

Roosevelt Elk Management in British Columbia

A Discussion Paper

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Executive Summary

Roosevelt elk (*Cervus canadensis roosevelti*) serve an important ecological role in coastal ecosystems of British Columbia. They are prey for top predators and they influence plant phenology and successional pathways in their preferred habitats. Roosevelt elk are also important in First Nations culture and provide resident and guided hunting and viewing opportunities.

This report presents a synopsis of current management and proposes objectives and strategies for a Roosevelt elk management plan. The report is intended to serve as a discussion paper to frame the development of a plan that will direct management of Roosevelt elk for the next 10 years according to provincial wildlife policy with input from First Nations and stakeholders.

Roosevelt elk are on the Provincial Blue list and are subject to a conservative, limited-entry hunt in the West Coast and South Coast regions. Although their global distribution is smaller and more fragmented than pre-1900, the BC population is growing, particularly in the South Coast region where transplants have re-established Roosevelt elk into portions of their historic range.

Roosevelt elk are managed by Elk Population Units (EPUs). Population size and trend, harvest rate, and habitat suitability have been estimated for all EPUs. Indicators are monitored according to conservation priorities and available funding.

Given the conservation status of Roosevelt elk and the high demand for cultural, recreational and commercial uses, the Ministry of Forests, Lands and Natural Resource Operations is proposing a management goal of increasing the population, expanding its distribution and mitigating threats, such that the subspecies could be removed from the provincial Blue List within the next 10 years. To meet this goal, the following objectives are proposed:

1. Maintain self-sustaining populations of Roosevelt elk throughout their current range in the West Coast and South Coast regions.
2. Re-establish Roosevelt elk in historic but unoccupied range where ecological conditions are suitable.
3. Maintain or restore the contribution of Roosevelt elk to natural biodiversity and ecosystem function.
4. Within the ecological limits of the species, provide opportunities for consumptive and non-consumptive use.
5. Mitigate risk of vehicle collisions.
6. Mitigate crop depredation impacts on agricultural crops and market gardens.
7. Mitigate conflicts with timber objectives.

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Introduction

Roosevelt elk (*Cervus canadensis roosevelti*) are the largest subspecies of North American elk and range in BC throughout Vancouver Island and portions of the south coast (Shackleton 1999). As the largest ungulate in their range, Roosevelt elk serve an important ecological role as prey for top predators such as gray wolves (*Canis lupus*) and cougars (*Puma concolor*), and as large browsers that influence plant phenology and successional pathways in their habitats. Roosevelt elk are important to First Nations, who are keenly interested in expanding their traditional use of the species. Resident hunters submit approximately 15,000 applications annually for approximately 300 hunting opportunities and guided hunts for non-residents are in high demand and provide a high return to guide-outfitters. Roosevelt elk are also highly sought after for wildlife viewing.

This report presents a synopsis of current management and proposes objectives and strategies for a Roosevelt elk management plan, based on preliminary input from the Ministry of Forests, Lands and Natural Resource Operations (FLNRO). The report is intended to serve as a discussion paper to frame the development of a plan that will direct management of Roosevelt elk for the next 10 years according to provincial wildlife policy with input from First Nations and stakeholders.

Conservation

Roosevelt elk are ranked by the Conservation Data Centre (2012) as S3S4 (*Vulnerable to Apparently Secure*) and are on the provincial Blue List (*Special Concern*). The Ministry of Environment's (2009) Conservation Framework priorities for Roosevelt elk are 3 for Goal 1 (contribute to global efforts for species and ecosystem conservation), 2 for Goal 2 (prevent species and ecosystems from becoming at risk), and 3 for Goal 3 (maintain the diversity of native species and ecosystems).

Roosevelt elk are hunted in specific management units in the West Coast and South Coast regions by licensed resident hunters under Limited Entry Hunting regulations, Guide Outfitters by allocation, and by First Nations for food, cultural, and ceremonial purposes, typically under harvest agreements with the Province.

Natural History

Brunt (1990), Quayle and Brunt (2003) and Shackleton (1999) provided detailed narratives of Roosevelt elk life history in BC. The following is a brief overview.

Feeding Ecology and Habitat Use

Roosevelt elk are generalist herbivores and browse or graze on a wide variety of shrubs, forbs, grasses, sedges and trees, depending on availability (Brunt 1990)

Shackleton 1999, Cook 2002). Elk focus their habitat use in forested habitats, particularly along forest edges, riparian areas and recently burned forest stands or clearcuts (Witmer and deCalesta 1983). Security is also a major factor in Roosevelt elk habitat use (Brunt 1990, Quayle and Brunt 2003). Dense forests provide security and snow interception cover, and habitat that can provide both abundant food and dense cover in close proximity are considered highly suitable for Roosevelt elk (e.g., mature-old forest edges and riparian areas).

Seasonal habitat use patterns are variable, with some Roosevelt elk moving seasonally to high-elevation summer ranges, others moving between low-elevation seasonal ranges, and still other remaining in year-round ranges (Brunt 1990, Shackleton 1999). Snow depth is an important determinant of winter habitat use, with Roosevelt elk moving into mature and old forest to seek snow interception cover when snow in more open areas becomes deep enough to cover low-growing plants (>30 cm; Brunt 1990).

Social Organization and Reproduction

Elk are social ungulates that congregate primarily in maternal groups comprised of adult females, young of the year (calves), and other juveniles (<2.5 years old) of both sexes. Adult males are typically solitary or are found in small bachelor groups except during the breeding season (September-October) when they defend harems of females and calves (Franklin et al. 1975, Shackleton 1999, Geist 2002).

Females usually breed for the first time when 2.5 years old (Shackleton 1999) and bear a single calf (twins have never been confirmed on Vancouver Island; Quayle and Brunt 2003) in late May or early June. During the first few weeks of the newborn calf's life, cows and their calves typically remain apart from other elk, and calves will often remain hidden in dense cover as an anti-predator tactic while the cow remains close by. After calves become more mobile, cows and their new calves re-join the main herd.

Population Size and Distribution

The global distribution of Roosevelt elk extends from northern California to southwestern BC (Shackleton 1999, O'Gara and Dundas 2002). In BC they are currently distributed throughout most of Vancouver Island, on the Sunshine Coast and in the north shore watersheds north of the Fraser Valley (Figure 1). The mainland populations are largely a result of transplants from Vancouver Island. Roosevelt elk were formally distributed more extensively throughout the south coast but were largely extirpated from the region by the 1880s as a result of an expanding human population and market hunting (O'Gara and Dundas 2002, Quayle and Brunt 2003).

