY MELNICK

FACULTY OF FORESTRY
DEPARTMENT OF FOREST SCIENCES

THE UNIVERSITY OF BRITISH COLUMBIA
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ABSTRACT

Mule deer winter range (MDWR) management aims to produce a forest with a tree species composition that favours Douglas-fir. Removing spruce, lodgepole pine, and deciduous components of the stand is the standard practice used on these ranges to increase the proportions of Douglas-fir. Large diameter Douglas-fir are especially favoured because they increase the stands ability to intercept snow. The optimal stand structure on a MDWR is a multi layered uneven aged stand. These management strategies can provide very effective snow interception that reduces the snow depth on the ground. Keeping the stand structure also is beneficial for many wildlife species. However, managing for MDWR in this way does not address a number of other issues such as fuel loading, forest health, tree species diversity, and some other wildlife species.

INTRODUCTION

Management strategies for mule deer winter ranges vary throughout British Columbia, in this essay, winter range management strategies will be taken from the Cariboo Chilcotin area of British Columbia. There are different types of mule deer winter range in North America. The Ministry of Forests, Lands, and Natural Resource Operations defines mule deer winter range as "landscapes dominated by Douglas-fir stands in areas and topographic positions which result in reduced snow depths," (Ministry of Forests, 1996). In this essay, I will be using this definition of mule deer winter range.

Managing for mule deer winter range can be problematic because it focuses on the success of one species and can also create negative issues for forest health, fire risk, and tree species diversity. This essay will assess how mule deer winter ranges are managed and whether or not this type of management covers broader ranges of issues.

WHAT IS MULE DEER WINTER RANGE

During the winter, deer face obstacles such as low temperatures, deep snow, high-energy costs, and reduced food quality and availability. When snow levels rise, deer have to move to areas that maximize their chance of survival; these areas are known as winter ranges. In late fall, before snow conditions worsen, deer will travel up to 100 km to reach their winter ranges that will provide forage and cover (Day, 1997). A good winter range will have conditions that have shallow snow, adequate food, thermal cover, snow interception, and security cover which allow deer to maintain their energy balance (Armleder, et al. 1986). These conditions are often present on South or West facing aspects in uneven-aged stands of Douglas-fir (Day, 1997), (Armleder, et al. 1986). Although high crown closure associated with uneven aged multi

story Douglas-fir stands increases the amount of snow interception, there are many other important factors to consider when managing for mule deer winter range.

ASPECT

Deer have to expend a great deal of energy (in the form of calories) to adequately heat their bodies in the cold winter conditions. When the deer can move to aspects that provide more sunlight and warmth, they have to expend less energy trying to maintain an adequate body temperature (Day, 1997). During winter, deer have been shown to favour the use of south or west facing areas (Armleder, 1994), (Day, 1997). These aspects are warmer and have lower snow depths because they receive the most sunlight throughout the day. The management of the area can depend specifically on the location of the winter range. In some areas, mule deer will favour stands on a North aspect because there is a desirable tree species composition that is not present on surrounding South or West aspects (Armleder, et al. 1986). Mule deer winter ranges are generally on areas with reduced snow depth, because of this, mule deer will commonly use valleys, exposed ridges, and areas at lower elevations where there are shallower snow depths (Armleder, 1994).

SNOW INTERCEPTION

Open ranges that mule deer use for forage in the spring will have the deepest snow conditions in the winter. This is because these areas do not have forest cover to intercept snow. Tree crowns intercept and hold large amounts of snow off of the forest floor; this creates shallow snow conditions that are beneficial to the overwinter survival of the deer. As snow conditions become deeper, the need for winter range becomes much greater. In deeper snow conditions, the most effective stands for mule deer winter range are comprised of old, large-diameter Douglas-fir stands with high crown closure (Day, 1997). The large size of the trees is beneficial because large thick branches are very strong; they are able intercept and hold substantial amounts of snow without breaking or bending. In a stand with 70% canopy closure, if there were 50cm of snowfall with a density of 0.3 g/cm^3, approximately 5cm of snow would lie on the forest floor; the canopy would intercept other 45cm (Parker, 1984).

