

Red Squirrel

Common Name: red squirrel

Scientific Name: *Tamiasciurus hudsonicus* (Erxleben)

Species Code: M-TAHU

Status: Yellow listed. Listed as a furbearer by regulation the British Columbia *Wildlife Act* (1982).

1.1.1. Provincial Range

Red squirrels are found throughout BC. They occupy coniferous and mixed forest habitats from sea level to the alpine zone throughout the province except on the southern coast.

The subspecies *T. hudsonicus lanuginosus* is found on Vancouver Island, the central coast of BC and has been introduced to Moresby and Graham islands, Q.C.I. (Banfield 1974).

1.1.1.1. Concentration/Best Region

Red squirrels are dependent on conifer seeds as their main food source. As a result they are found in forests dominated by conifers, particularly lodgepole pine, white spruce and Douglas-fir. The area of highest red squirrel concentration in the coastal regions of BC has not been determined at this time.

1.1.1.2. Ecoregion/ Ecoregion

Red squirrels are found in the following ecoregions of the Coast and Mountains, and Georgia Depression ecoregions within coastal BC (Demarchi 1996).

- SPR, EPR, NPR, OUF ecoregions of the Pacific Ranges Ecoregion
- HEL, KIR ecoregions of the Coastal Gap Ecoregion
- NAB ecoregion of the Nass Basin Ecoregion
- NAR ecoregion of the Nass Ranges Ecoregion
- BOR ecoregion of the Northern Coastal Mountains Ecoregion
- NWC ecoregion of the Northwestern Cascade Ranges Ecoregion
- QCL ecoregion of the Queen Charlotte Lowlands Ecoregion
- SKP, WQC ecoregions of the Queen Charlotte Ranges Ecoregion
- NWL, NIM, WIM ecoregions of the Western Vancouver Island Ecoregion
- NAL ecoregions of the Eastern Vancouver Island Ecoregion
- FRL, GEL ecoregions of the Lower Mainland Ecoregion

➤ JDF, SGI, SOG ecosections of the Georgia Puget Basin Ecoregion

1.1.1.3. Biogeoclimatic Zones (BEC)

Red squirrels inhabit all subzones of the CDF, CWH, MH, and ESSF on the coast of BC.

1.1.2. Seasonal Habitat Use/Life Cycle

Red squirrels are solitary and normally active during the day. They are year round residents and do not hibernate. Adults average 31 cm in length and weigh 188 to 193 grams (Banfield 1974). Red squirrels are an important prey species to many animals including martens, fisher, coyotes, wolves, lynx and a variety of raptors (including northern goshawk, red-tailed hawks, great horned owls, and broad winged hawks). Predation may have a significant impact on red squirrel populations. Squirrel populations tend to vary among years and occasionally increase to high densities. In those years, squirrels can cause significant damage to regenerating conifer seedlings which are used as emergency winter food (Banks et al. 1996).

1.1.3. Key Habitat Requirements and Attributes

1.1.3.1. Reproduction

Natural cavities in trees are the preferred nest sites although they will also build outside tree nests of leaves and bark or utilize underground burrows. White spruce is a preferred nest site. Large diameter trees are chosen over small diameter and dense branch structure over sparse branching (Stevens and Lofts 1988). Where available, mature spruce trees are preferred for branch nests (Fancy 1980). In stands that are primarily pine, many nests are underground (Stevens and Lofts 1988).

Squirrels become sexually mature and capable of breeding before the end of their first year. Females produce their first litter at the age of 1 (Banfield 1974).

The breeding season begins in March and lasts for 3 - 4 months. Gestation is approximately 35 days and litter sizes range from 3 to 5 young (Rusch and Reeder 1978). The young stay in the maternal nests for up to 4 months before dispersing to new territories.

1.1.3.2. Feeding

The red squirrel is omnivorous and will eat a variety of seeds, nuts, berries, fungi, insects, birds eggs, juvenile animals (birds, rodents and hares), mice, carrion, sap and cambium (Obbard 1987; Gadd 1995; Stevens and Lofts 1988). Occasionally mushrooms are stored for winter use (Stevens and Lofts 1988).