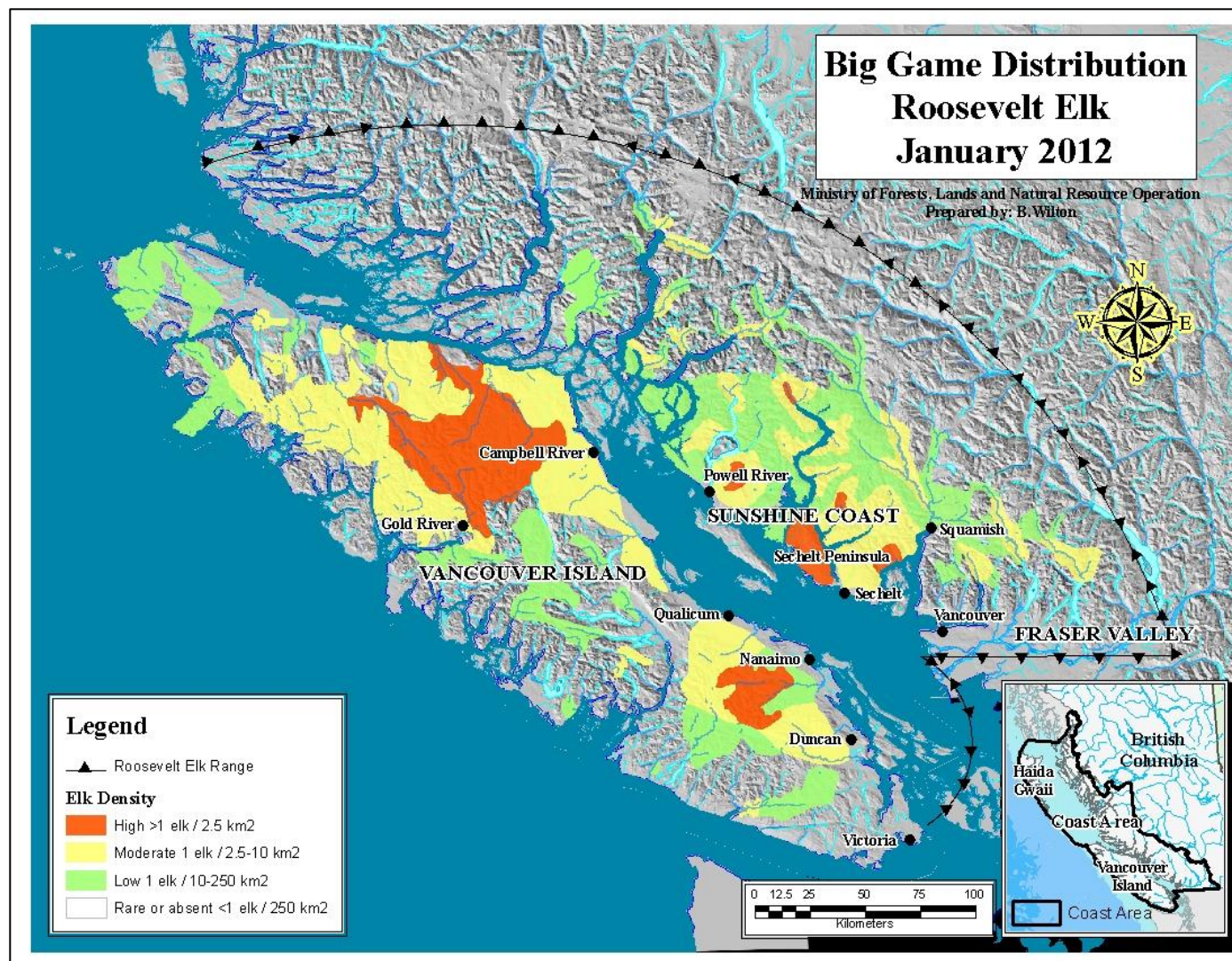


Figure 1. Estimated distribution and population density of Roosevelt elk in British Columbia.

Transplants to the Sechelt Peninsula during the 1980s and near Powell River in the 1990s were followed by releases into the north shore watersheds from the growing Sunshine Coast population during the 2000s (Appendix I). Although elk are found farther southeast in the Cascade Mountains, they are likely Rocky Mountain elk (*Cervus canadensis nelsoni*; Shackleton 1999) descended from transplants into Washington State (Washington Department of Fish and Wildlife 2000).

A small population of elk (100-150) persists on Graham Island in the Haida Gwaii archipelago; however, they are not native, having descended from Rocky Mountain elk originating from Alberta and transplanted in 1929 and 1930. Red deer (*Cervus elaphus*) were also transplanted from New Zealand in 1918 and may have later interbred with the Rocky Mountain elk transplants (Shackleton 1999, O’Gara and Dundas 2002).

The Roosevelt elk population is experiencing an overall increase in BC (Table 1). The increase is most evident in the South Coast Region where transplanted populations are increasing rapidly.

Table 1. Estimated population size of Roosevelt elk in British Columbia, by Region.

Year	West Coast Region	South Coast Region	BC (approximate)
1986	2500	<50	2550
2001	3400	<400	3800
2012	5200	1400	6600

Management

Monitoring Population Size and Trend

Elk Population Units (EPUs) are the spatial management units by which Roosevelt elk are assessed and managed (Figure 2). Roosevelt elk are usually inventoried by aerial surveys conducted in late winter or early spring (Simpson 1997). Only portions of the range are typically surveyed in any given year. The size of the area flown is funding dependent and priority areas for surveying are those:

1. With the largest hunted populations;
2. Where a new hunt is anticipated;
3. Where populations have been recently transplanted;
4. Of particular interest to First Nations; and/or,
5. Where high levels of illegal or unregulated hunting are suspected to occur.

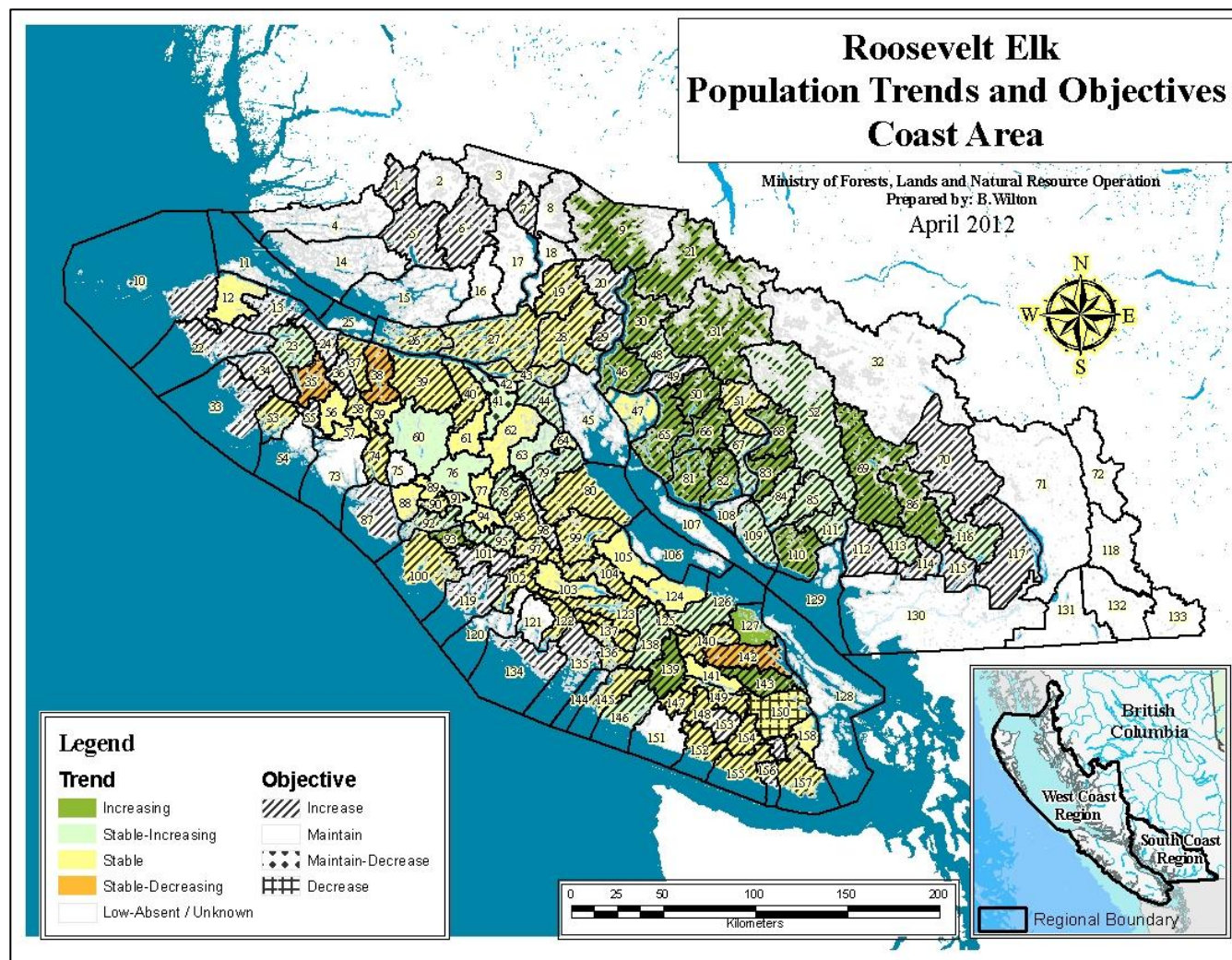


Figure 2. Roosevelt elk population units (EPUs) in the South Coast and West Coast Regions. Detailed information on each EPU is referenced in Table 6. Also illustrated is the estimated population trend for each and objective for each EPU.

Surveys are focused primarily on estimating population size, determining calf:100 cow and bull:100 cow ratios and the age class distribution of bulls. These indicators are used to evaluate population status and the effects of hunting. Bull:100 cow ratios of 20-25 and calf:100 cow ratios of 30-40 are considered indicative of a stable population (Bender and Miller 1999, Oregon Department of Fish and Wildlife 2003, Montana Department of Fish, Wildlife, and Parks 2004, Arizona Game and Fish Department 2007, BC Ministry of Environment 2010, Ontario Ministry of Natural Resources 2011). Survey data from the West and South Coast Regions indicate that ratios have generally fallen within these ranges over the past 18 years (Figure 3, Figure 4).

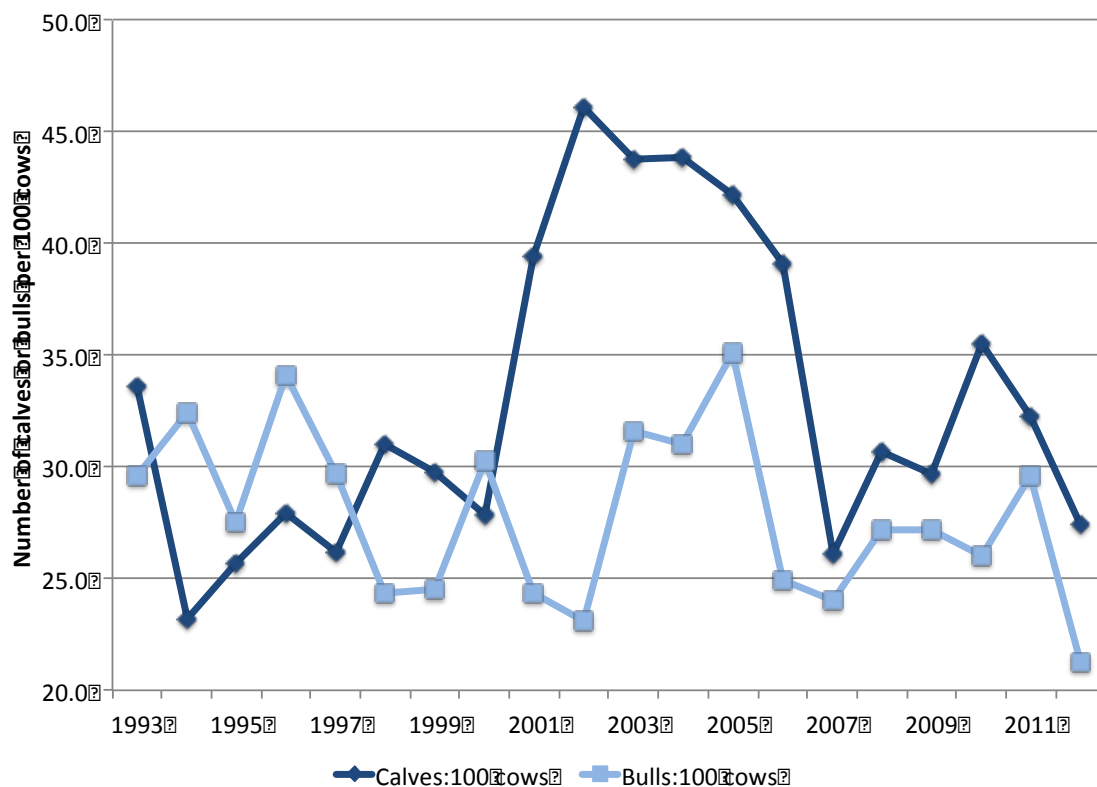


Figure 3. Ratio of Roosevelt elk calves:100 cows and bulls:100 cows for the West Coast Region, as observed during spring surveys.

The total population of Roosevelt elk in an EPU can also be estimated in part from aerial surveys, after correcting for sightability. Sightability of elk in west coast forested habitats are generally 0.33-0.5 (Simpson 1997, Gilbert and Moeller 2008). Sightability corrections are applied based on a subjective assessment of the following factors:

1. Weather – effect of fog, snow and rain on visibility;
2. Habitat – canopy cover conditions where elk occur in the area;

3. Ground snow conditions – relative abundance and location of tracks following a recent snowfall relative to the number of groups counted on surveys;
4. Proportion of the range likely to be occupied that was surveyed;
5. Time of day – use of open habitats is more likely within 2 h of sunrise or sunset.
6. Group size (typically a reflection of elk density) – larger groups are more likely to be sighted.

A sightability of *very low* to *very high* is assigned to each survey and elk counts are inflated accordingly to generate population estimates (Table 2).

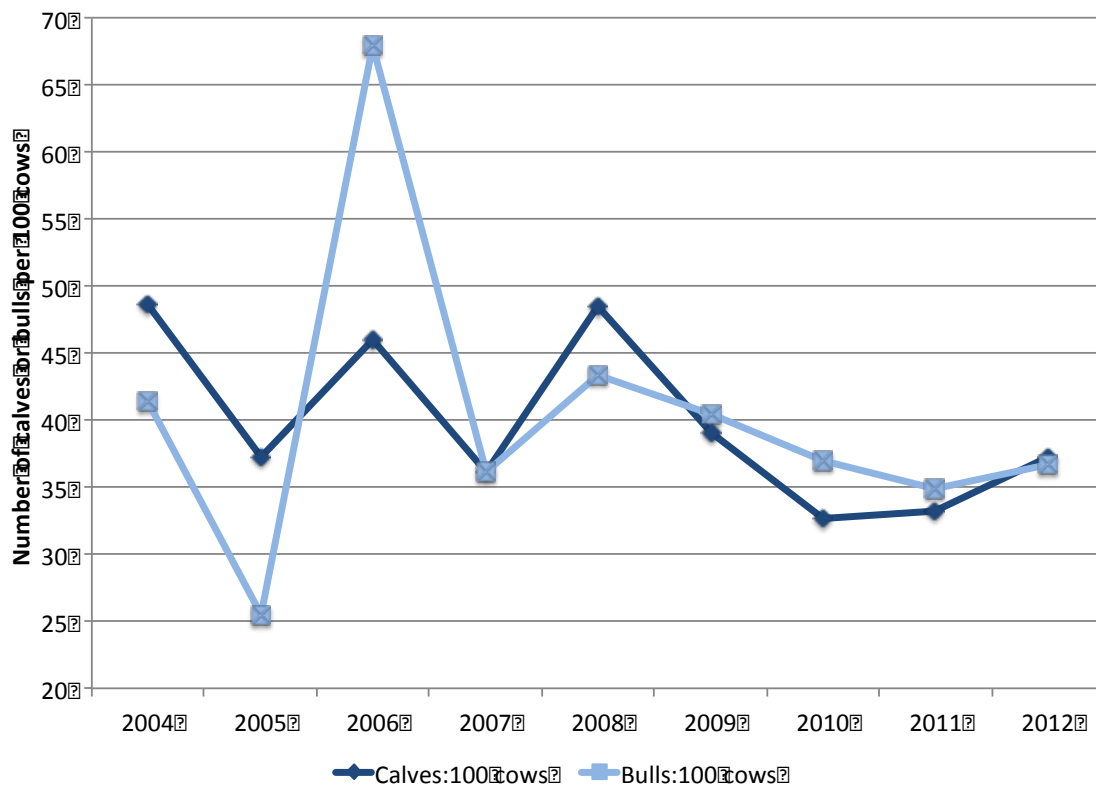


Figure 4. Ratio of Roosevelt elk calves:100 cows and bulls:100 cows for the South Coast Region, as observed during spring surveys.

Table 2. Sightability classes for Roosevelt elk surveys estimated proportion of the population visible and multiplication factors used to estimate populations from aerial inventory data.

Sightability	Estimated proportion of population visible on surveys	Multiplication Factor
Very low	<30%	>3.3
Low	30-45%	2.2-3.3
Moderate	45-55%	1.8-2.2
High	55-70%	1.4-1.8
Very high	70-95%	1.05-1.4

Roosevelt elk counts and composition data are also collected during spring (April-May) and summer (August), ground-based inventories. These data can be used to contribute to population ratio and population size estimates.

Consumptive Use Management

Harvest Objectives

Harvest is closely regulated and monitored throughout the West Coast and South Coast regions (Figure 5). Roosevelt elk are vulnerable to hunting because they are highly visible and relatively easy to hunt. Demand for hunting opportunities is high (i.e., approximately 15,000 applications from resident hunters for approximately 300 permits, and high demand for guided hunts that provide a high return to guide-outfitters; K. Brunt, *pers. comm.*) because elk provide a high reward value to hunters in terms of both meat and trophies.

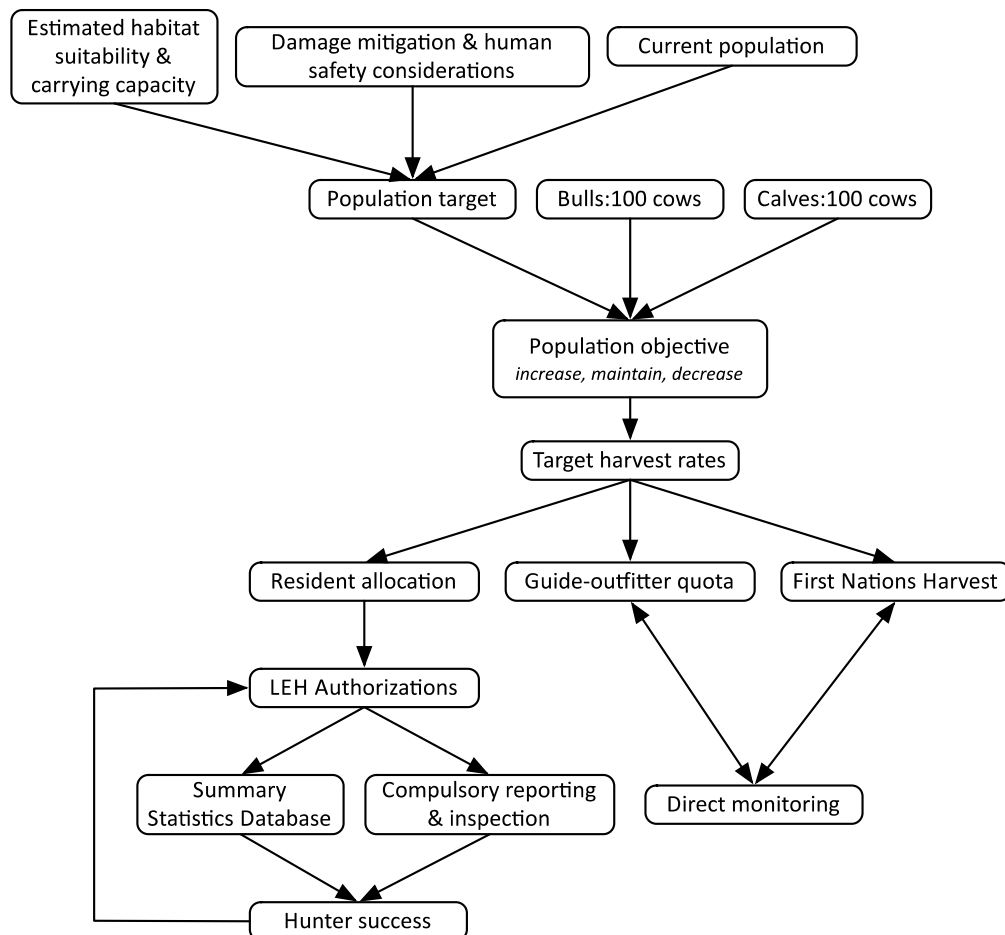


Figure 5. Consumptive use management of Roosevelt elk in British Columbia.

Consumptive use opportunities are provided where indicators of population size and status relative to population targets (see [Conservation](#) and [Sustainable Use](#)

objectives below) indicate that the EPU can support a sustainable harvest. Harvest objectives are set based on these indicators and targets.

Under agreements with the Province, First Nations typically harvest up to 50% of the annual allowable harvest of Roosevelt elk in BC. Allocation among licensed resident and guided hunters follows a Ministry Allocation policy (BC Ministry of Environment 2007; Table 3).

Table 3. 2012 FLNRO harvest allocation policy for Roosevelt elk (applied after First Nations harvest agreements).

Region	Roosevelt elk	Resident (%)	Non-resident (%)
West Coast	Bull	87	13
West Coast	Any sex (archery)	70	30
South Coast	Bull	81	19

Access to hunting opportunities for resident hunters is granted via *Limited Entry Hunting* (LEH), which is BC's method of controlling harvest by resident hunters for particular wildlife species. Allocation is implemented where hunting demand is high and/or game species are relatively vulnerable. LEH controls harvest by limiting the number of resident hunters who are provided an opportunity to hunt Roosevelt elk, as opposed to *General Open Seasons* (GOS) which are used for more common game species and regulate the hunt by bag limits and limiting the length of time that species can be hunted. LEH generally results in a more predictable harvest than GOS.

The number of LEH authorizations issued depends on the success rates of hunters from previous years. Where hunter success is low, a larger number of authorizations will be issued to achieve a target harvest compared to areas or species where hunter success is high. Note that issuing a large number of authorizations where the target harvest is small carries the risk that circumstances not under management control might allow hunters to over-achieve (e.g., unexpectedly favourable hunting conditions) and hence exceed the target harvest. In addition, safety and quality of the hunting experience may be compromised if too many authorizations are issued. To control for these risks, the number of authorizations issued is conservative.

Authorizations are distributed via a lottery among resident hunters who apply.

Harvest Monitoring

Because the number of LEH authorizations issued to hunters regulates Roosevelt elk resident licensed harvest, and because the number of authorizations issued is based on hunter success, determining hunter success is critical to managing a sustainable harvest.

First Nations and guide-outfitters report their harvest directly to the Ministry, and the Ministry queries the success of resident hunters granted LEH authorizations via annual questionnaires. By analyzing the success of hunters who return questionnaires, the Ministry can estimate the hunting success of the entire population of resident hunters who held authorizations. However, relatively few

authorizations are issued for Roosevelt elk and not all questionnaires are returned. As a result, analyses are prone to sampling errors because few Roosevelt elk harvest events are reported each year. This can lead to imprecise estimates of hunter success.

To address the analytical limitations of hunter surveys, compulsory reporting and compulsory inspection programs are used. Under these programs, hunters are required to either report (“compulsory reporting”) or present for inspection their harvest (“compulsory inspection”). Compliance with compulsory inspection programs is considered to be higher than with compulsory reporting, but both programs provide more accurate harvest information than analyses of the LEH or hunter questionnaires. Compulsory inspection is in place for the South Coast region and the West Coast region is planning to return to compulsory reporting in 2012.

Habitat Management

The capability of habitats to support Roosevelt elk ultimately determines carrying capacity and, consequently, population targets, objectives, and opportunities for consumptive and non-consumptive use. As a result, managing habitat is an important component of Roosevelt elk management.

The distribution of capable and suitable elk habitat has been estimated at a regional scale through *Broad Ecosystem Unit* mapping and associated wildlife habitat ratings (Resource Inventory Standards Committee 1998). Although useful at a regional scale, the mapping is not suitable for identifying the abundance and distribution of Roosevelt elk habitat at finer scales. This requires more detailed modelling based on Terrestrial Ecosystem Mapping or Predictive Ecosystem Mapping (RISC 1999), alternative methods based on available terrain and vegetation information (e.g. Brunt 1991, Appendix II), or qualitative assessments based on field reconnaissance. Of these, field reconnaissance has been used most frequently to assess the capability and suitability of Roosevelt elk habitat.

Legal protection of Roosevelt elk habitat is provided by Parks and Protected Areas (to the extent they comprise suitable habitat) and areas designated as Ungulate Winter Range (UWR) under the *Forest and Range Practices Act*. Protection is focused on winter habitat because winter is the most limiting season for ungulates; they are most likely to face energetic stresses in winter because forage is more limited and of poorer quality than during other seasons, and animals expend more energy to maintain stasis in cold weather (Brunt 1990).

UWRs for Roosevelt elk and black-tailed deer (*Odocoileus hemionus columbianus*) have been established throughout Vancouver Island but not in the South Coast region. UWRs capture areas of crown land with the highest current habitat suitability, while limiting impacts on the forest industry through legal approval tests under the *Government Actions Regulation of the Forest and Range Practices Act*.

The total crown land base protected as UWRs on Vancouver Island for both Roosevelt elk and black-tailed deer is 45,437 ha. Of this 10,227 ha are designated

specifically for elk and 33,090 ha for deer. The remaining 2,120 ha are designated for the protection of winter range for a combination of both deer and elk.

Parks and Protected Areas and UWRs capture only a small proportion of suitable Roosevelt elk habitat in BC. On crown forest outside UWRs, Roosevelt elk habitat is managed either by the forest industry through professional reliance and forest certification obligations, or is unmanaged.

Habitat management can be stratified into three general categories:

1. Retaining currently suitable habitat – this corresponds to management in Parks and Protected Areas and UWRs where natural succession and other ecological processes dominate.
2. Integrated management planning with industrial forestry – this involves implementing forest harvest planning and silviculture strategies, predominantly based on a stewardship approach, to retain and enhance Roosevelt elk habitat characteristics throughout the forest rotation (Becker et al. 1990). Suitable prescriptions vary by habitat type (e.g., snow zone, deciduous versus coniferous stands, etc.).
3. Habitat enhancement – techniques aimed at increasing the carrying capacity of currently suitable habitats, such as controlled burning (Janz 2005) and other activities to enhance forage availability and/or snow interception capability of habitats.

The first phase of UWR designation on Vancouver Island is mostly complete. Because most South Coast Region populations have resulted from relatively recent transplants, there has been no formal land base budget established for Roosevelt elk UWRs in the Region.

Habitat enhancement generally treats small areas and is relatively expensive, so its application has and will be limited in scope and dependent on available funding (e.g., Materi 2006). As a result, integrated management planning with the forest industry will continue to dominate habitat management activities related to Roosevelt elk on crown forest land.

Human Safety, Damage Prevention and Mitigation

Roosevelt elk populations can conflict with other land uses. Specifically, elk pose a risk to human safety when using habitats adjacent to highways and roads, and can cause damage to agricultural crops, ornamental gardens, golf courses and tree plantations.

Reducing Risk of Vehicle Collisions

The BC Ministry of Transportation and Infrastructure collects information on wildlife mortalities on highways in the Province and applies the information to profile risk and to develop policies, strategies and mitigation actions (BC Ministry of Transportation and Infrastructure 2010).

Accidents involving Roosevelt elk are relatively infrequent, with only a few (<10) reported each year in the South Coast and West Coast regions combined. Accidents are most frequent in summer and early fall (BC Ministry of Transportation and Infrastructure 2010).

Strategies to mitigate the risk of accidents involving Roosevelt elk include: habitat management on rights-of-way (i.e., plantings that do not attract wildlife), signage, reflectors, over/underpasses, exclusion fencing, repellents and hazing, liberal hunting seasons near highways and Roosevelt elk relocations (BC Ministry of Transportation and Infrastructure 2010).

To date the most common strategies employed have been liberalized hunting seasons (to harass Roosevelt elk as well as to reduce populations), transplanting Roosevelt elk away from problem areas, fencing on portions of Highway 19 on Vancouver Island, and road signage.

Agricultural Conflicts

As generalist browser-grazers a variety of commercial agricultural crops can be attractive to elk and lead to economic losses. Strategies to deal with conflicts can involve harvest strategies to reduce populations (e.g., liberal antlerless hunts) and increase harassment (e.g., long or split hunting seasons). Exclusion fencing is effective but expensive to construct and maintain. Electric fencing is less costly and has been used effectively to deter elk use of farm lands in the Sayward Valley on Vancouver Island.

Extended and split hunting seasons, as well as transplants have been used to address chronic agriculture conflicts.

Interactions with Forestry

As large herbivores, elk play an important role in ecosystems by influencing plant phenology and succession (Marquis 2010), but they can also conflict with forestry interests by browsing and trampling young plantations, rubbing against saplings and spreading invasive plants. This damage can substantially increase costs associated with the legal obligation to achieve free-to-grow status and may adversely affect the longer-term timber quality and quantity of stands in some areas inhabited by Roosevelt elk. There are concerns that increasing elk populations will result in increasing conflicts in specific areas.

Integrating Roosevelt elk ecology and habitat management in forestry planning is the preferred approach to minimize the risk of conflicts. Comprehensive management strategies were developed by Nyberg and Janz (1990). More recently, the Coast Forest Region FRPA Implementation Team (2010) reviewed planning, silviculture, policy and legislative options to mitigate Roosevelt elk impacts on reforestation. Forestry concerns can also be addressed during the development of the Roosevelt elk management plan by adjusting proposed target populations and management strategies for specific EPU's (see following section).

Proposed Goals, Objectives and Strategies

This section provides a proposed list of goals, objectives and strategies that could guide Roosevelt elk management in BC for the next 10 years. The section is intended to promote discussion and will be refined following consultation with First Nations and stakeholders.

The Ministry is committed to consulting widely during the development of the plan, to continuing to monitor Roosevelt elk populations as well as the benefits and costs of management policies and actions, and to adjusting proposed goals, objectives and strategies accordingly.

Given the conservation status of Roosevelt elk and the high demand for cultural, recreational and commercial uses, FLNRO is proposing a management goal of increasing the population, expanding its distribution and mitigating threats, such that the subspecies could be removed from the provincial Blue List within the next 10 years.

Conservation Objectives

1. Maintain self-sustaining populations of Roosevelt elk throughout their current range in the West Coast and South Coast regions.
2. Re-establish Roosevelt elk in historic but unoccupied range where ecological conditions are suitable.
3. Maintain or restore the contribution of Roosevelt elk to natural biodiversity and ecosystem function.

Progress on achieving conservation objectives will be measured by assessing the current elk population against the population objective for each EPU. The population objective for each EPU is generally 50-100% of the estimated carrying capacity, unless achieving this population would likely result in unacceptable conflicts with other land uses (e.g., highways, agriculture, forestry). Identifying these circumstances and adjusting objectives and strategies based on stakeholder input will be one of the tasks required to complete the management plan (see [Next Steps](#)).

For the purpose of this discussion paper, carrying capacity is defined as the estimated maximum population size that can be sustained indefinitely, given the current suitability of habitat in an EPU. Habitat suitability for elk is estimated for each EPU based on an expert assessment of habitat conditions over the entire unit, which is then related to estimated carrying capacity (Table 4).

Note that both habitat suitability and carrying capacity are ecological concepts that are difficult to measure with precision. As a result, expert assessments of these parameters are necessarily coarse and are used as guidance in setting management strategies.

Table 4. Roosevelt elk habitat suitability classes and associated estimated carrying capacity.

Estimated Roosevelt elk habitat suitability	Estimated carrying capacity of Roosevelt elk/km²
Very low	0.005 - 0.050
Low	0.150
Low-moderate	0.225
Moderate	0.300
Moderate-high	0.375
High	0.450
High-very high	0.575
Very high	0.700+

Management strategies aimed at achieving population targets (Table 5) are directed towards EPU's with the strongest First Nations and stakeholder interest (Table 6).

Table 5. Possible management strategies to achieve Roosevelt elk population targets. Codes are cross-referenced by elk population unit (EPU) in Table 6.

Code	Management Strategy
A	Inventory population regularly (i.e. every 1-2 years) to determine population parameters and performance
B	Inventory population less frequently (i.e. every 3-5 years) to determine population parameters and performance
C	Enhance populations via transplant(s) to this EPU
D	Reduce populations via transplant(s) from this EPU
E	Adjust hunting to facilitate population enhancement (e.g. eliminate or decrease antlerless harvest)
F	Adjust hunting to facilitate population reduction (e.g. initiate or increase antlerless harvest)
G	Directly manipulate habitat to enhance suitability (e.g. carry out seedings of preferred elk forage)
H	Directly reduce elk access to key areas (e.g. use exclusion fencing adjacent to highways or agricultural operations)
I	Modify forestry activities to enhance elk habitat suitability (e.g. amend block harvest timing in an area to maintain forage availability over time)
J	Modify forestry activities to reduce elk habitat suitability (e.g. minimize edge and increase block size)

Table 6. Elk population units, estimated current habitat suitability and estimated carrying capacity, as well as current and target populations for Roosevelt elk in British Columbia. ID number is referenced in Figure 2. Proposed management strategies to meet target populations are listed for each unit:

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
Vancouver Island Subpopulation									
40	Adam	182	S	H-VH	259	230	I	Very high interest in maintaining a huntable population.	A, I
44	Amor	95	S-I	H	146	120	I	Very high interest in maintaining a huntable population.	A
57	Artlish	70	S	H-VH	90	70	M	Very high interest in maintaining a huntable population.	B
104	Ash	15	S	H	212	60	I	High interest in establishing a huntable population. Private forest land concerns	C
58	Atluck	20	S	M	48	30	I	Maintenance of population for ecosystem function in the area is desirable.	-
102	Bedwell	15	S	M-H	108	50	I	Maintenance of population for ecosystem function in the area is desirable. Significant habitat is located in Strathcona Park	-
4	Belize	0	N/A	L	158	0	M		-
35	Benson	65	S-D	M	114	80	I		B, I
38	Bonanza	110	S-D	H	192	150	I	Very high interest in maintaining a huntable population.	B, I, E
120	Bulson	0	N/A	L	38	0	M	Insufficient quality habitat	-
95	Burman	20	S-I	M-H	111	40	I	Significant portion of habitat in the park	B, I
125	Cameron	30	S	H	50	50	I	High interest in establishing a huntable population.	B

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
42	Camp Point	5	UNKNOWN	L	9	5	M		-
64	Campbell River	62	S	VH	55	50	M		A, F
151	Carmannah/Walbran	0	N/A	L	64	0	M	Low capability west coast watersheds	-
147	Caycuse	5	S	M	58	30	I	Mod. Capability	B
143	Chemainus	62	I	M	123	80	I	Very high interest in maintaining a huntable population.	A
121	Clayoquot	0	N/A	L	47	0	M	Insufficient quality habitat	-
24	Cluxewe/Keogh	10	UNKNOWN	M	88	30	I	Increasing the population for ecosystem function in the area is desirable.	B, I
99	Comox	60	S	M	182	80	I	Highways, Agriculture and Human settlement conflicts eliminate some of the area as suitable habitat.	B, F (FN harvest in ag. areas), H (fencing of highways)
89	Conuma	60	S	H-VH	72	60	M		B
144	Deer Group	0	N/A	VL	1	0	M	Isolated islands with extremely low capability	-
98	East Buttle	0	N/A	L	24	20	I	Establishment of population for ecosystem function in the area is desirable.	I
18	East Knight	0	N/A	VL	2	0	M		-
135	Effingham	0	N/A	M-H	149	50	I	Very high interest in establishing a huntable population.	C
78	Elk	70	S-I	H	125	70	I	Good summer range and winter range. Almost completely within Strathcona Park. Maintenance of	B