ENERGY EXPENDITURE BY MULE DEER

The amount of energy deer use during the winter can determine the likelihood of their survival (Parker, 1984). A deer can use 5X more energy walking in a 50cm of snow compared to a snow free area (Armleder, 1994), (Parker, 1984). Deep snow also restricts movement; the ability to move freely affects the likelihood of a deer escaping a predator. Moving through the snow requires a large amount of energy, which is taken from the deer's the fat reserves that they build up in the spring. It is more difficult to restore their energy reserves in these

conditions because deep snow physically covers many of the energy rich species of shrubs and plants that the deer use for forage (Willms, 1976), (Day, 1997), (Waterhouse, 2003), (Parker, 1984), (Wickstrom, 1984). If a deer spends more energy trying to find forage covered by snow than the energy it receives from the forage it finds, the deer could experience a negative energy balance severe that could kill it. Clearcuts on a section of winter range would decrease the rate of snow interception, causing a dramatic increase in the snow depth on the forest floor, reducing the probability of their overwinter survival (Parker, 1984), (Eastham, 2005).

Research has shown that when snowpack depth exceeds 25cm, mule deer will strongly select old forests with crown closures higher than 36% (Armleder, Winter habitat use by mule deer in the central interior of British Columbia, 1994), (Ministry of Forests, 1996). These high crown closure old forests also act as a barrier to wind, which reduces wind speeds in the forest. In turn, this will reduce radiative heat loss, which allows the deer to use less energy to maintain a sufficient body temperature (Day, 1997).

FEEDING HABITS OF MULE DEER

In normal conditions, deer will use up to 40-60% of their time for forage (Wickstrom, 1984). During spring, deer have the ability to forage on energy rich food sources throughout a number of different ranges. Deer use the high-energy food sources to build fat reserves that will provide an energy source they can use to increase their chance of overwinter survival when conditions become more severe (Parker, 1984). Winter ranges reduce snow depth and increase thermal cover, which together, greatly reduce the amount of energy deer use to move and stay warm.

During the winter, one of the main food sources for winter forage is litterfall from conifer foliage, mainly from old Douglas-fir. The nutrient rich foliage grows higher up in the crowns of the trees where it is more sun exposed. Mule deer gain access this foliage when branches break off from snow loading or wind. They can also forage on the foliage when the branches are pushed down far enough by the weight of the intercepted snow (Willms, 1976). Older trees provide an important source of energy because during winter storms, many of their brittle branches will frequently break off (Armleder, et al. 1986). A study near Kamloops, British Columbia on the feeding habits of mule deer has shown that the deer will avoid the less palatable Douglas-fir foliage present on lower sections of the crown (Willms, 1976). The study also suggested that mule deer gain the majority of their forage from the broken or weighted down branches. The proportion of Douglas-fir foliage in the mule deer's diet becomes larger as snow depths increase (Waterhouse, 2003), (Day, 1997), (Willms, 1976). Mule deer will also eat a wide range of plant and shrub species throughout the winter. Arboreal lichen is another

important variety of winter forage for mule deer. These lichen take a long time to grow and are found in old stands of Douglas-fir (Day, 1997).

HOW TO MANAGE FOR MULE DEER WINTER RANGE

There are many issues to consider when managing for mule deer winter range. Many of the ways in which winter range are managed for depend on the geographic location. First of all, although mule deer will migrate to their respective winter ranges, high valued winter ranges are those associated with good spring ranges (Armleder, et al. 1986). Winter ranges with good quality spring ranges can allow the mule deer access to a high energy food source for spring forage, this will give them a better chance of building up more fat reserves which will provide a larger energy source for the winter. Spring ranges are often in the form of grasslands or scattered thickets of trees. These sites are found in areas that are moisture receiving; such as lower slopes or valley bottoms (Armleder, et al. 1986).