Conifer seeds are the most important diet item, especially white spruce (*Picea glauca*), lodgepole pine and Douglas-fir (*Pseudotsuga menziesii*) seeds. Red squirrels show a marked preference for white spruce cones over black spruce (*Picea mariana*) cones (Brink and Dean 1966). Whitebark pine (*Pinus albicaulis*) seeds are also an important food for red squirrels (BC Environment 1994).

Engelmann spruce (*Picea engelmannii*) seeds, twigs and buds are also eaten by red squirrels (Alexander and Sheppard 1984). Red squirrels are also known to eat seeds from cached subalpine fir (*Abies lasiocarpa*) cones. They generally eat these seeds after other cached seed has been consumed (Lanner 1983).

Season 1 (growing season)

During late summer and fall, red squirrels store cones in caches or middens located under ground or in shady, moist areas. The middens are often around the base of large spruce trees, under old windfalls, or in large standing snags (Vahle and Patton 1983).

Season 2 (winter)

In winter, squirrels maintain tunnels to their seed caches under snow. Spruce buds will be consumed during winter (Smith 1968).

Overwintering and maternity dens are usually located in hollow trees or abandoned tree cavities, as well as in large witches brooms and under stumps, fallen logs, or rock piles (BC Environment 1994).

1.1.3.3. Bedding

Summer dens for resting are often located in tree cavities or can be constructed out of twigs and leaves in the forks of tree limbs (BC Environment 1994).

1.1.3.4. Migration/Movement

Red squirrels are active all year but will remain in nests during severe winter weather. They are primarily diurnal. Squirrel migrations from areas of excess populations have been recorded (Banfield 1974).

Squirrel populations in mature forests that have a significant component of spruce will peak in the year after a significant crop. This is due to increased reproduction, recruitment, and survival. The resulting surplus of squirrels in the mature forest will eventually move into stands of juvenile lodgepole pine, which are presumably sub-optimal habitat (Sullivan 1987).

1.1.3.5. Home Range

The home ranges of red squirrels vary from 1 to 2.5 ha. (Banfield 1974), with an average size of 1 ha. (Chan 1982). They will defend the entire home range, especially during the fall.

Territory size is highly variable depending on food abundance (Smith 1968). Territory size appears to closely approximate an area which would produce sufficient cones in very poor cone crop year to support one squirrel. Territories in spruce habitat vary from 0.2 - 0.5 ha (Obbard 1987). Highest densities are found in white spruce, Englemann spruce and white spruce/black spruce mixed conifer forests. Pine forests support low densities and aspen forests support much lower densities of primarily juvenile red squirrels (Rusch and Reeder 1978).

1.1.3.6. Cover/Escape

Nests are required for resting, escape cover, thermal cover, and reproduction (Stevens and Lofts 1988).

Optimum cover occurs in mature, dense coniferous forest (Sullivan and Moses 1986). Dense coniferous stands provide winter food, nest sites, cover, moisture and shade for food storage. They also provide protection from wind and permit the accumulation of low density snow cover for squirrels to forage beneath during winter (Zirul and Fuller 1971).

A study of logging debris piles (Gyug 1994) showed very low use of clearcut openings by red squirrels when populations were stable. However, when red squirrel population densities were very high, the use of logging debris piles within clearcut areas by squirrels was also high.

1.1.3.7. Information Gaps

Literature for red squirrels within coastal ecosystems in BC is not available. There is limited literature available from Alaska and Washington State, however, much of this is also oriented to interior ecosystems.

From the literature obtained, it appears that the principal habitat requirement of the red squirrel is an adequate food supply provided by mature conifers. Other important features include suitable nest sites, snags or fallen logs (around which the food cache is centered), protective cover, moisture and a dense stand of trees to provide cover for cone storage (Rothwell 1979; Vahle and Patton 1983; Sullivan 1987).

Mixed forest in mid and late seral stages (3-6) are the most important habitat elements. However, they will also use early seral stage (1 and 2) and deciduous, riparian shoreline forest, snag, downed wood, burrows, and man made habitats (Radcliffe et al. 1994).

1.1.4. Rating Guide

1.1.4.1. Hierarchy of Critical Factors

Dormant season (cover and forage)

Cover (escape, nesting and young, resting)

Production of spruce, fir and pine cones (food for both growing and winter)

Growing season (cover and forage)

1.1.4.2. Rating System

A 4-class/2 season rating was used to rate habitat use by red squirrels within the study area. These ratings were based on the habitat's potential under optimal conditions to support red squirrels and reflect squirrel use of the best habitat in the province. The habitat use was evaluated as the expected use and was based on the measure of the number of animals that may use the habitat during a specified time period for a specified area of habitat. For mapping red squirrels at a 1:20,000 scale this will be number of individuals/day/hectare.

Red squirrels were rated for two seasons (the growing season - snow free period from May to October) and the winter season or snow present period - from November to April). This is due to their relatively low mobility and lack of movement between habitats.

Ratings were assigned for both thermal cover and security cover (ST); and feeding (FD). These codes correspond to the codes on the new wildlife habitat assessment form which will be used to assign ratings to habitats visited during field surveys.

1.1.4.3. Model Assumptions

In the preparation of this model the following assumptions have been made:

1. Because they do not hibernate, the dormant season (winter) is the critical season for red squirrels.
2. Red squirrel winter food is obtained only from within their immediate territory, thus composition and height of trees at the stand scale is important in determining habitat suitability.
3. Winter nesting needs are adequately provided by habitat which provides winter food and cover.
4. Growing season (spring to fall) habitat is adequate in areas with suitable winter habitat. Winter habitat is critical for survival and is the main determinant on squirrel habitat area and potential carrying capacity.
5. Red squirrel habitat is not affected by proximity to human disturbances.
6. The regional field guide (Banner et al. 1993) accurately predicts ecosystem unit characteristics in the study area.

1.1.4.4. Modeling Theme

The area mapped will delineate growing and dormant season areas for feeding and proximity to mature forest cover (thermal and security cover, denning and bedding areas).

1.1.4.5. Ecosystem Unit Values and Assumptions

The regional field guide (Banner et al. 1993) was used to predict ecosystem unit characteristics in the study area. The provincial benchmark for red squirrels has not yet been established. The highly productive white spruce boreal forest is believed to be the best habitat in the province. Areas of red squirrel concentration in mature spruce cone producing forest were highest for feeding and security/thermal cover within the floodplain and moist forested units in the CWH biogeoclimatic zone.

Ratings were assigned to the ecosystem units within the study area based on the habitat attributes and structural stages considered to be important. Habitat requirements for red squirrels in the Upper Kitimat River/Davies Creek/Dala River study area are summarized in Tables 1 and 2.

Table 1: Summary of habitat requirements for red squirrels in the study area.

Season	Life Requisite	Structural Stage	Requirements
Growing (G)	Feeding (LIG_FD)	6-7	Mature cone producing coniferous forest (spruce preferred). Well drained mesic to hydric Sites with abundant CWD (>100m ³ /ha dead and down woody material)
	Thermal and security cover (LIG_ST)	6-7	Optimum cover occurs in mature dense coniferous forest (>30% canopy closure). Spruce trees are preferred for outside branch nesting as they have more dense branches and higher canopy coverage than pines. Presence of large snags (>40 DBH).
Winter (W)	Feeding (LIW_FD)	6-7	Well drained mesic to hydric sites with abundant CWD (>100m ³ /ha of dead and down woody material) Mature dense coniferous forest.
	Thermal and security cover (LIG_ST)	6-7	Large conifers >40cm DBH. Optimum cover occurs in mature dense coniferous forest (>30% canopy closure)

Table 2: Summary of measurable habitat attributes for red squirrels (winter season).

Activity	Measurable Qualities	Habitat Features
Feeding (FD)	CWD	Volume, piece size, and decay class
	Leading species	Mature cone producing conifers, spruce are preferred over all other conifers
	Canopy height	The importance of tree canopy height is in the ability of trees to produce good seed crops. Large trees produce more cones.
	Canopy closure	Increased canopy closure results in higher cone production.
	Tree pathology	Middens may be located in large standing snags
Security/thermal cover (ST)	CWD	Volume, piece size, and decay class
	Snags	Mean dbh and density
	Slope	Slopes of 20-70% retain the most elevated CWD
	Live crown	Dense live crown will allow subnivean access in deep snow
	Leading species	Conifers preferred over deciduous; spruce over all other conifers
	Canopy closure	Dense canopy closure provides security from avian predators and allows easy movement to escape arboreal predators. Dense canopy will also protect against wind chill and moderates the snow cover on the forest floor.
Birthing (BI)	Elevation	Lower elevations will have less snow and higher average annual temperatures
	CWD	Volume, piece size, and decay class
	Canopy closure	Canopy closure of >60% will provide the necessary cover
	Tree cavities	Used for nesting
	Leading species	Where available spruce trees are used for branch nests. In pine stands, many nests are underground

1.1.5. Field Sampling Scheme

The methods used to sample important habitat attributes to red squirrels are outlined below.

Table 3: Sampling scheme for red squirrels.

Habitat attribute	Sample Method
Abundance of red squirrel food plants	Recorded on ecosystem field form (vegetation data sheet).
Abundance and quality of cones and cone producing trees	Recorded in comments on wildlife data form. Subjective rating of high, moderate, low and nil.
Presence of red squirrel middens	Record the number in the plot on the wildlife tree form in the comments section; note if active or inactive.
Structural stage	Recorded on the ecosystem field form.

Canopy closure	Recorded on ecosystem field form.
Presence of coarse woody debris (CWD)	Complete a coarse woody debris form
presence of wildlife trees/snags >40cm DBH	Complete a wildlife tree form

1.1.6. Relative Abundance Sampling

Red squirrels are present in low to moderate numbers in all habitats throughout the study area with the exception of the upper elevation MH and AT units. Relative habitat use was tested for red squirrels, in January, February and March of 1998, using linear transects with track counts from random starting positions. Sampling was undertaken within 96 hours of fresh snow and track density/encounters was related as relative use of ecosystem units sampled. Sampling efforts were kept equal among samples to ensure that relative comparisons could be made. All transects were in lower elevation CWH units within 600 m of valley bottom river courses.

The results of the sampling reflected the high red squirrel use of floodplain units with at least a 40% component of mature Sitka spruce and amabilis fir. Units with less than 40% component of mature spruce and fir supported relatively less red squirrels and those units lacking both of these species were found to support very low numbers. Suitability ratings within the units tested were adjusted to reflect the results of these surveys.

1.2. Black Bear

Common Name: Black bear

Scientific Name: *Ursus americanus* (Pallas)

Species Code: M-URAM

Status: Yellow listed except *Ursus americanus emmonsii* which is blue listed (Harper 1996).

1.2.1. Provincial Range

Black bears inhabit all forested regions of BC. They can be found within all biogeoclimatic zones and occupy a wide variety of habitats ranging from coastal estuaries to alpine meadows.

There are 16 subspecies of black bears found in North America. BC has half of these. The subspecies which can be found on the west coast of BC are:

- *Ursus americanus* ssp. *kermodei* (white colour phase found in the Terrace/Kitimat area).
- *Ursus americanus* ssp. *vancouveri* (Vancouver Island only).
- *Ursus americanus* ssp. *carlottae* (Queen Charlotte Islands, Alaska).
- *Ursus americanus* ssp. *altifrontalis* (Pacific northwest coast).
- *Ursus americanus* ssp. *emmonsii* (“blue” colour phase found in the Tatshenshini-Alsek area of extreme northwestern BC).

Black bears on the coast of BC occur in many habitats, but are primarily associated with a mosaic of forest and non-forested cover types. Coastal bears are often larger than interior species (because of their protein rich fish and carbohydrate rich berry diets).

1.2.1.1. Concentration/Best Region

The black bear is relatively common throughout BC. Populations in BC are considered to be stable at an estimated 120,000 animals (BC Environment 1996b). On the coast of BC, black bears are common throughout all biogeoclimatic zones.

1.2.1.2. Biogeoclimatic Zones (BEC)

Coastal black bears inhabit all biogeoclimatic subzones of:

- Coastal Douglas-Fir (CDF);
- Coastal Western Hemlock (CWH);
- Mountain Hemlock (MH);
- Engelmann Spruce Subalpine Fir (ESSF); and
- Alpine Tundra (AT).

The best habitat for black bears on the coast of BC is found in the floodplain units of the CWH (Stevens and Lofts 1988).

1.2.1.3. Ecosession/ Ecoregion

Coastal black bears are found in the following ecosessions of the Coast and Mountains and Georgia Depression Ecoprovinces within BC:

- SPR, EPR, NPR, OUF ecosessions of the Pacific Ranges Ecoregion
- HEL, KIR ecosessions of the Coastal Gap Ecoregion
- NAB ecosession of the Nass Basin Ecoregion
- NAR ecosession of the Nass Ranges Ecoregion
- BOR, ecosession of the Northern Coastal Mountains Ecoregion
- NWC ecosession of the Northwestern Cascade Ranges Ecoregion
- QCL ecosession of the Queen Charlotte Lowlands Ecoregion
- SKP, WQC ecosessions of the Queen Charlotte Ranges Ecosession
- NWL, NIM, WIM ecosessions of the Western Vancouver Island Ecosession
- NAL ecosessions of the Eastern Vancouver Island Ecoregion
- FRL, GEL ecosessions of the Lower Mainland Ecoregion
- JDF, SGI, SOG ecosessions of the Georgia -Puget Basin Ecoregion

The highest concentrations of black bears on the coast of BC are believed to be in the KIR and NAR ecosessions.

1.2.2. Key Habitat Requirements and Attributes

Black bears prefer forested and shrubby areas, but use wet meadows, high tidelands, ridgetops, burned areas, riparian areas and avalanche chutes (Pelton 1982). They prefer mesic over xeric sites and timbered over open areas (Unsworth et al. 1989).

1.2.2.1. General

Black bears are very adaptable and inhabit a wide variety of plant communities. In the Pacific Northwest black bears are found in spruce-western red cedar-hemlock forests as well as pine and fir forests (Pelton 1982). They also use Engelmann spruce, subalpine fir, and mountain hemlock forests as summer habitat.

Old-growth stands of western red cedar provide hiding and thermal cover as well as dens for black bears (Arno 1977).

1.2.2.2. Reproduction

Breeding occurs in May and June (Stevens and Lofts 1988). Gestation is 6 or 7 months with 1 to 3 cubs being born from late November through February. Birth and early maternal care occurs in the winter den. The cubs will remain with the mother for 1 or 2 years.

Black bears generally mate every 2 years with females becoming sexually mature at age 5 years.

1.2.2.3. Feeding

Black bears are opportunistic omnivores and alter their food habits according to the availability of food items throughout the various seasons. They depend heavily on plant foods but will feed on fish, wildlife and domestic animals when available. Their diet changes seasonally with the relative abundance of various food items. They will also climb trees to feed on young shoots (Stevens and Lofts 1988). Some of the preferred forage species of black bears include:

cow parsnip (<i>Heracleum lanatum</i>)	mountain ash (<i>Sorbus</i> spp.)
dogwood (<i>Cornus</i> spp.)	kinnikinnick (<i>Arctostaphylos uva-ursi</i>)
cranberry (<i>Viburnum</i> spp.)	<i>Vaccinium</i> spp.
<i>Ribes</i> spp.	<i>Rhus</i> spp.
<i>Rosa</i> spp.	<i>Lupinus</i> spp.
sarsaparilla (<i>Aralia nudicaulis</i>)	thistle (<i>Cirsium</i> spp.)
soopallalie (<i>Shepherdia canadensis</i>)	<i>Lomatium</i> spp.
Labrador tea (<i>Ledum groenlandicus</i>)	clover (<i>Trifolium</i> spp.)
tree cambium	skunk cabbage (<i>Lysichiton americanum</i>)

Spring

After emerging from their winter dens in the spring, black bears seek southerly slopes at lower elevations for forage and move to northerly and easterly slopes at higher elevations as summer progresses (Hatler 1972; Jonkel 1987).

In the early spring, black bears on the coast feed on the early green vegetation found in wet meadows, riparian inclusions, skunk cabbage swamps, avalanche chutes and burns that become snow-free first (Stevens and Lofts 1988). Grasses, sedges and horsetails are the most commonly selected spring food items of bears, mainly due to

these plants early phenological development. (Hatler 1967; Lloyd and Fleck 1977; Ruff 1982). South-facing green-up areas are critical in the spring (BC Environment 1995).

Summer

In the summer black bears diet preferences shift to ripe berries, and a variety of green leafy forbs (Stevens and Lofts 1988). They will also feed on carrion, and insects such as carpenter ants (*Camponotus* spp.), yellow jackets (*Vespula* spp.), bees (*Apidae*), and termites (*Isoptera*) and sometimes kill and eat small rodents and young ungulates (USDA Forest Service 1991).

Late Summer and Fall

In the late summer and fall they concentrate on feeding on salmon as they become readily available in the spawning channels. During this period of gorging on salmon black bears will eat large quantities of live and eventually dead salmon to attain the fat reserves they require to over winter. When the salmon supplies have been depleted, they return to feeding on skunk cabbage and other vegetation until they enter their dens to overwinter.

1.2.2.4. Bedding

During periods of inactivity, black bears will utilize bed sites in forested habitats with dense understory vegetation. These sites are often a simple shallow depression in the forest leaf litter but may also be a deep excavation (Pelton 1982).

1.2.2.5. Denning

Black bears hibernate between October and May. Black bears in coastal habitats may not enter their dens until late November or early December and emerge in April dependent on weather conditions.

Bears choose den sites that are usually underground and in locations that are exposed to early snow and maximize snow's insulative qualities. The dens are lined and closed with leaves, grass and detritus from the forest floor (Pelton 1982). They will use tree cavities, caves, culverts, excavations under logs or rocks or into banks, or shallow depressions (USFWS 1996).

1.2.2.6. Migration

Seasonal movement of black bears within a geographic area are influenced by the juxtaposition or availability of seasonally important food resources or habitat components, breeding activity, reproductive status of individuals and availability of denning habitat (Rogers 1977; IGBC 1987).

Black bears make extensive seasonal movements to localities of food abundance such as spring green-up sites, spawning areas, berry patches and garbage dumps (Amstrup and Beecham 1976; Rogers 1977; Modafferi 1978). In particular, these extensive movements occur to and from winter den sites and during the late summer and fall when foraging activities increase (Pelton 1982).

Black bears will utilize movement corridors such as dry creek beds, snow filled avalanche chutes, logging roads, sandbars or rivers (Stevens 1995).

1.2.2.7. Home Range

Generally, adult males have the largest home ranges, which may be several times as large as those of females and overlap more than those of females (Amstrup and Beecham 1976; Rogers 1977; Young and Ruff 1982). Home ranges of females are well defined and maintained throughout their adult life and may be used by a female offspring after death of the mother (Kolenosky and Strathearn 1987).

In western Canada, male home ranges have been reported to be from 55 to 500 km² and female home ranges have been reported to be from 10 to 125 km² (MacHutchon and Smith 1990).

Black bears usually avoid each other except during mating season and when high concentrations of food are available (e.g. salmon spawning areas or productive berry patches).

1.2.2.8. Cover/Escape

Black bears use dense cover for hiding and thermal protection, as well as for bedding. Large trees are important escape cover for cubs. Black bears will use dense cover and/or trees to escape from predators. They commonly bed in dense shrub communities and use forested areas as travel corridors (Jonkel 1978). Generally they do not move more than 100 meters from cover (Stevens and Lofts 1988).

1.2.3. Rating Guide

1.2.3.1. Hierarchy of Critical Factors

- 1) Late summer and fall forage
- 2) Spring forage
- 3) Cover/Escape/Bedding
- 4) Summer forage
- 5) Overwinter denning

1.2.3.2. Rating System

A 6-class/2 season rating scheme (1=high; 2=moderately high; 3=moderate; 4=low; 5=very low; 6=nil) was used to rate habitat use by season for black bears within the study area. Ratings were assigned for security/thermal cover (ST), and feeding (FD) during early spring (PE) and growing (G) seasons and hibernating (HI) during the winter season.

The provincial benchmark for black bear is in the NAR and KIR ecosections of the Coast and Mountains ecoprovince. Best habitats for black bears are those that produce abundant seasonally important foods in proximity to security and thermal cover, which generally corresponds to a mosaic of structural stages 2-3 and 6-7. Floodplains, wetlands, and forests with large diameter snags or rock outcrops and caves are considered the best habitat for black bears.

Ratings were assigned to the ecosystem units within the study area based on habitat attributes and structural stages considered to be important. Habitat requirements for black bears in the Upper Kitimat River/Davies Creek/Dala River study area are summarized in Tables 4 and 5.

Table 4: Summary of habitat requirements for black bears in the study area.

Season	Life Requisite	Structural Stage	Requirements
Spring (LIPE)	Feeding (FD)	2-3, 6-7	Abundance of early green up vegetation. Skunk cabbage, sedges, horsetails, devil's club, hellebore and grasses are particularly important. Flood plains, valley bottoms and lower snow free side slopes with moist to wet soil moisture regimes and a rich soil nutrient regime support the best spring habitat.
	Thermal & security (ST)	6-7 3b,5-7	Mature and old-growth coniferous forests. Mixed coniferous/deciduous mature forest. Shrub cover >50% and canopy closure >66%. Larger trees (>40cm DBH) within 100 m of foraging areas) are required for security cover, particularly for sows with cubs.
Growing (LIG)	Feeding (FD)	2-3, 6-7	Bears will congregate at salmon spawning areas during this period. Moist forests with skunk cabbage and berry producing shrubs close to salmon streams are also important feeding areas during this period.
	Thermal & security (ST)	6-7 3b, 5-7	Mature and old-growth coniferous forests. Canopy closure >50% and tree compositions dominated by spruce and hemlock/spruce. Larger trees (>40cm DBH) within 100 m of foraging areas) are required for security cover, particularly for sows with cubs.

Table 5: Summary of critical black bear habitat attributes measured.

Season/Activity	Measurable Attribute	Habitat Features
Spring feeding (LIPE_FD)	Herb layer	Percent cover of herbs (see preferred species list)
Growing feeding (LIG_FD)	Salmon spawning stream	Presence of salmon stream in or adjacent to polygon.
	Berry abundance	Preferred berry producing shrubs measured as no. of stems and no. of fruit/stem.
	Berry producing quality	Berry producing shrubs below 2.5 m in height
Spring thermal cover (LIPE_ST)	Aspect	South and southwest aspects have lower snow depths and increased outflow wind protection.
	Crown closure	Canopy closure >66% in spruce and spruce/hemlock forest.
	Elevation	Lower elevations will have lower snow levels and higher average temperatures.
Growing thermal	Crown closure	Mature or old-growth coniferous forest.

cover (LIG_TH)		
Spring and growing security cover (LIPE_ST) LIG_ST	Distance from (mature forest)	Black bears require trees (dbh >40cm) within 100 m of foraging areas for security cover from grizzlies.
	Shrub cover	Shrubs over 2 meter in height (>50% cover).
	Crown closure	Canopy closure >50% in spruce and spruce/hemlock forest.

1.2.3.3. Modeling Theme

The area mapped delineates early spring and summer/fall feeding areas and proximity to mature forest cover (thermal and security cover, denning and bedding areas).

1.2.3.4. Model Assumptions

In the preparation of this model, the following assumptions were made:

- Availability of abundant food items in the late summer and fall is critical to black bear recruitment and survival. On the coast of BC, berry crops and salmon spawning are the major food sources during this season.
- Black bears require mature forest for escape and thermal cover as well as travel corridors. They require cover within 100 m of feeding areas.
- Water and minerals are not limiting.
- All roads have the same effect on bear behaviour or survival regardless of use.
- All human activities are the same in affecting bear behaviour and survival.
- The regional field guide (Banner et al. 1993) accurately predicts ecosystem unit characteristics in the study area.

1.2.4. Field Sampling Scheme

The methods used to sample the habitat attributes important to black bears are outlined below.

Table 6: Sampling scheme for black bears.

Habitat Attribute	Sample Method
Abundance of black bear food plants	Recorded on ecosystem field form (vegetation data sheet).
Presence of security cover (>40cm DBH trees) within 100 m of foraging areas.	Recorded in comments on wildlife data form.
Presence of shrub canopy closure of >50% (security cover)	Recorded on ecosystem field form (vegetation data sheet).
canopy closure >30% (thermal cover)	Recorded on ecosystem field form (vegetation data sheet).
Abundance and quality of berries	Recorded in comments on wildlife data form Methodology developed by T. Hamilton (no. of stems and no. of fruit/stem) was employed.
Evidence of habitat use (scat, diggings, marking)	Recorded on wildlife data sheet.
Presence of dens	Recorded in comments on wildlife data form.
Presence of salmon stream within polygon	Sightings were recorded in comments on wildlife data form FISS and SISS mapping and DFO/BCE escapement records and reports were researched.

REFERENCES

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