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
								population for ecosystem function in the area is desirable.	
126	Englishman River	60	S-I	M	141	100	I	Highways, Agriculture and Human settlement issues eliminate part of the area as suitable habitat. Moderate interest in maintaining a huntable population	B, E
73	Espinosa	20	UNKNOWN	L-M	130	20	M		-
39	Eve/Tsitika	202	S	H	386	250	I	Very high interest in maintaining a huntable population.	A, I
138	Franklin (Mainland)	0	N/A	VL	2	0	M		-
8	Franklin (V. Island)	30	S-I	M-H	174	100	I	High interest in establishing a huntable population.	B, I
15	Gilford/Broughton	0	N/A	L	147	0	M		I
76	Gold/Muchalat	394	S-I	VH	406	380	M	Very high interest in maintaining a huntable population.	A, I
103	Great Central	10	S	L	57	10	M	Insufficient quality habitat	-
63	Greenstone	199	S-I	H-VH	205	160	M	Very high interest in maintaining a huntable population.	A, I
43	Hardwicke - Thurlow	0	N/A	L-M	59	30	I	Establishment of population for ecosystem function in the area is desirable.	-
77	Heber	80	S	H	84	80	M		A, I
136	Henderson	5	S	M-H	93	50	I	Very high interest in establishing a huntable population.	B

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
119	Herbert Inlet	0	N/A	L-M	104	30	I	Establishment of population for ecosystem function in the area is desirable.	-
100	Hesquiat	10	S	L-M	132	30	I	Maintenance of population for ecosystem function in the area is desirable.	I
27	Heydon	0	N/A	L-M	220	30	I	Maintenance of population for ecosystem function in the area is desirable.	-
14	Huaskin	0	N/A	L	152	0	M		-
93	Jacklah/Houston	40	I	M-H	61	50	I		B, C
155	Jordan	5	S	M	103	50	I	Very high interest in establishing a huntable population.	B
16	Kakweiken	0	N/A	L	84	0	M		-
55	Kauwinch	10	UNKNOWN	H	66	50	I	Very high interest in establishing a huntable population.	I
122	Kennedy	10	S	M	77	50	I	Very high interest in establishing a huntable population.	I
36	Kilpala	10	UNKNOWN	M	61	35	I	Maintenance of population for ecosystem function in the area is desirable.	I
6	Kingcome	0	N/A	L-M	202	50	I	Increasing the population for ecosystem function in the area is desirable.	C
146	Klanawa	25	S-I	M-H	147	50	I	Mod. to high capability	B, I
33	Klaskish	10	UNKNOWN	L-M	108	50	I	Increasing the population for ecosystem function in the area is	I

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
								desirable.	
22	Koprino	15	UNKNOWN	L	88	30	I	Increasing the population for ecosystem function in the area is desirable.	-
54	Kyuquot	10	UNKNOWN	L	33	10	M		-
153	Lens/Harris	0	N/A	M	81	30	I	Re-establishment of population to maintain ecosystem function is desirable.	I
134	Long Beach	0	N/A	L-M	82	30	I	Establishment of population to maintain ecosystem function in the area is desirable.	I
150	Lower Cowichan	75	S	L	99	50	D	Significant conflicts with highways, agriculture, golf courses and private forest land.	A, D, F, H (fencing ag. areas and highway)
7	Lower Klinaklini	0	N/A	M	79	30	I	Increasing the population for ecosystem function in the area is desirable.	C
59	Lower Nimpkish	54	S	H	81	60	M	Not currently a hunted population	B, I
41	Lower Salmon	231	S-I	VH	267	230	M-D	Very high interest in maintaining a huntable population. Agriculture and reforestation issues preclude increase of the population.	A, D, F, H (fencing ag. areas and highway), J
34	Mahatta	10	UNKNOWN	L-M	106	30	I	Increasing the population for ecosystem function in the area is desirable.	B, I
25	Malcolm	0	N/A	L	14	0	M	Insufficient habitat to sustain a	-

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
								population	
92	McCurdy	70	S-I	M-H	90	80	I	McCurdy near capability; Kleeptee understocked	B, I
101	Moyeha/Megin	0	N/A	L-M	96	30	I	Establishment of population for ecosystem function in the area is desirable.	-
156	Muir/Leech	0	N/A	L-M	52	30	I	Establishment of population to maintain ecosystem function is desirable.	-
137	Nahmint	70	S	H	105	85	I	Very high interest in maintaining a huntable population.	B, I
12	Nahwitti	55	S	M	146	60	M		B, I
127	Nanaimo	63	I	M	93	60	M	Includes large settled areas	A
140	Nanaimo Lakes	228	S	VH	256	230		Very high interest in maintaining a huntable population. Private Forest Land concerns regarding reforestation	A
11	Nigei	0	N/A	L	19	0	M	Insufficient habitat to sustain a population	-
139	Nitnat	40	I	M-H	167	80	I	Very high interest in maintaining a huntable population.	A, I
87	Nootka	5	UNKNOWN	L-M	118	30	I	Establishment of population for ecosystem function in the area is desirable.	I
141	North Shore Cowichan Lk.	275	S	VH	374	275	M	Very high interest in maintaining a huntable population.	A
106	Northern	0	N/A	L	23	0	M	Agriculture and Human settlement	-

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
	Gulf Islands							conflicts eliminate much of the area as suitable habitat.	
80	Oyster/Tsolum	50	S	L-M	187	100	I	Highways, Agriculture and Human settlement conflicts eliminate significant part of the area as suitable habitat.	B, F (FN harvest in ag. areas), H (fencing of highways)
146	Phillips	15	S	M	274	100	I	SHARED EPU WITH SOUTH COAST REGION: One of only 2 remnant Roosevelt Elk populations on the mainland coast.	B, C, I
96	Phillips/Wolf	15	S	L-M	77	30	I	Good summer range but winter range is limited. Completely within Strathcona Park. Maintenance of population for ecosystem function in the area is desirable.	B
26	Port Neville	0	N/A	L-M	68	50	I	Increasing the population for ecosystem function in the area is desirable.	-
53	Power	30	S	M-H	108	60	I	Very high interest in re-establishing a huntable population in the Power.	B, E (maintain no hunting season until population increases)
45	Quadra	0	N/A	M	213	0	M	Significant conflicts likely to occur if population established.	-
124	Qualicum	20	S	M	128	20	M	Highways, Agriculture and Human settlement conflicts eliminate much of the area as suitable habitat.	H (fencing of highway)

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
13	Quatse	5	UNKNOWN	L	67	30	I	Increasing the population for ecosystem function in the area is desirable.	I
79	Quinsam	60	S-I	M-H	168	120	I	Moderate interest in maintaining a huntable population.	I
128	Saanich Peninsula/ Southern Gulf Islands	0	N/A	N/A	0	0	M	Excessive human development and/or agricultural activity preclude suitability of area for establishment of elk population.	-
152	San Juan/ Lower Gordon	70	S	H	149	100	I	Very high interest in increasing huntable population.	A, I
145	Sarita/ Pachena	10	S	H	162	75	I	High capability area. Very high interest in increasing huntable population.	C, I
1	Seymour	0	N/A	L-M	75	30	I	Increasing the population for ecosystem function in the area is desirable.	I
158	Shawnigan Lake	10	S	M	55	10	M	Agriculture, highway and human settlement conflicts likely if population expands.	-
157	Sooke/ Metchosin	10	S	H	217	30	I	Increase of population to maintain ecosystem function in the Sooke watershed is desirable. Expansion beyond the Sooke watershed would be problematic due to high human densities.	-
142	South	115	S-D	M-H	194	150	I	Very high interest in maintaining a	A, I

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
	Fork/Haslam							hunnable population.	
149	South Shore Cowichan Lk.	20	S	M	87	50	I		B, I
123	Sproat	20	S	L-M	116	50	I	Highways, Agriculture and Human settlement conflicts eliminate highest capability part of the area as suitable habitat. Some interest in establishing a huntable population	-
19	Stafford/Apple	10	S	M	167	50	I	Increasing the population for ecosystem function in the area is desirable.	B, I
10	Stranby	15	UNKNOWN	L	80	30	I	Increasing the population for ecosystem function in the area is desirable.	B, I
88	Sucwoa	60	S	H	102	60	M		B
75	Tahsis	40	UNKNOWN	M	65	40	M		B
56	Tahsish	50	S	M	87	50	M		B
97	Thelwood	15	S	M	61	30	I	Maintenance of population for ecosystem function in the area is desirable. Completely within Strathcona Park	B
90	Tlupana	30	S	H-VH	70	50	I		B, I
105	Tsable	60	S	M	129	60	M	Highways, and Human settlement conflicts eliminate part of the area as suitable habitat.	B, H (fencing of highway)
37	Tsulton	60	S	H	126	70	I	Very high interest in maintaining a huntable population.	B, I

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
94	Ucona	71	S	M-H	83	75	M		A, I
91	Upana	30	S	H	28	30	M		B
148	Upper Gordon	5	S	M	55	30	I	Increase of population to maintain ecosystem function is desirable.	B, I
2	Upper Kingcome/Wakeman	0	N/A	VL	25	0	M		-
3	Upper Klinaklini	0	N/A	VL	3	0	M		-
60	Upper Nimpkish	348	S-I	VH	649	350	M	Very high interest in maintaining a huntable population.	A, I
62	Upper Salmon	422	S-I	VH	477	420	M	Very high interest in maintaining a huntable population.	A, I
154	Upper San Juan/Fleet	20	S	M	82	50	I	Private Forest Land	B
5	Wakeman	0	N/A	L-M	192	50	I	Increasing the population for ecosystem function in the area is desirable.	C
23	Waukwaas	40	S-I	M	131	65	I	Very high interest in establishing a huntable population.	B, I
17	West Knight	0	N/A	L	115	0	M		-
61	White	196	S	H-VH	206	200	M	Very high interest in maintaining a huntable population.	A, I
74	Zeballos	40	S	M	98	60	I	Very high interest in maintaining a huntable population.	B, I
	Total West Coast Region	5,239			13,771	7,245			

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
South Coast Region									
115	Alouette	3	S-I	M	105	50	I	Consider transplants, BC Hydro Watershed, possible research opportunity for elk habitat & enhancement study	B
20	Bear	3	S	L	58	25	I		
48	Brem	25	S-I	L-M	69	50	I		A
67	Brittain	50	S-I	M	93	60	I-M		A, I,
112	Cap-Seymour	5	S-I	L	85	50	I	Consult GVRD	B
117	Chehalis	3	S	L	176	90	I	Translocation Plan to release 20-25 elk in 2013	C,A
85	Clowhom	60	S-I	M	146	75	I	BC Hydro Watershed, Possible research opportunities for elk habitat, enhancement study	A, G Enhance disturbed sites and powerline corridors
114	Coquitlam	5	I	L-M	59	35	I	Consult GVRD	B
68	Deserted	70	I	H-VH	236	120	I		A
66	Eldred	25	I	M	133	65	I	Allow natural recovery from adjacent units. Consider transplants	B, G Enhance disturbed sites and powerline corridors
81	Haslam (Stillwater)	125	I	VH	312	200	I		B, E, I, G Enhance disturbed sites and powerline corridors
49	Hat	0	S	L	32	15			

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
9	Homathko	40	I	M-H	422	200	I	Hunt Planning for 2016	A
113	Indian	50	S-I	M	94	60	I	Allow and encourage dispersal to adjacent areas, i.e Seymour and Coquitlam	A, I, G Enhance disturbed sites and powerline corridors
82	Lois	25	I	VH	247	125	I	Allow natural recovery from adjacent units. Consider transplants	B Enhance disturbed sites and powerline corridors
70	Lower Lillooet	3	S-I	L	243	120	I	Translocation Plan to release 20-25 elk in 2014	A, C, G Enhance disturbed sites and powerline corridors
69	Mamquam	15	I	VL-L	137	70	I	May need to manage/ control elk along highway	A, I, G Enhance disturbed sites and powerline corridors
111	McNab	100	S-I	H	150	120	I-M		A, G Enhance disturbed sites and powerline corridors
29	Moh	2	S	L-M	53	30	I	Consider translocation release	
84	Narrows	95	S	H	163	100	I-M		A, G Enhance disturbed sites and powerline corridors
108	Nelson	3	I	VH	74	50			
30	Orford	35	I	M-H	194	100	I	Hunt planning for 2014-16	A

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
86	Pitt	50	I	M-H	280	175	I	Hunt planning for 2014-16	A
50	Powell-Daniels	50	I	L-M	102	60	I		A, G Enhance disturbed sites and powerline corridors
46	Quatam	30	I	M-H	132	60	I		A
110	Rainy-Gray	60	I	H	223	110	I	May need to control elk at urban fringe and near highway	A, H
47	Redonda Islands	6	S	VL-L	14	0	M		
109	Sechelt Peninsula	200	S-I	VH	273	200	M-I	Source population for transplants. Need to control elk along highway, and urban fringe.	A, D, G, H Control populations with Transplants - Enhance disturbed sites and powerline corridors.
51	Skwawka	60	S	M	134	70	M-I		A
21	Southgate	26	I	L	191	75	I		A
52	Squamish	50	S-I	L-M	429	200	I		A
116	Stave	40	S-I	L	90	50	I		A, G Enhance disturbed sites and powerline corridors
107	Texada	0			0	0	N/A		
65	Theo	30	I	H-VH	390	195	I	Hunt planning for 2016	A

ID	Elk population unit	Current population estimate	Trend (Stable/Increasing/Decrease)	Estimated habitat suitability (Low/Mod/High)	Estimated carrying capacity	Proposed Target population	Proposed population objective (Increase/Maintain/Decrease)	Rationale/Notes	Proposed Management Strategies
31	Toba	30	I	M	463	225	I	Hunt planning for 2016	A, G Enhance disturbed sites and powerline corridors
32	Upper Lillooet	1		VL	211				
83	Vancouver River	60	I	M-H	121	70	I		A
133	Manning			VL	33			Rocky Mountain Elk Zone	
118	Coquihalla	0		L	144			Rocky Mountain Elk Zone	
130	Greater Van	0			0			Not suitable for elk recovery	
71	East Harrison	5	S		508			Hybrid Elk Zone	
131	Chilliwack	5	s	L	159			Assumed to be hybrid Elk Zone	
132	Skagit	3			146			Assumed to be hybrid Elk Zone	
72	Fraser	0			45			Rocky Mountain Elk Zone	
	Total South Coast Region	1,448			7,369	3,300			
	Total BC	6,687			21,140	10,545			

Sustainable Use Objective

1. Within the ecological limits of the species, provide opportunities for consumptive and non-consumptive use.

Consumptive use opportunities (i.e., First Nations' sustenance, licensed resident and guided hunting) are typically considered only in EPU's where Roosevelt elk populations are:

- >50 animals;
- >20 bulls:100 cows; and,
- >30% of bulls are branch-antlered.

There may be exceptional circumstances where hunting will be considered when these conditions are not met (e.g., goal is to severely reduce the population, or where the proportion of branch-antlered bulls cannot be reliably estimated). Opportunities are provided in a manner consistent with Ministry policy (BC Ministry of Environment, Lands and Parks 1996).

Decisions regarding harvest are made in the context of an EPU's population objective. Whether the EPU population objective is to *maintain*, *decrease*, or *increase* depends on whether the conditions listed above are met and on the EPU's calf:cow ratio and target population size.

Low bull:100 cow ratios can result from over-harvest, severe winters or predation (primarily wolf or cougar). Low calf:100 cow ratios could result from severe winters, predation, or populations exceeding carrying capacity.

Calf:100 cows ratios are cross-referenced with population size relative to the population target to indicate a population objective for an EPU (Table 7). The harvest regime is guided by the population objectives (Table 8).

Table 7. Population objectives for Elk Population Units as a function of current population size and target population size and observed calf:100 cow ratios.

Current population size relative to target (%)	Calves:100 cow		
	<25	25-35	>35
<75	Increase	Increase	Maintain
75-100	Increase	Maintain	Decrease
>100	Maintain	Decrease	Decrease

Table 8. Harvest regime (expressed as percentages of the total population) for Roosevelt elk, depending on population objectives for Elk Population Units.

Population objective	Antlered harvest rate (%)	Antlerless harvest rate (%)	Either sex (archery) harvest rate (%)
Increase	5	0-2	3
Maintain	7.5	4	6
Decrease	10	6	10-20

Damage Prevention and Mitigation Objectives

- 1. Mitigate risk of vehicle collisions.**
- 2. Mitigate crop depredation impacts on agricultural crops and market gardens.**
- 3. Mitigate conflicts with timber objectives.**

An integrated approach to human safety and damage prevention and mitigation will continue to be an important focus of Roosevelt elk management. Issues are site-specific and often complex, and strategies will vary.

Preferred strategies are those that improve human safety or mitigate damage while still achieving Roosevelt elk population objectives. These include:

- Transplants from areas where Roosevelt elk populations are higher than EPU population targets;
- Installations and actions designed to exclude Roosevelt elk from areas where damage problems are chronic (e.g., fencing, reflectors, repellents);
- Habitat management to discourage use of, or divert use away from, high damage areas (e.g., appropriate seed-mix planting on rights-of-way, forest harvest and regeneration planning strategies that integrate Roosevelt habitat use and requirements, etc.);
- Revising forestry planning, harvest and reforestation activities to address Roosevelt elk habitat use and requirements; and,
- Changing human behaviour to mitigate risk (e.g., signage, controlling vehicle speeds) or increase hazing of Roosevelt elk (extending or splitting hunting seasons).

