WOLVERINE

Gulo gulo

Original[1] prepared by R.D. Weir

Species Information

Taxonomy

Wolverines (*Gulo gulo*) are members of the family Mustelidae (subfamily Mustelinae) in order Carnivora. Wolverines are currently considered one species throughout their circumpolar range (Kurten and Rausch 1959), although two subspecies are recognized: *G. gulo luscus* (North America), and *G. gulo gulo* (Eurasia). Banci (1982) determined that there were insufficient differences in cranial morphology to consider the Vancouver Island wolverine as a subspecies distinct from mainland wolverines in British Columbia. Although they are the sole members of their genus, wolverines are most closely related to members of the genus *Martes* (e.g., American Marten, Fisher; Dragoo and Honeycutt 1997).

Description

Wolverines are the largest terrestrial members of the weasel family. Wolverines are sexually dimorphic, with the body mass of males ranging from 12 to 18 kg and females ranging from 8 to 12 kg (Hash 1987). Wolverines have stout bodies ranging from 65 to 105 cm in length with moderately bushy tails 17–26 cm in length (Hash 1987). Wolverines are most easily identified by their pelage that is dark chocolate brown over most of the body with lighter-coloured hair around the forehead and along a lateral stripe extending from the ears or shoulder to the sacral region.

Distribution

Global

Wolverines are holarctic in their distribution, generally occurring between 45° and 70° latitude in North America and 50° and 70° latitude in Eurasia (Wilson 1982). Wolverines occur in the tundra, taiga plains, and boreal forests of North America, Europe, and Russia, and in many of the montane habitats of the western Cordillera of North America.

British Columbia

Wolverines are widely distributed, albeit at low densities, throughout much of British Columbia. Wolverine populations do not occur on the Queen Charlotte Islands and may be extirpated from Vancouver Island, the lower Fraser Valley, the Okanagan Basin, and the Thompson Basin.

Forest region and districts

Wolverines likely occur in portions of each forest region, except for the Queen Charlotte Islands, South Island forest districts, and possibly other districts on Vancouver Island (e.g., North Island and Campbell River).

Ecoprovinces and ecosections

Wolverines occur in all terrestrial ecoprovinces, except for the Georgia Depression Ecoprovince.

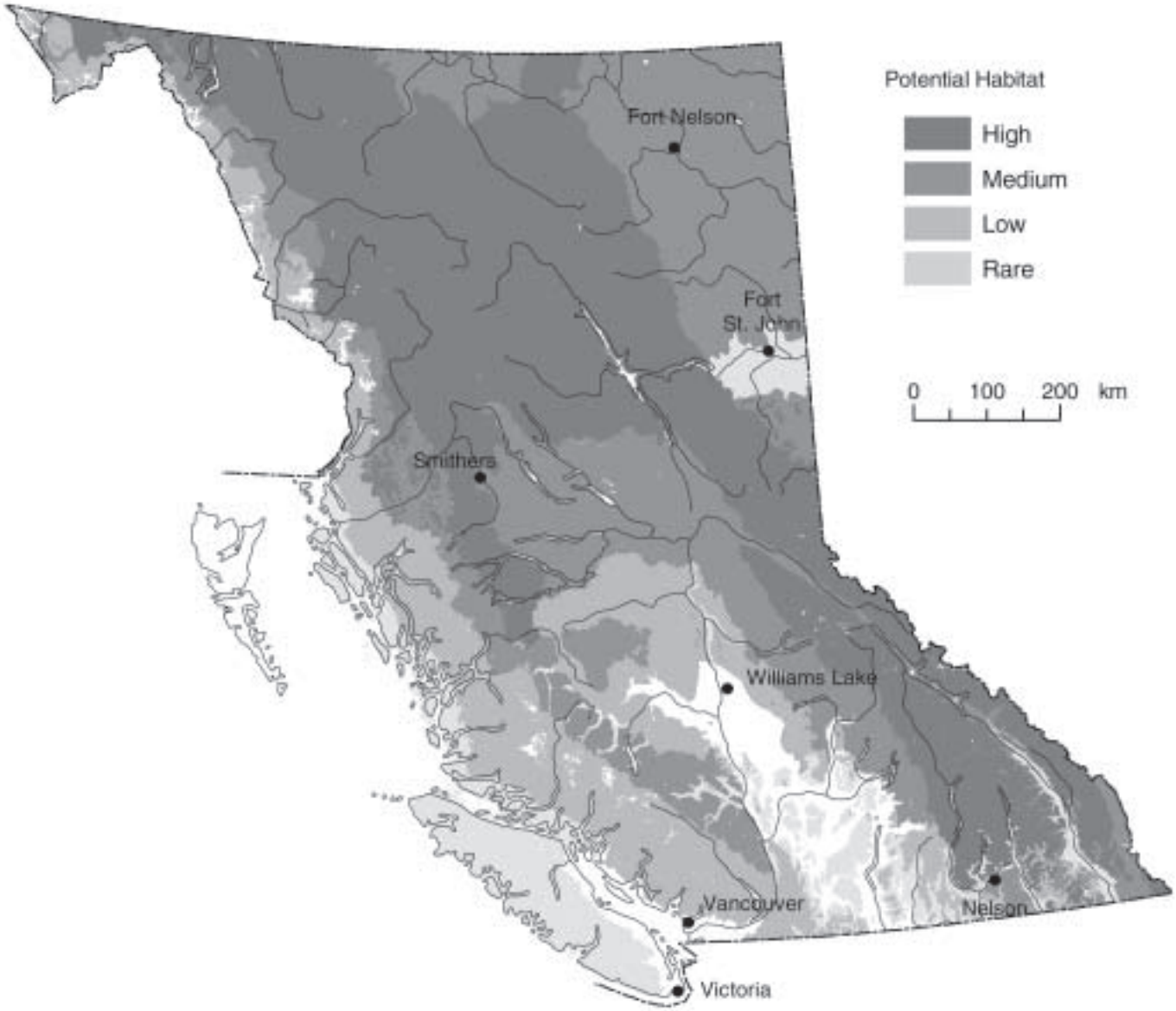
Biogeoclimatic units

Wolverines can occur in all biogeoclimatic zones, except for BGxh, BGxw, CDFmm, CWHwh, IDFxh, IDFxm, IDFxw (and all grassland phases in the IDF), PPdh, and PPxh subzones.

1 Draft account for Volume 1 prepared by E. Lofroth.

Wolverine

(Gulo gulo)



Note: This map represents a broad view of the distribution of potential habitat used by this species. The map is based on several ecosystem classifications (Ecoregion, Biogeoclimatic and Broad Ecosystem Inventory) as well as current knowledge of the species' habitat preferences. This species may or may not occur in all areas indicated.

Biogeoclimatic zones and subzones with the capability to support wolverines

AT: p

BWBS: dk, mw, unr, vk, wk

CWH: dm, ds, mm, ms, unc, vh, vm, wm, ws, xm

ESSF: dc, dcp, dk, dkp, dv, dvp, mc, mk, mm, mv, mw,,mwp, ung, vc, vcp, wc, wcp, wk, wm, wv, xc, xcp, xv

ICH: dk, dw, mc, mk, mm, mw, vc, vk, wc, wk, xw

IDF: dk, dm, dw, mw, unk, unn, unv, ww

MH: mm, unr, wh

MS: dc, dk, dm, dv, unk, unv, xk, xv

PP: dh

SBPS: dc, mc, mk, xc

SBS: dh, dk, dw, mc, mh, mk, mm, mw, unk, unr, vk, wk

SWB: dk, mk, unr, vk

Note that wolverines may not currently occur in each of the subzones listed.

Broad ecosystem units

Wolverines likely use a wide variety of broad ecosystem units (BEUs). The following BEUs may be used by wolverines; however, the intensity and frequency of use is likely highly variable and linked to the ability of the habitat to support specific food sources (e.g., moose, caribou, hoary marmots). Each unit has been assigned a rank to denote its relative importance to wolverine ecology (1 = high, 2 = medium, 3 = low, 4 = very low) (Lofroth 2001, J.A. Krebs, pers. comm.). There is very limited data for the coastal habitats.

Elevation

Wolverines range from valley bottoms to alpine meadows. The upper limit of their elevational range is likely limited by the distribution of prey at higher altitudes (J.A. Krebs, pers. comm.). In areas with mountainous terrain, there appears to be some segregation in use of different elevations among sex and age classes (Whitman et al. 1986, Lofroth 2001); adult females typically occur at higher elevations than other sex and age classes, followed by subadult females, then adult males (Lofroth 2001). Subadult males typically occur at the lowest elevations.

Unit	Likely Importance	Unit	Likely Importance
AD	4	LP	2?
AG	1	ME	4
AH	1	MF	3
AM	1	MR	4
AN	3	MS	3
AS	2	PB	4
AT	1	PR	1
AV	1	RB	3
BA	2	RD	3
BB	4	RR	1
BG	4	RS	3
BK	2	SA	2
BL	3	SB	3
BP	3	SC	3
CG	3	SD	3
CH	3	SF	2
CP	4	SG	2
CR	1	SH	3
CS	2	SK	2
CW	3	SL	3
DF	4	SM	1
DL	4	SR	2
EF	2?	SU	2
ER	1	SW	2
ES	3	TA	1
EW	2?	TB	2?
FB	3	TF	4?
FE	4	WB	2
FP	1	WG	4
FR	3	WL	3
HB	3	WM	3
HL	4	WP	2
HP	2	WR	1
HS	3	YB	4
IG	2	YM	3
IH	2	YS	4?
IS	2?		

Life History

Diet and foraging behaviour

Wolverines consume a variety of food items, but large ungulates (e.g., moose [*Alces alces*], elk [*Cervus elaphus*], caribou [*Rangifer tarandus*], deer [*Odocoileus* spp.], and mountain goats [*Oreamnos americanus*]), primarily obtained as carrion, form a large component of their diet (Hash 1987). Wolverines are also reported to eat snowshoe hares (*Lepus americanus*), porcupines (*Erethizon dorsatum*), sciurids (including marmots), mice and voles, birds, fish, and vegetation (Banci 1994).

Composition of the diet appears to vary seasonally and with the sex of the individual. In the Omineca region, moose are consumed throughout the year by all age and sex classes (Lofroth 2001). However, during summer, adult females with kits included hoary marmots (*Marmota caligata*) as a substantial portion of their diet. Banci (1987) speculated that small mammals become more important as a prey item as the availability of large ungulate carrion diminishes.

The reliance upon particular species for food likely varies regionally with availability of the species. In the Omineca region, wolverines consume moose throughout the year (Lofroth 2001). In the north Columbia Mountains, wolverines consume caribou, mountain goats, and moose most frequently (J.A. Krebs, pers. comm.). In areas with anadromous salmon runs, fish may be an important supply of food for wolverines (Banci 1987).

Female wolverines are faced with an energy bottleneck while using natal and maternal dens. Their dens appear to have specific structural requirements (see "Habitat," below), but they must also be relatively close to a reliable source of food. In both the Omineca region and northern Columbia Mountains, female wolverines situate their natal and maternal dens in areas bordering the ESSF/ESSFp ecotone in early April. The timing of this process concurs with the movement of caribou to high-elevation areas in late winter. The prevalence of caribou remains in scats collected at natal dens suggests that female wolverines rely heavily upon caribou as a predictable food source during this period (Lofroth 2001). Krebs and Lewis (2000) speculated that kit production and survival might be strongly linked to carrion supply.

Researchers have long assumed that wolverines primarily scavenge for food. Wolverines are well-known for their ability to detect animal remains buried under several feet of snow and are also reported to cache food that they have scavenged and revisit these sites later in the year (Hash 1987). It is speculated that wolverines obtain about 60% of their food intake through carrion (E. Lofroth, pers. comm.). However, in the Omineca region and Columbia Mountains, researchers have observed wolverines attacking and killing caribou (Lofroth 2001). In the rugged and snowy northern Columbia Mountains, wolverines appear to rely heavily upon avalanche-killed ungulates (e.g., caribou, mountain goats, moose) during winter and may be less reliant on wolf predation as a source of carrion than in other areas (J.A. Krebs, pers. comm.). Wolverines appear to actively hunt smaller prey during non-winter periods and rely less upon carrion (E. Lofroth, J.A. Krebs, pers. comm.).

