8.0 SPECIES – HABITAT MODEL FOR FISHER

Common Name: **Fisher**
Scientific Name: *Martes pennanti*
Species Code: M-MAPE
B.C. Status: Blue-listed (B.C. MELP, 1996; B.C. CDC, 1997)
Identified Wildlife Status: Yes (B.C. MELP, 1997)
COSEWIC Status: Not applicable

8.1 Introduction

In British Columbia, the fisher is considered to be vulnerable to over-harvest because it is not present on most registered traplines in manageable numbers, and is therefore managed as a Class 2 fur-bearer (B.C. Ministry of Environment, 1991). Fishers are blue-listed (vulnerable status) in B.C. by the Ministry of Environment, Wildlife Branch because of suspected population declines. Consequently it has been identified as a species of management concern and has recently been included as an Identified Wildlife Species in the *Identified Wildlife Management Strategy* (1998) for the *Forest Practices Code of British Columbia*.

Most of the research regarding this species has been conducted in the eastern half of North America. Some studies have taken place in the west, however, predominantly in the United States. Research on fisher in B.C. has increased over the last decade due to the reported decrease in numbers and lack of information for B.C. fisher ecology. In B.C., Weir (1995 and 1998) examined the diet, spatial organization, and habitat relationships of fishers in the Williams Lake area, south central (1995) and northwest of Mackenzie, in North-Central B.C. (1998). The later study is currently ongoing as part of a 5 year research project. Information from it is considered directly applicable to this species-habitat model, because the Klawli project area contains similar habitat and many of the same subzones and variants. In addition to using local information, supplemental literature sources from western North America have been included where applicable.

At this time, general habitat ratings for the fisher are predicted to have a low to moderate reliability. No model verification has been done to confirm levels of use (i.e. inventory) within the ecosystem units and structural stages mapped for the Klawli project area.

8.2 Distribution

Fishers only occur in North America (Douglas and Strickland, 1987), where they range through most of the Canadian Provinces, from B.C. east to Nova Scotia. They extend north into the southern Yukon and southern Northwest Territories, and extend south into parts of the western and eastern United States. They are largely absent from the central United States, and do not occur in Alaska.

8.2.1 Provincial Range

Fishers are generally thought to be well distributed across British Columbia, occurring in most ecoprovinces and biogeoclimatic zones, with the exception of the coastal islands and the southern portions of the Southern Interior and Southern Interior Mountains Ecoprovinces. However, detailed distribution is not known and could be quite patchy. Further inventory is required to confirm suspected ranges (RIC, 1997).

Fishers are found at low densities throughout the boreal forests of British Columbia, where they reach the northern extent of their range in the province (Banci, 1989). However, fishers also occur within the southeast corner of the Yukon where they are also believed to be rare (Hagmeier, 1956; