Species – Habitat Model for Mule Deer

Species Data

Common Name:	Mule Deer
Scientific Name:	*Odocoileus hemionus*
Species Code:	M-ODHE
BC Status:	Yellow-listed
Identified Wildlife Status:	
COSEWIC Status:	

Project Data

Project Name:	Central Okanagan Terrestrial Ecosystem & Wildlife Habitat Mapping Project
Project Type:	Terrestrial Ecosystem Mapping
Area:	Central Okanagan
Ecoprovince:	Southern Interior
Ecoregions:	Thompson-Okanagan Plateau
Ecosections:	Northern Okanagan Basin (NOB)
BGC Units:	IDFxh1, PPxh1
Map Scale:	1:20 000

1 Distribution

1.1 Continental Range

In North America, mule deer range covers most of the western half of the continent extending from the western coast to central North Dakota, east-central south Dakota, Nebraska, west-central Kansas, and extreme northwestern Oklahoma and Texas (Mackie *et al*. 1982). The northern limit approximates the tree line while the southern boundary occurs near central Mexico and through the Baja peninsula.

1.2 Provincial Range

Within British Columbia, three subspecies of mule deer are identified. Mule deer (*Odocoileus hemionus hemionus)* are distributed throughout much of the interior, east of the coastal mountain range to the Alberta border. They are most common in the southern interior and northeastern portions of the province while remaining absent or sparse in coastal forests and northwestern British Columbia. West of the coastal range, including Vancouver island, is occupied by 2 species of black-tailed deer (*O. h. columbiana* and *O. h. sitkensis*), which inhabit coastal forests

north to Glacier Bay National Park of Alaska. The coastal mountain range represents the approximate zone of subspecies overlap and will provide a boundary for the western most distribution of *O. h. hemionus* (Banfield 1974, Blower 1988, Stevens and Lofts 1988, Fish and Wildlife 1989*)*. The black-tailed deer and mule deer are broadly characterized as different subspecies due to extreme differences in external appearances and behavior patterns.

The geographic range of mule deer encompasses most of temperate British Columbia and essentially all of the Rocky Mountain regions where the species approaches its northern limit of distribution. Table 1 lists areas of highest reported abundance of mule deer in BC.

Table 1. Areas of highest reported abundance of mule deer in British Columbia (densities > 1 deer / 0.2 km^2)

ECOPROVINCE	ECOREGION	ECOSECTION	GENERAL LOCATION
Southern Interior	Thompson-Okanagan Plateau	Northern Thompson Upland	North Thompson River
		Southern Thompson Upland	City of Kamloops
		Thompson Basin	Copper Creek
		Northern Okanagan Basin	City of Kelowna
	Interior Transition Ranges	Southern Chilcotin Ranges	Yalakom River
	Northern Cascade Ranges	Okanagan Range	Okanagan River
Boreal Plains	Central Alberta Upland	Halfway Plateau	Charlie Lake
		Clear Hills	Beatton River
	Peace River Basin	Peace Lowland	City of Fort St. John
Central Interior	Fraser Plateau	Chilcotin Plateau	Churn Creek
		Fraser River Basin	Town of Gang Ranch
		Cariboo Basin	San Jose River
		Cariboo Plateau	Meleese Lake
	Chilcotin Ranges	Central Chilcotin Ranges	French Bar Creek
Southern Interior Mountains	Selkirk Bitterroot Foothills	Selkirk Foothills	Lower Arrow Lake
	Nothern Columbia Mountains	Eastern Purcell Mountains	Doctor Creek and Dutch Creek
		McGillivray Range	Bloom Creek
		Southern Columbia Mountains	Moyie River
	Southern Rocky Mountains Trench	East Kootenay Trench	Columbia River
	Northern Continental Divide	Border Ranges	Wigwam River
	Western Continental Ranges	Southern Park Ranges	Fairmont Hot Springs

1.3 Distribution in Project Area

1.3.1 Elevation Range

Mule deer occur throughout all biogeoclimatic units in the Okanagan Valley wherever suitable habitat exists. In mountainous habitats of British Columbia, mule deer are primarily migratory, using upper elevation and alpine habitats during the summer and lower valleys and south facing slopes during the winter (MELP 1996).

2 Ecology and Habitat Requirements

Primary habitats for mule deer can be found in a landscape that provides food, security habitat, and thermal habitat interspersed in a pattern that facilitates reasonable access between habitats (MELP 1996). While mule deer occupy several unique habitat types, they have a propensity for edge or transitional habitats. Thus mule deer can be considered an ecotonal species, favoring high contrast forest edges that typically provide an abundance of forage in close proximity to escape and thermal cover.