Wolverines search widely for food. Daily movements for wolverines can be up to 65 km (Wilson 1982). Female wolverines regularly move 20 km a day even while maintaining a natal den (E. Lofroth, pers. comm.). It is unknown if they use any specific habitats preferentially for foraging, although the activity rates of wolverines within late successional and riparian forest indicate that this may be a heavily used habitat while foraging or searching for prey or carrion (Lofroth 2001).

Reproduction

Wolverines breed between late April and early September but embryos do not implant until January. Sometime between late February and mid-April, females give birth to between one and five cubs. They nurse for 8–9 weeks after which they leave the den but stay with mother for their first winter learning to hunt. Young disperse in spring. Natal dens are often underground.

Site fidelity

Wolverines are not widely reported to exhibit strong site fidelity, except for females with natal or maternal dens. While rearing kits, females will use a natal den for approximately 20–60 days and between one and four maternal dens for 5–20 days each (Magoun and Copeland 1998; Lofroth 2001). These dens are not likely reused between years.

Home range

Only adult wolverines maintain distinct home ranges. Wolverines have mildly intrasexually exclusive home ranges, where males will overlap with one or more females and other males, but females will not overlap their home ranges with other females (Krebs and Lewis 2000). Male home ranges are typically three times the size of those of females (Omineca, males: 1366 km², females: 405 km² [Lofroth 2001]; northern Columbia Mountains, males: 1005 km², females: 311 km² [Krebs and Lewis 2000]). Home ranges are maintained between years.

Movements and dispersal

Daily movements of wolverines are likely mediated most strongly by the availability and distribution of food throughout the year, although wolverines do spend substantial time moving through mature and old forest structural stages (E. Lofroth, pers. comm.). Wolverines in the northern Columbia Mountains seem to prefer moving about the landscape by following watercourses and using low elevation passes between valleys (J.A. Krebs, pers. comm.).

However, human-caused features can have a substantial effect on the ability of wolverines to move successfully throughout the landscape. Human activity (e.g., log hauling, logging, mining) may displace or alter movement paths of wolverines in highly modified landscapes (Lofroth 2001) and wolverines will often avoid entering young (<25 years) cutblocks while travelling (J.A. Krebs, pers. comm.). Transportation corridors can interrupt or alter daily movements (Austin et al. 2000) and can be a source of mortality within the population (Krebs and Lewis 2000). Man-made reservoirs may alter the dispersal routes of wolverines in the landscape (E. Lofroth, J.A. Krebs, pers. comm.). Kyle and Strobeck (2001) speculated that habitat loss, overharvest, major transportation corridors, and other anthropogenic factors limit successful dispersal among metapopulations. The viability of populations of wolverines in southern portions of the range may depend upon large areas of undisturbed habitat with corridors connecting them.

Subadult female wolverines typically disperse short distances away from their natal home ranges and males disperse 30–100 km (Magoun 1985), although dispersals of up to 378 km have been documented (Gardner et al. 1986). Subadult wolverines are slightly nomadic and travel widely prior to establishment of a permanent home range. Movements by subadults are characterized by periods of concentrated use of a relatively small area, interspersed by large-scale movements (Lofroth 2001). Subadults typically establish a home range by the time they reach 24 months. Habitat composition likely plays a relatively small role in dispersal; however, extensively clearcut watersheds would likely be avoided while transient (J.A. Krebs, pers. comm.).

Habitat

Structural stage

Wolverines, being dependent upon a variety of different food items throughout the year, use a wide assortment of structural stages in their day-to-day life, although mature and old forest structural stages are used predominately. In the Omineca region of north-central British Columbia, Lofroth (2001) reported that at least 50% of the locations of radio-tagged wolverines were in late successional stands (structural stages 6 and 7) and wolverines had relatively little use of mid-successional stands (stages 3 and 4). He also noted that the use of structural stages by wolverines varied among sexes and seasons; females tended to use both early-successional (stages 1 and 2) and late-successional stands (stages 6 and 7), while males used mostly late-successional stands. Most of the use of early-successional stands by females occurs in the use of high elevation habitats during the rearing season, when they are provisioning for young. In the northern Columbia

Mountains, wolverines tend to use late-successional stands (stages 6 and 7) most frequently when they are not using alpine habitats. Wolverines in this area may use late-successional forests because they confer some thermal and security cover benefits (J.A. Krebs, pers. comm.). To date, neither of these studies has completed their respective habitat selectivity analyses, so these results are preliminary estimates of use, not selectivity.

At a landscape spatial scale, wolverines tend to have some broad patterns of use. In mountainous areas of British Columbia, females tend to use ESSF biogeoclimatic zones during winter and AT zones during the summer. Males, on the other hand, tend to use lower elevation zones during winter and switch to ESSF zones during the summer (Krebs and Lewis 2000, Lofroth 2001). Wolverine populations tend to occur in areas where a diversity of abundant seasonal food is available within home ranges, which is often related to elevational diversity.

Important habitats and habitat features

"Habitat" for wolverines is not easily delineated as a set of vegetative parameters, such as those that are typically used to identify and classify terrestrial ecosystems, but is likely defined by the distribution and abundance of food, including carrion as well as suitable habitat/structures for denning and rendezvous points (i.e., sheltered places where kits are left during foraging periods). Most studies of wolverine habitat use show little, if any, selection for habitat at the stand scale (e.g., Whitman et al. 1986; Banci and Harestad 1990). This is likely because wolverines are not small-scale habitat specialists but rather require a suite of habitat variables that occur at larger spatial scales (e.g., landscapes, regions).

Thus, wolverines do not have easily defined habitats or small-scale habitat features for which they select. For lactating females and their young, an arrangement of habitats that provide a suitable supply of large ungulate carrion during the late winter in close juxtaposition to an area that supplies adequate food during summer (e.g., marmots) and suitable shelter is important (Krebs and Lewis 2000).

Natal and maternal dens are probably the only small-scale structures for which wolverines exhibit selection. Female wolverines typically situate dens in snow tunnels leading to masses of fallen trees (accumulations of classes 1–3 coarse woody debris [CWD]) or rocky colluvium (Magoun and Copeland 1998; Krebs and Lewis 2000; Lofroth 2001). The CWD associated with natal and maternal dens is likely formed through a variety of processes, such as windfall, avalanches, and insect-induced mortality. Natal and maternal dens are generally associated with small-scale forest openings (e.g., <100 m across) at high-elevations (i.e., ESSF/ESSFp ecotone; Krebs and Lewis 2000; Lofroth 2001). The composition and placement of dens within the landscape is important because these structures provide security for kits (i.e., snow cover) with proximity to food resources (i.e., late-winter carrion or prey).

Conservation and Management

Status

The Vancouver Island Wolverine is on the provincial *Red List* in British Columbia; whereas the mainland subspecies is on the provincial *Blue List*. The eastern Canadian population in the Ungava Peninsula and Labrador is designated *Endangered* (COSEWIC 2002). The western Canadian (YT, NT, NU, BC, AB, SK, MB, ON) population of wolverines is considered to be of *Special Concern* (COSEWIC 2002). Wolverine populations in Eurasia are believed to be at a low density, but stable (Hash 1987).

Summary of ABI status in BC and adjacent jurisdictions (NatureServe Explorer 2002)

Population	BC	ID	MT	Canada	Global
Vancouver Island	S1	–	–	N1	G4T1Q
Mainland BC	S3	S2	S2	N4	G4T4

Trends

Population trends

Very little is known about the size of the population of wolverines in British Columbia and no current estimate of the population size exists for the province. However, a specific density estimate was produced for 1996 and 1997 in the northern Columbia Mountains, where researchers estimated the density of wolverines at approximately 25 wolverines in the 4000 km² study area, or 1 wolverine/160 km² (Krebs and Lewis 2000). This estimate is not substantially different than the estimate produced for the south-western Yukon of 1 wolverine/177 km² (Banci and Harestad 1990). It is not known how applicable these estimates are to other areas in the province.