Winter ranges are critically important to the survival rate and reproductive rate of mule deer populations (Armleder, et al. 1986). Many silviculture systems that are commonly used would not work on a mule deer winter range. They are not designed to preserve the values of a winter range. It is essential that special management requirements are taken when logging in a winter range area to preserve the values that encourage survival and reproduction of mule deer. Mule deer winter ranges are often comprised of old growth Douglas-fir that has a high economic value. The winter ranges would be seriously compromised if this high value timber was removed, especially in the form of a clearcut (Eastham, 2005). Using partial cuts to remove low volumes of timber is an effective way to preserve and maintain the mule deer winter ranges (Armleder, et al. 1998).

STAND STRUCTURE

Currently, there are specific management objectives for two different groups of mule deer winter ranges in the Cariboo Chilcotin; there is low to moderate snowpack and transition to deep snowpack zones. Management strategies for mule deer winter range will vary depending on the depth of the snowpack. Areas that have a deeper snowpack will require higher volumes of snow interception. Clumpy distributions of old, large diameter Douglas-fir are significant in these areas (Day, 1997). The distribution and size of these trees will create the high level of snow interception needed for a successful winter range in an area with a deep snowpack.

Winter range is most beneficial for mule deer when it is a multi-layered uneven aged stand. This forest structure provides the optimal level of forest cover and food for the deer

(Day, 1997), (Armleder, et al. 1986), (Ministry of Forests, 1996). Low volume selective patch cutting is a silviculture system known as small group selection. When used correctly, it can maintain the stand values and structural attributes of a mule deer winter range (Armleder, et al. 1986). Current management practices on mule deer winter range use low volume, partial cutting with long re-entry times that aim to preserve the values of the winter range.

These values are maintained by keeping Douglas-fir as a priority species in the winter ranges. Lodgepole pine, spruce, and deciduous trees are considered less valuable than Douglas-fir and are therefore targeted for removal from the stand. This will create a species composition favouring Douglas-fir. After harvesting, the regeneration of Douglas-fir is favoured though increased light penetration into the stand for natural regeneration or it is planted. This is the only tree species that is planted on mule deer winter ranges (Dawson, 2007).

CARIBOO FOREST REGION - RESEARCH SECTION

TABLE 2. Residual basal area targets for mule deer winter range stands in IDFxm and IDFdk3 Biogeoclimatic units in the Cariboo Forest Region These are minimum basal area targets for the Douglas-fir stand component at the beginning of the cutting cycle. For table values to apply, the cutting cycle must be at least 30 years. The residual basal area targets are the average for the net harvested area which does not include roads, landings or Wildlife Tree Patches. Two recommendations are given for moderate habitat in IDFxm: (A) for warm aspect stands with slopes ≥30%, (B) for all other stands.

Habitat Class	Biogeoclimatic Unit	Minimum Residual Basal Area Immediately Post Harvest		Other Criteria Applicable to All IDF Zone Mule Deer Winter Range Prescriptions
		Total Basal Area ≥12.5 cm. (m^2/ha)	Basal Area in stems ≥37.5 cm. (m^2/ha)	
Low	IDFxm and IDFdk3	≥16	≥6	• Create canopy gaps 0.3-1 tree height, averaging 0.5 • Minimize residual damage
Moderate	IDFxm (A)	≥22	≥8	• Harvest non–Douglas-fir species first
	IDFxm (B)	≥22	≥11	• Maintain clumpy stem distribution
	IDFdk3	≥22	≥11	• Distribute harvest in relation to micro-topography
High	IDFxm	≥27	≥15	• Maintain or promote multi-storied stands
	IDFdk3	≥29	≥16	

Note: Special recommendations are provided for warm, steep slopes in the IDFxm because these sites are common and because good habitat mangement will require that some of them be managed as moderate crown closure habitat even though they may not be capable of being managed with a residual large tree basal area of 11 m^2/ha. Warm slopes >60% will only have the capability to produce low crown closure habitat.