Where these strategies are not practicable or cannot adequately address damage, population objectives can be adjusted through the development and monitoring of the management plan.

Data Limitations

The analyses and proposed strategies presented in this discussion paper are necessarily limited by available data. The following are limitations that may affect the accuracy and/or precision of population or harvest estimates and, hence, warrant a conservative approach to Roosevelt elk management:

- Harvest rate reporting errors – not all hunters respond to harvest questionnaires, which could result in sampling errors and biases in harvest rate estimates;
- Inventory errors – adult females can be mistaken for calves on surveys, leading to inflated calf counts; differential sightability among age-sex classes; and,

- Resource limitations – funding restricts the extent and intensity of inventory (i.e., air- or ground-based population and habitat surveys) and harvest assessments (i.e., compulsory inspection), which limits the confidence of estimates and increases the number of years required to establish reliable trends.

Next Steps

This discussion paper has outlined the available tools and current strategies used to manage Roosevelt elk in BC. It proposes population objectives and strategies for EPU, objectives for sustainable use, and options to address human safety concerns and economic loss issues. The Ministry is seeking input on these proposed objectives and plans to consult with First Nations and interested stakeholders before preparing a final Roosevelt elk management plan.

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Appendix I – Roosevelt Elk Transplant History

History of Roosevelt elk transplants in British Columbia, 1933- January 2012.

Year	Trap location	Release location	Elk transplanted
1933	Vancouver	McNab	5
1978	Upper Heber	N/A	1
1979	Upper Heber	Constitution Hill	13
1982	Nanaimo River	N/A	14
1983	Nanaimo Lake	N/A	1
1984	Nanaimo Lake	San Juan River	7
1985	Campbell River	Trent River	7
1986	Campbell River	Trent River	12
1987	Campbell River	Sechelt Peninsula	7
1988	Campbell River	Sechelt Peninsula	6
1989	Qualicum	Nahmint River	3
1989	Qualicum	Sechelt Peninsula	11
1989	White River	Nahmint	13
1991	Nahwitti River	N/A	5
1992	Elk River	N/A	11
1993	Haslam Ck.	San Juan River	16
1994	Fanny Bay	Powell River	5
1996	Sechelt Peninsula	Powell River	20
1997	Takla Rd.	Jordan Meadows	6
1997	Takla Rd.	Nanaimo Lakes	2
2000	Union Bay	Lower Klanawa	10
2001	Duncan	Caycuse	1
2001	Sechelt Peninsula	McNab	25
2001	Sechelt Peninsula	Rainy River	6
2001	Sechelt Peninsula	Skwawka River	12
2002	Lois	Tzoonie River	7
2002	Sechelt Peninsula	McNab	1
2002	Sechelt Peninsula	Skwawka River	7
2002	Sechelt Peninsula	Tzoonie River	4
2003	Lois	Narrows	9
2003	Lois	Rainy River	3
2003	Sechelt Peninsula	Clowhom River	5
2003	Sechelt Peninsula	Narrows	2
2003	Sechelt Peninsula	Rainy River	2
2004	Lois	Clowhom River	7
2004	Sechelt Peninsula	Clowhom River	8
2004	Sechelt Peninsula	Rainy River	2
2004	Sechelt Peninsula	Stakawus Creek	13
2005	Duncan	Lower Nitinat River	9
2005	Sechelt Peninsula	Brittain River	20
2005	Sechelt Peninsula	Stakawus Creek	7
2005	Sechelt Peninsula	Upper Pitt River	23
2006	Duncan	Waterloo Mt.	9

Year	Trap location	Release location	Elk transplanted
2006	Lois	Salmon Inlet	8
2006	Lois	Vancouver River	11
2006	Sechelt Peninsula	Indian River	20
2006	Sechelt Peninsula	Vancouver River	10
2007	Campbell River	Waukwaas River	16
2007	Lois	Squamish River	26
2007	Powell River	Quatum River	12
2007	Sechelt Peninsula	Upper Stave River	19
2008	Lois	Quatam River	6
2008	Sechelt Peninsula	Powell/Daniels	17
2008	Sechelt Peninsula	Quatam River	1
2008	Sechelt Peninsula	Stave River	1
2008	Sechelt Peninsula	Theo	3
2009	Lois	Homathko River	2
2009	Lois	Orford River	19
2009	Sechelt Peninsula	Brem River	14
2009	Sechelt Peninsula	Homathko River	18
2009	Sechelt Peninsula	Orford River	1
2009	Sechelt Peninsula	Toba River	10
2010	Lois	Theo	3
2010	Sechelt Peninsula	Daniels River	7
2010	Sechelt Peninsula	Toba River	10
2011	Sechelt Peninsula	Mamquam	8
2011	Sechelt Peninsula	Rainy River	5
2011	Sechelt Peninsula	Southgate	20
2011	Sechelt Peninsula	Theo	13
2012	Gold River	Houston River	12
2012	Sechelt Peninsula	Brem River	10
2012	Sechelt Peninsula	Rainy	8

Appendix II – Vancouver Island Roosevelt Elk Winter Range Assessment Variables

Variables used to assess the suitability of Roosevelt elk winter range (*pers. comm.*).

VARIABLE	VALUE	RANK	COMMENTS
% SLOPE	70+ 50-70 0-50	LOW MOD HIGH	Flat to moderate slopes preferred
ASPECT	NW-NE NE-SSE; WSW-NW Flat; SSE-WSW	LOW MOD HIGH	Generally south aspect slopes preferred; west usually better than east
ELEVATION (m)	>1000 <200; 700-1000 200-700	LOW MOD HIGH	
OVERSTORY COMPOSITION	LOW <i>HIGH</i> MOD <i>MOD</i> HIGH <i>LOW</i>	LOW MOD HIGH	Non-italicized=Relative amounts of Douglas-fir and hemlock to other areas within watershed <i>Italicized=Relative amounts of cedar (red or yellow) and balsam to other areas within watershed</i>
STAND VOLUME	LOW MOD HIGH	LOW MOD HIGH	Relative to average stand volumes within the watershed
% CANOPY CLOSURE	<50; >90 50-60; 80-90 60-80	LOW MOD HIGH	
LICHEN LOAD	LOW MOD HIGH	LOW MOD HIGH	Relative to amounts within the watershed
UNDERSTORY COMPOSITION	LOW MOD HIGH	LOW MOD HIGH	Rank relative amounts of sword fern, skunk cabbage, deer fern and salmonberry to other sites within the watershed. They are associated with rich, moist sites which produce the best forage for elk.
UNDERSTORY ABUNDANCE	LOW MOD HIGH	LOW MOD HIGH	Relative to amounts within the watershed
OTHER FACTORS:	<i>The following factors are not currently quantified during EWR assessments but they can significantly influence the overall ability of an area to satisfy EWR requirements</i>		
TOPOGRAPHIC SHADING	The amount of shading from adjacent hillsides is a critical factor influencing winter range suitability (the more shaded, the less valuable the area). Preferably shaded for less than 2 hours per day.		

HETEROGENEITY	Topographic heterogeneity ("benchiness") is preferable to a uniform slope. Overstory heterogeneity (variations in canopy closure) provides enhanced forage production and thickets for hiding in open canopy areas, and greater snow interception in areas of more closed canopy. Gullies, wetlands, and hummocky terrain also increase value of elk winter range.
ROCK OUTCROPS	Rock outcrops provide topographic security cover (vantage points), favourable thermal conditions on sunny days, and areas that lose snow more readily during snow ablation periods.
RELATIVE ELK USE	Pellet groups, tracks, trails, sightings, beds, rubs and shed antlers all indicate relative amounts of use. Shed antlers conclusively indicate late winter/spring use; rubs indicate late summer or early fall use. Current elk population levels in the area need to be known before the relative level of use can be determined (i.e. what is heavy use during a period of low elk population levels may only be considered moderate or low use during high elk density periods).
LANDSCAPE FACTORS	Important landscape level considerations affecting the relative value of an area as a elk winter range include the following: a) position in the watershed (low, mod, or high snowfall area - EWR more critical in areas of higher snowfall); b) distance to other winter ranges (greater distances between winter ranges increases their individual importance); c) adjacency to high quality spring and summer range; d) the capability of adjacent areas to satisfy elk habitat requirements; and e) factors affecting local climatic conditions such as exposure to dominant winds or marine influences.