The relative ability of a population to remain stable or increase is largely dependent upon the survivorship of individuals within it. In a review of population vital rates of wolverines in western North America from 11 research studies, Krebs et al. (2000) determined that survivorship rates of wolverines varied depending upon whether the population was from tundra, boreal, or temperate regions and if the population was exposed to trapping. The highest survivorship rates were among the tundra-untrapped populations, while the lowest were among the temperate-trapped populations. They also concluded that human-caused mortality (e.g., trapping) is additive, not compensatory. Using this as a framework, wolverine populations are probably healthiest in the northern, inaccessible mountain regions of the province. Populations in the southern half of the province that are exposed to human development and trapping pressure likely have poorer survivorship and are thus more tenuous. Kyle and Strobeck (2001) speculated that the high degree of genetic isolation among the wolverines in the northern Columbia Mountains was due to a lack of connectivity between subpopulations and indicated an isolated population that may be more susceptible to stochastic events.

Habitat trends

The suitability of habitat in much of the range of the wolverine has declined over the past 30 years. Conversion of large, contiguous tracts of mature and old forests have likely affected the diversity and abundance of prey and carrion available to wolverines and likely affected the permeability of the landscape for dispersal. Development of previously inaccessible watersheds has introduced trapping mortality and transport-related (i.e., roads, rail) mortality into previously unharvested populations. Logging of high elevation forests may also influence the availability or success of natal and maternal dens.

Threats

Population threats

As noted by Banci and Proulx (1999), wolverine populations have low resiliency to population perturbation (e.g., fur trapping) because of their low densities, large home range sizes, and relatively low reproductive rate. Wolverine populations are believed to sustain a harvest rate of 6% of the population per year (Krebs et al. 2000). Recent analysis of wolverine survivorship has suggested that trapping mortality is additive, not compensatory (Krebs et al. 2000). Historic overharvest of wolverines has certainly contributed to their North American decline. A changing prey base, mediated by habitat and population manipulations by humans, may have also been a source of population decrease over the past 100 years. The primary population threat is the additive mortality resulting from fur harvesting. The increased access provided by forest development greatly enhances the ability of trappers to harvest wolverines in previously inaccessible areas.

Wolverines may also be very sensitive to disturbance particularly disturbance from roads and recreational activities (e.g., heli-skiing, snowmobiling).

Habitat threats

As stated by Banci (1994), the cumulative impacts of trapping, habitat alterations, forest harvesting, and forest access on wolverine populations are not well

understood. Although wolverines are not widely reported to be a habitat specialist, habitat loss and alienation are commonly thought to be a major contributing factor to population declines (Banci 1994). The major habitat threat is the large-scale conversion of mature and old forest structural stages into early structural stage habitats. Logging of high elevation forests may also affect rearing success.

Legal Protection and Habitat Conservation

Under the provincial *Wildlife Act,* wolverines are protected from killing, wounding, and taking, and legal harvest for their pelts is regulated. Intentional harvest of wolverines is not permitted in regions 1, 2, and 8. Open trapping seasons on wolverines occur in regions 3, 4, 5, 6, and 7. There is no quota for harvests of wolverines in these regions but trappers must report the capture of wolverines within 15 days following the end of the trapping season. As recorded in the Fur Harvest Database, an average of 168 wolverines were harvested annually over the past decade (Lofroth 2001). Unreported harvests and discrepancies in the harvest reporting system suggest that the actual harvest of wolverines in British Columbia may be different (I. Adams, pers. comm.). Wolverines are also considered "small game" and may be hunted in regions 4, 6, and 7. The annual bag limit for these regions is one wolverine.

Areas protected from timber harvest and trapping are likely an important component of conservation of wolverines in British Columbia (Hatler 1989). Because of large space requirements, low density, and low resiliency to trapping, these refugia are likely critical to the persistence of wolverines in many landscape units. Several parks likely include suitable habitat for wolverines (e.g., Glacier National Park); however, wolverines have very large home ranges and most parks in British Columbia are not large enough to encompass the home range of a wolverine.