Mountainous habitats occupied by mule deer in British Columbia are characterized by a variety of topographical, climatic, and elevation factors. Seasonal use of habitats will vary but is typically described as open coniferous forest, climax brush, aspen stands, steep broken terrain, and river valleys (Banfield 1974).

Typical of most species, mule deer living habitat should encompass forage, security, and thermal features while allowing them to address other life requisites, such as reproduction. Mule deer habitat use strategy involves the selection of several structural and successional stages of a forested landscape during different times of the year.

Migratory movements are characteristic of mule deer in mountainous habitats (Banfield 1974, Mackie *et al.* 1982). Fall and early winter movements are associated with increased snow depth while spring and early summer movements are influenced by the emergence of green vegetation in areas of high snow melt. Generally, mule deer movements are elevational and are based on prevailing weather conditions. Summer conditions allow the deer to range into high elevation biogeoclimatic zones. Conversely, winter conditions (dependent on the severity) usually force the deer to lower elevations where the increased tree cover and reduced depths of snowpack allow them to minimize energy losses. Stevens and Lofts (1988) report movements of up to 120 km between seasonal ranges in the Cariboo area. However, McNay and Doyle (1987) typically report seasonal migrations of 2-5 km. As per the definition of 'migrating habitat', mule deer do not have specific habitat requirements for migratory activities. Migrating habitat will not be rated separately.

Mule deer typically calve in late May or early June. Their gestation period is approximately 203 days (Robinette *et al*. 1977). Calving sites are generally in protected areas with abundant food, nearby water, and security cover. These sites are often located on gentle terrain such as terraces and benches in otherwise steep topography between the animal's winter and summer ranges. Security cover (provided by shrubby understorey vegetation or coarse woody debris), forage areas, and thermal cover combine to comprise optimum calving areas.

3 Life Requisites and Habitat-uses

Significant habitat-uses of Mule Deer are reproducing, and general living during the four seasons: spring, summer, fall, and winter. Within the project area, habitat requirements of Mule Deer do not change significantly between spring, summer, and fall. Therefore, ratings for general living

during spring, summer, and fall will be lumped into one rating called *general living during growing season*. Habitat requirements during winter are significantly different and therefore *general living during winter* will be rated separately. Habitat requirements for reproducing (birthing sites) are not very distinct and are often difficult to distinguish from habitat used for *general living during growing season* and therefore reproducing will not be rated.

During the growing season, habitat for mule deer must provide food and security habitat. During winter, habitat for mule deer must provide food, security habitat, and thermal habitat. Habitat attributes that contribute to food, security habitat, and thermal habitat are quite distinct from each other. Therefore, food and security habitat will be rated separately for *general living during growing season*. In addition, food, security habitat, and thermal habitat will be rated separately for *general living during winter*. Table 2 lists the life requisites and habitat-uses rated for mule deer.

Table 2. Life Requisites and habitat-uses rated for mule deer in the Central Okanagan project.

Life requisite	Habitat-use	Months	Rating column title
Food	General Living during Growing Season	Apr, May, Jun, Jul, Aug, Sep, Oct	MODHE_FDLIG
Security Habitat	General Living during Growing Season	Apr, May, Jun, Jul, Aug, Sep, Oct	MODHE_SHLIG
Food	General Living during Winter	Apr, May, Jun, Jul, Aug, Sep, Oct	MODHE_FDLIW
Security Habitat	General Living during Winter	Nov, Dec, Jan, Feb, Mar	MODHE_SHLIW
Thermal Habitat	General Living during Winter	Nov, Dec, Jan, Feb, Mar	MODHE_THLIW

3.1 General Living during Growing Season

3.1.1 Food

Mule deer are considered generalist feeders with diets that vary with seasonal availability of forage. Seasonal variations in diet are experienced by mule deer throughout their range in the province, as spring and summer diets consist of grasses and forbs, while, browse and other lower quality forages predominate their diet throughout the fall and winter seasons. Although succulent graminoids and forbs are utilized as supplemental forage when available, browse provides the bulk of the annual diet for mule deer (Cowan 1947, Sheppard 1960, Flook 1964). Cowan (1947) analyzed mule deer diet content to be 79% browse, 15% graminoids, and 6% forbs in the winter. Similarly, Waterhouse *et al.* (1994) reported diet compositions from winter ranges in the central interior of British Columbia as 45-76% conifers, 15-50% shrubs, 1-7% graminoids, and 1-6% forbs. Willms *et al.* (1976) recorded a shift from low shrubs, graminoids, and forbs to tall shrubs and trees as snow depths increased. Table 3 lists common food plants expected in the Okanagan valley. In the Rocky Mountains mule deer diets are comprised of a diversity of over 750 plant species, including 202 shrubs and trees, 484 forbs, and 84 graminoids (Kufeld *et al*. 1973).

Habitats typically yielding moderate to high quantities of trees and shrubs have been described as the primary sources of annual forage for mule deer. Historically, forest fire was the major natural event resulting in a multi-structured landscape producing open habitats and, thus, abundant quantities of available trees and shrubs in the understorey. Recently, forest fire suppression has limited the availability of open habitats, however in the Okanagan Valley this natural disturbance has been replaced by timber harvesting and other anthropogenic land surface disturbances. The resulting habitats created from these types of disturbances provide significant mule deer habitats used for feeding, and typically provide good summer foraging sites.

3.1.2 Security Habitat:

Annual security habitats utilized by mule deer include rugged and broken terrain, wooded river valleys, shrubby draws, steep slopes, and dense tree or shrub growth. Winter security habitats are similar, although, the depth of the snowpack determines the suitability of habitat for mule deer security purposes. Ideal security cover minimizes predation rates on mule deer by limiting predators to diseased, juvenile, and exposed deer. Typical predators of mule deer include coyotes (*Canis latrans*), wolves (*Canis lupus*), mountain lions (*Felis concolor*), bobcats (*Lynx rufus*), lynx (*Lynx canadensis*), and golden eagles (*Aquila chrysaetos*) (Banfield 1974, Mackie *et al.* 1982, Jalkotzy *et al.* 1984). Mule deer research suggests that optimal security habitat will hide an average of 90% of a mule deer from view at a 60m distance or less (Thomas et al. 1979). Patches of security cover need to be 180 m or more in diameter.

3.2 General Living during Winter

Bunnell (1990) has defined critical features of stand structure for mule deer winter range, as follows: (1) long, well developed crowns which intercept snow efficiently, thereby reducing rates of food burial and costs of movement, (2) small openings in a variable canopy that averages 65-70% closure, permitting growth of key forage species, interception of substantial amounts of snow, and provision of overhead thermal cover (thus good interspersion); and (3) multiple canopy layers with an understorey of shade-tolerant conifers that provide additional thermal and security cover and forage, if Douglas-fir is present.

3.2.1 Food

Winter foraging habitat preferences for mule deer are generally dictated by temperature, snow depth, quality, and quantity of forages. Areas of lower temperature and shallow snow depths (south facing slopes) are selected by mule deer during winter and result in greater concentrations of mule deer at these sites. In other areas of their North American range, Douglas-fir is a common feature of winter foraging habitat for mule deer (Geist 1981, Berg 1983, Stevens and Lofts 1988, Armleder *et al.* 1986, Dawson *et al.* 1990, Armleder and Dawson 1992, Waterhouse *et al.* 1994). Within the central interior of BC, Waterhouse *et al.* (1994) reported that the average amount of Douglas-fir in the diets of mule deer was between 24% and 73%, and was the most abundant forage species in winter diets. Wallmo (1981) found that the consumption of Douglas-fir also increased when deer used forests as a refuge from deep snow conditions in open habitats. Table 3 presents a compilation of some of the key forage species reported in the literature (Stevens and Lofts 1988, AEP1989, Waterhouse *et al*. 1994).

Table 3. Important food plants for mule deer

Latin Name	Common Name

Trees and Shrubs	
Abies balsamea	
Amelanchier alnifolia	Saskatoon
Cornus stolonifera	red-osier dogwood
Elaeagnus commutata	wolf-willow
Mahonia aquifolium	tall Oregon grape
Populus tremuloides	trembling aspen
Prunus virginiana	choke cherry
Pseudotsuga menziesii	Interior Douglas-fir
Rosa acicularis	prickly rose
Salix spp.	willows
Shepherdia canadensis	Soopolallie
Symphoricarpos albus	common snowberry
Thuja plicata	red cedar
Tsuga heterophylla	western hemlock
Vaccinium spp.	blueberries
Graminoids and Forbs	
Artemesia spp.	
Aster spp.	asters
Avena sativa	
Cirsium arvense	Canada thistle
Epilobium augustifolium	fireweed
Heracleum lanatum	cow parsnip
Medicago sativa	alfalfa
Triticum spp.	

3.2.2 Security Habitat

Security requirements for mule deer in winter are similar to security requirements during growing season. In winter, snow depth is an additional factor that determines the suitability of habitat for mule deer security purposes. Snow depths greater than 50 cm will essentially preclude the use of a habitat by mule deer, while depths of 25-30 cm impede or hinder deer movements (Walmo *et al.* 1977, Mackie *et al.* 1982, Stevens and Lofts 1988). A study by Parker *et al.* (1984) reported a 150% increase in energy required when walking in 41 cm of snow, and a 50% increase in 25 cm of snow, compared to walking on bare ground. For much of the Central Okanagan study area snow depths are not expected to …

3.2.3 Thermal Habitat

Thermal habitats for mule deer have only been described for over-wintering purposes, as mule deer have little requirement for summer thermoregulation. During winter, several researchers have described low temperatures and the duration and depth of snowpacks as the primary limiting factors to mule deer (Mackie *et al.* 1982, Wishart 1986, Stevens and Lofts 1988). The primary mode of thermoregulation is habitat selection. Specifically, mule deer concentrate in habitats with lower snow depth, gentle to moderate south and west facing slopes, climax forests with high crown closures, and lower elevations (Telfer 1978). Within the context of thermal habitat, Bunnell (1990) and Armleder *et al.* (1986) described the physical criteria generally used as thermal habitat as (1) warm aspects (with the exception of large river valleys), (2) gentle to moderate slopes, (3) low elevations, and (4) Douglas-fir as the dominant tree species.

4 Ratings

4.1 Provincial Benchmarks

MELP (RIC 1998) has identified high-rated habitats and provincial benchmark habitats for mule deer in British Columbia as shown in Table 4.

Table 4. Provincial benchmark habitats for mule deer. Bold rows indicate the provincial benchmark against which all other mule deer habitats are compared.

Ecoprovince	Ecosection	BGC unit	Rating
Winter			
Central Interior	**FRB**	**IDFxm**	**1**
Sub-Boreal Interior	PEF	BWBSmw	3
Southern Interior Mountains	**EKT**	**IDFdm**	**1**
Southern Interior	NOB	PPxh	1
	OKR	IDFxh	1
	SOB	PPxh	1
	SOH	IDFxh	1
	THB	PPxh	1
Boreal Plains	PEL	BWBSmw	2
Taiga Plains	MUP	BWBSmw	3
Northern Boreal Mountains	MUF	BWBSmw	3
Growing Season			
Central Interior	CAB	2	IDFdk
Sub-Boreal Interior	PEF	3	BWBSmw
Southern Interior Mountains	**EPM**	**1**	**ESSFdk**

	MCR	2	ESSFdk
	SCM	2	ESSFwv/wm
Southern Interior	OKR	1	ESSFxc
Boreal Plains	PEL	2	BWBSmw1
Taiga Plains	MUP	3	BWBSmw
Northern Boreal Mountains	MUF	3	BWBSmw

4.2 Assumptions

This model uses a six-class rating scheme because there is a large body of knowledge about mule deer in British Columbia. Table 5 lists assumptions used in this model.

Table 5. Assumptions for habitat-use by mule deer in the Central Okanagan study area.

Attribute	Assumptions for Food for General Living during Growing Season
Site series	• Open grasslands are used during spring green up and those ecosystems with abundant fescues, Poa's, junegrass and bluebunch wheatgrass are preferred and rated up to class 1 • Low elevation riparian habitat with closed canopy (>35% crown closure) rated up to class 1 • Wetlands and marshes rated up to class 2 • CF (Cultivated fields) rated up to class 1
STRCT_S	• Stages 3-7 with shrubby openings rated up to class 1 • Non-rocky ecosystem units containing aspen and cottonwood rated down to class 3
Tree species	• Ecosystem units containing cottonwood rated class 1
Attribute	**Assumptions for Security Habitat for General Living during Growing Season**
Site series	• Low elevation riparian habitat with closed canopy (>35% crown closure) rated up to class 1 • Level, open areas rated class 5
SITE_M	• q and z (greater than 100% slope) rated class 6 (nil)
STRCT_S	• Stages 3b-7 with dense understorey >1.5 m tall rated up to class 1
Attribute	**Assumptions for Food for General Living during Winter**
Site series	• Site series: dominated by dense tree and shrub growth rated up to class 1, particularly if Douglas fir is the main tree species • Open Douglas-fir forests (less than 25% crown closure) rated class 3 • Low elevation riparian habitat in PP BGC zone. with closed canopy (>35% crown closure) rated class 1 • Wetlands and marshes rated up to class 3
SITE_M	• warm aspect, Douglas-fir dominated forests with a closed canopy (>35% crown closure) on moderate to gentle slopes (<45% slope) with available understorey forage rated class 1