Source: Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin (Dawson, 2007)

TABLE A2.1 *Definition of snowpack zones for mule deer winter range management in the Cariboo-Chilcotin*

Snowpack zone	Biogeoclimatic unit[a]	Applicable Management Plan
Shallow	BG-all, IDFxm, IDFxw	This plan
Moderate	IDFdk3 and 4, IDFdw, SBPSxc, MSxk, SBSmh[b]	
Transition	SBSdw1 and 2, SBPSmk, SBPSdc, MSxv, SBSmh[b]	*Management Plan for Transition and Deep Snowpack Zones (2006)*
Deep	IDFmw2, ICH-all, SBSwk, SBSmc, SBSmw	

a Biogeoclimatic zones: BG=Bunchgrass, IDF=Interior Douglas-Fir, SBPS=Sub-Boreal Pine–Spruce, MS=Montane Spruce, SBS=Sub-Boreal Spruce, ICH=Interior Cedar–Hemlock.
b Note that the SBSmh is shown in two snowpack zones. The portion of the SBSmh south of Quesnel is in the moderate snowpack zone while the portions of the SBSmh north and east of Quesnel are in the transition snowpack zone.

Source: Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin (Dawson, 2007)

CUTTING CYCLES AND SPECIES COMPOSITION

Management on low to moderate snowpack zones aims to create a species composition of at least 80% Douglas-fir on sites capable of growing Douglas-fir. The cutting cycles in these areas are set at a minimum of 30 years. At each entry, the Douglas-fir composition should be increased by at least 20% until an 80% Douglas-fir composition is achieved (Dawson, 2007).

Management on transition to deep snowpack zones aim to create a species composition of 60% Douglas-fir in the “Cedar- Hemlock (ICH), wet cool subzone of Sub-Boreal Spruce (SBSwk), moist cold subzone of Sub-Boreal Spruce (SBSmc), or moist warm subzone of Sub-Boreal Spruce (SBSmw)” biogeoclimatic units. All other biogeoclimatic units in deep snowpack zones are managed to achieve a species composition of at least 80% Douglas-fir (Dawson, 2006). To maintain an older stand, there is a minimum cutting cycle of 30 or 40 years depending if the area has a moderate or deep snowpack. At each entry, the management objective is to remove timber and maintain or increase the Douglas-fir composition (Dawson, 2006).

CHOOSING AREAS TO HARVEST

When harvesting, spruce, lodgepole pine, and deciduous trees are targeted for removal (Ministry of Forests, 1996), (Ministry of Forests, Lands, and Natural Resource Operations, 2008), (Armleder, et al. 1986). Trees are harvested in small groups to minimize the size of opening in the canopy. The amount of timber that is removed from an area is correlated with the amount of mule deer activity that the area experiences during the winter. Areas like gullies and Northerly aspects have higher levels of harvesting because they are less beneficial for mule deer winter range (Armleder, et al. 1986). The crown closure of a stand can also determine when it is harvested. Low volume harvests take place if a stand has a higher crown closure than the minimum requirement (Day, 1997).

FOREST HEALTH ISSUES

OVERSTOCKING

Crown closure is important for mule deer winter range, but a high crown closure does not always produce a high interception rate. The Handbook for Timber and Mule Deer Management Co-ordination on Winter Ranges in the Cariboo Forest Region, clearly states that "A stand with high crown closure, made up of 25-year-old trees, 6 metres in height, cannot provide the same litterfall forage or snow interception as can a stand of the same crown closure, made up of 200-year-old trees, 35 metres in height... Also, habitat types on mule deer winter range are most valuable if older age classes predominate," (Armleder, et al. 1986).

Although these blocks are not managed on the basis of crown closure, there is still a very serious threat of overstocking. Many of the IDF (Interior Douglas-fir) zones are naturally adapted to regular small-scale fires that remove understory vegetation. With fire suppression on the landscape, these small-scale fires no longer remove the understory. Eliminating frequent ground fires has allowed an overabundance of small diameter trees and saplings to establish in the understory of many winter ranges (Day, 1997), (Dawson, 2007). In this dry ecosystem, moisture is the limiting factor for tree growth and vigour and the high density of small diameter trees could reduce the available moisture. This could eventually lead to the mortality of the larger and older trees, which require more water to survive. If these areas are not managed properly overstocking will result. If this happens, the area could eventually experience stagnation and a reduction in growth rates (Day, 1997).