Several provisions of the results based code should maintain small-scale habitats for wolverines including recommendations for landscape unit planning and riparian management. Wildlife habitat features may also be used to manage den sites. However, because wolverines occur at low densities and cover large areas, maintaining wolverine habitat will also need to be implemented through higher level plans.

Identified Wildlife Provisions

Effective management of wolverine habitat needs to occur at the landscape spatial scale. Maintaining refugia (i.e., areas with limited resource and recreational activities and trapping), seasonal foraging areas, secure denning sites, adequate movement corridors, and limiting mortality within populations need to be implemented for successful conservation of the species. These issues can best be addressed by incorporating the connectivity of habitats, creation of refugia, and the arrangement and timing of forest development in strategic level plans.

Sustainable resource management and planning recommendations

- Refugia are probably the single most important landscape planning mechanism for the conservation of wolverine populations in British Columbia. Refugia should be designed using suitable portions of watersheds in juxtaposition with protected areas and no trapping areas that are determined in consulation with the Fish, Wildlife and Allocation Branch of the Ministry of Water, Land and Air Protection, and as part of a recovery planning process.
- Plan forest development to occur on one side of a watershed at a time where practicable. Limiting concurrent development will concentrate the activity at any one time and allow wolverines to avoid operational areas as much as possible during their daily movements. This will reduce the mortality risk (e.g., road kill, trapping) and displacement associated with forest development and will help facilitate normal movement throughout the landscape.
- Minimize road access (i.e., number of km and length of time active). The increase in access associated with forest development into previously pristine areas (especially large drainages) exposes resident wolverines to a much higher mortality risk from hunting, poaching, and road traffic. Careful road planning and deactivation should be considered.

- ❖ Maintain seasonal foraging areas. Seasonal foraging areas can be maintained through the appropriate juxtaposition of structural stages throughout a watershed. Adequate foraging habitat for wolverines is likely closely linked to the suitability of habitats to support their primary food sources (ungulates, snowshoe hares, porcupines, marmots). Maintaining these habitats near adequate thermal and security cover (generally mature and old forest structural stages) will be important to securing seasonal foraging areas for wolverines. In mountainous regions, this will entail planning for seasonal prey across several biogeoclimatic zones (e.g., ICH, ESSF, AT).
- ❖ Maintain suitable denning sites. Suitable sites are secure and undisturbed, and have the appropriate structure (see "Important habitats and habitat features" above). These need to be close to reliable food sources (carrion from late winter avalanches, prey) and are likely best supplied in the ecotone of the ESSF/ESSFp/ATp.
- ❖ Minimize disturbance at suitable denning sites. Logging should not occur near identified avalanche chutes or late-winter areas for caribou. Forestry operations should not occur in these areas between March and June when females are more sensitive to human disturbance. In areas without a diversity of elevations (and resulting BEC zones), additional factors will need to be taken into consideration to ensure the provision of secure den sites for wolverines. In relatively flat areas, such as the Fraser Plateau, denning wolverines may be more vulnerable to the effects of habitat alterations because their dens are more likely to occur in harvestable areas.
- ❖ Retain suitable movement and dispersal corridors. Habitat connectivity within and between watersheds is very important for successful daily movements, foraging, and dispersal of wolverines. Connectivity of valley bottom habitats is important, specifically along watercourses. These corridors should be dominated by older forests (stage 6 or 7) and it is important to connect, not only the valley bottom habitats, but also provide movement corridors between the valley bottom and patches of ESSF/AT habitats. Large connectivity corridors should be maintained between refugia where human disturbance is prevalent. These should also be dominated by older forests (stages 5–7).

Additional Management Considertaions

Minimize disturbance from recreational activities (e.g., heli-skiing, snowmobiling) near maternal dens.

Information Needs

1. Ecology in non-mountainous landscapes.
2. Dispersal through fragmented landscapes.
3. Reproductive rates.

Cross References

Fisher, Caribou

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