Attribute	Assumptions for Security Habitat for General Living during Winter
Site series	• Site series: dominated by dense tree and shrub growth rated up to class 1 • Open Douglas-fir forests (less than 25% crown closure) rated class 3 • Low elevation riparian habitat in PP BGC zone. with closed canopy (>35% crown closure) rated class 1
Snow depth	• Ecosystem units with snow averaging deeper than 25 cm rated up to class 3
SITE_M	• w (warm and 25-100% slope) rated up to class 1 • k (cool and 25-100% slope) rated up to class 1 in the PP BGC zone. • k rated up to class 3 in the higher elevations of the IDF BGC zone • q and z (> 100% slope) rated class 6 • warm aspect, stage 6 and 7 Douglas-fir dominated forests with a closed canopy (>35% crown closure) on moderate to gentle slopes (<45% slope) with shrub cover rated class 1
Attribute	**Assumptions for Thermal Habitat for General Living during Winter**
BGC zone	• The PP zone rated higher than the IDF zone because of warmer, lower elevation sites. • warm aspect, Douglas-fir dominated forests with a closed canopy (>35% crown closure) on moderate to gentle slopes (<45% slope) with available understorey forage rated class 1
SITE_M	• w (warm and 25-100% slope) rated up to class 1 • k (cool and 25-100% slope) rated up to class 4 in the PP BGC zone. • k rated class 6 in the IDF BGC zone • q and z (> 100% slope) rated class 6
STAND_A	• B (broadleaf EUs) in PPxh on warm aspect rated up to 2 • B (broadleaf EUs) in IDFxh on warm aspect rated up to 3
Tree species	• EUs in PPxh1 containing aspen or cottonwood rated up to class 3 • EUs in IDFxh1 containing cottonwood usually rated class 4. Some warm aspect ones rated class 3.
SITEMC_S	• In PPxh1, structural stages 6 and 7 of DS and SP unit rated down to 2

5 Map Themes

Two map themes were made for mule deer: (1) *General living during growing season*, and (2) *general living during winter*.

5.1 General Living during Growing Season

During the growing season, mule deer are heavily dependent upon both food (FD) and security habitat (SH). Therefore, both FD and SH ratings were combined to produce one theme for *general living during growing season*.

The first step in generating the *general living during growing season* theme was to produce two themes. A simple suitability theme was generated by using MODHE_FDLIG column in the ratings table and averaging the ratings within each polygon. Another simple suitability theme was generated by using MODHE_SHLIG column in the ratings table and averaging the ratings within each polygon. For the discussion below, the first theme is called a food (FD) theme, and the second theme is called a security habitat (SH) theme. The next step was to divide the landscape into 25 x 25 m cells and assign each cell a FD rating and a SH rating according the FD and SH

themes above. Subsequently, the two themes were combined with rules that depended on the FD and SH ratings.

The rules are shown in Table 6. The first row in the table can be read as: If a cell is class 1, 2, or 3 security habitat, and if the cell is class 1, 2, or 3 food, then the rating assigned to the cell is equivalent to the food rating.

Table 6. Rules for combining food (FD) and security habitat (SH) to make the theme *general living during growing season* for mule deer.

Rule #	SH	FD	Rule
One	1,2,3	1,2,3	Rating = FD
Two	1,2,3	4,5,6	Rating = averaged of FD and SH
Three	4,5	1,2,3	If cell is within 100 m of class 3 or better SH, then Rating = FD
Four	4,5	1,2,3	If cell is beyond 100 m of class 3 or better SH, then Rating = average of FD and SH
Five	4,5	4,5,6	Rating = average of FD and SH
Six	6	1,2,3,4,5,6	Rating = SH

5.2 General Living During Winter

During winter, mule deer are dependent upon food (FD, security habitat (SH), and thermal habitat (TH). Therefore, FD, SH, and TH ratings were combined to produce one theme for *general living during winter*. The rules for combining FD and SH were the same as the rules for *general living during growing season*. After FD and SH were combined into one theme (called a FD/SH theme), then a final *general living during winter* theme was made by taking a weighted average of the FD/SH and TH theme, with weights of 1:2 respectively.

6 References

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