ADDRESSING INSECT/PATHOGEN ATTACK

Douglas-fir bark beetle (*Dendroctonus psuedotsugae*) is an insect of particular concern, mule deer winter range is comprised mainly of Douglas-fir which makes these areas susceptible to attack from this insect. Managers address this problem by making infested Douglas-fir trees to first priority of removal at each entry (Dawson, 2007). This is done to reduce the probability of a bark beetle outbreak and control their ability to spread. These entries are spaced 30-40 years apart, which is too long to reduce the spread of Douglas-fir bark beetle populations.

Late September to early December is considered the best time to harvest because it greatly reduces the chance of an infestation. Douglas-fir bark beetles are active during spring and summer; the accumulation of fresh slash from logging and processing will attract the beetles, which will then attack nearby standing Douglas-fir. Standing trees that have been damaged during harvesting have a higher susceptibility to bark beetle attack (Armleder, et al. 1986), so preventing damage to standing trees is important.

Western spruce budworm (*Choristoneura occidentalis*) is another insect species of serious concern that attacks interior Douglas-fir. Stands that have high resiliency to attack by this insect have high species diversity, lower stand densities, and fewer canopy layers. Management practices of mule deer winter range create multi-layered uneven aged Douglas-fir dominated stands, which is the opposite management strategy required for western spruce budworm.

The "Handbook for Timber and Mule Deer Management," published in 1986 states that all spruce, lodgepole pine, and deciduous trees may be removed from winter ranges. Although many of the principles and information from this handbook are still used today, some aspects of the management practices have changed since 1986. Douglas-fir is still favoured as the priority tree species in mule deer winter range. However, research shows that keeping deciduous trees is beneficial in preventing root to root contact between Douglas-fir (Dawson, 2007). This is important because armillaria root disease (*Armillaria ostoyae (Romagn.) Herink*) and laminated root rot (*Phellinus weirii*) spreads through root-to-root contact between Douglas-fir. Blackstain root disease (*Leptographium wagenerivia*) destroys the integrity of root systems in Douglas-fir by interrupting the flow of water to the tree, this root disease is transferred by root beetles (Ministry of Forests - Forest Health Section, 2008). In the interior of BC, armillaria root disease can kill up to 30% of a stand. All conifer species in British Columbia are susceptible to armillaria root disease. Douglas-fir is also the primary host of and is highly susceptible to *Phellinus weirii* (Ministry of Forests, Lands, and Natural Resource Operations, 2008). Laminated root disease will compromise the strength of the root system and eventually the tree will be blown down in a windthrow or snowloading event, this disease can cause up to 50% mortality of a stand (Ministry of Forests, Lands, and Natural Resource Operations, 2008). Replanting or promoting the growth of Douglas-fir in areas that have any one of these root diseases is the incorrect management decision (Ministry of Forests - Forest Health Section, 2008).

Although some of these methods may help in preventing an insect attack, the management for MDWR does not consider many other factors. Stands that have a high tree species composition are naturally more resilient to biotic disturbances. This is because many pathogens and insects are specialized to use a specific tree species as their host. Having different tree species in the same stand make it harder for the biotic disturbance to spread from tree to tree. The management for MDWR clearly states that spruce, lodgepole pine, and deciduous components of the stand should be removed because they are of lower value to the winter range. This may be a beneficial strategy for improving snow interception but it reduces resistance to biotic disturbances.

MANAGING FOR BIODIVERSITY

Deer can have negative impacts on ecosystems and the biodiversity within them. In areas with an overabundance of deer, the foraging of the deer has been shown to create a cascading effect on the other animals. An overabundant deer population can have drastically negative effects on other herbivore populations by directly competing for vegetation. They can also indirectly compete with other animals in the area by the way in which their foraging habits and frequency can change the physical structure of the habitat, (Côté, 2004). Selection of forage by deer can determine the species composition on the ground level, increasing the cover of browse resistance species.

The long-term objective of harvesting to create a Douglas—fir dominated forest by favouring the removal of spruce, lodgepole pine, and deciduous trees. This is beneficial for mule deer that forage of Douglas-fir foliage but it does not consider is not beneficial for all the animals that make up the biodiversity in these ecosystems.

The relatively long cutting cycles of 30 years used in MDWR management allows for the regeneration of small diameter trees. At each entry, many of the wildlife trees in the area are felled to meet faller safety requirements. The method of removing low quality trees further exacerbates this because trees that would have become wildlife trees are removed because they had a high probability of mortality (Dawson, 2007). This negatively impacts the long-term biodiversity aspects on MDWR by removing snags and potential snags that could be used for nesting purposes by species like the flammulated owl, Lewis' woodpecker, and the rubber boa.

FIRE RISK OF MULE DEER WINTER RANGE

The government of British Columbia has acknowledged that there is an elevated fire risk associated with many of the areas in the IDF. Historically, frequent small-scale fires would burn quickly through the understory of the forest. The understory vegetation is adapted to these natural fire patterns. Because of fire suppression, there are many areas in which there are far too many small diameter trees. Overstocking on MDWR would greatly increase the fire risk. The tree spacing is so close that fire is able to spread from crown to crown very easily.

The uneven aged multi-layered stand structure managed for on MDWR is a major fire risk. Multi-layered stands have an abundance of ladder fuels as well as low vertical and horizontal crown spacing. A ladder fuel allows a ground fire to burn up into the canopy. The low vertical spacing in a multi-layered stand would allow the fire to spread vertically at a rapid speed. This would start a crown fire, which is much more difficult to control than a ground fire. The crown fire would be able to spread rapidly because the high crown closure that makes

MDWR desirable is also hazardous for fire because it allows the fire to spread from crown to crown very quickly and easily. The damage caused to a forest by a crown fire is more severe than the natural groundfires that this ecosystem has adapted to. So, instead of low severity ground fires, there is the threat of a high severity, stand-replacing fire.

Continual management of these areas is needed to avoid overstocking and reduce the fire hazard of these winter ranges. Fire suppression has stopped the natural fire regimes that these ecosystems have adapted to; management of these areas must aim to emulate these disturbance regimes in order to reduce the risk of catastrophic fire (Day, 1997).

RECCOMENDATIONS

Management for mule deer winter range does not cover a broad range of issues; there should be less focus on timber productions and species composition and more on managing the ecosystem as a whole. Using ecosystem-based management would be more beneficial than managing for mule deer. Also, areas should be assessed and ranked based on the amount of mule deer activity they receive each winter. High-ranking areas should be managed as reserves, maintained to emulate natural disturbance regimes of small ground fires that frequent dry IDF ecosystems. Promoting the growth of Douglas-fir dominated stands reduces the resilience of the stand by making it more susceptible to attack by specific pathogens and insects. Moving the focus away from timber development allows managers to address preserving and maintaining the habitat in a way that will promote longevity and resilience.

CONCLUSION

The management of MDWR does not address some issues relative to forestry such as fuel loading, species biodiversity, and forest health. Although managing for a multi-layered uneven aged stand with large components of old large diameter trees benefits many species other than just mule deer, there are other factors that this type of management does not address. This stand structure has a high fire hazard because of the fuel loading and high concentration of ladder fuels. The deciduous components of the stand are harder to burn and removing them will increase the susceptibility of the stand to fire. Shifting the species composition of a stand to favour Douglas-fir by removing deciduous components, spruce, and lodgepole pine decreases the species diversity of the forest which can make it more susceptible to pathogen or insect attacks. Stands with higher tree species diversity are more resilient to biotic disturbances. Overall, the management for MDWR is beneficial for many aspects of the habitat because it allows for harvesting to take place while retaining the canopy. Managing for an ecosystem rather than a specific species may be a more effective approach to cover a broader range of issues.

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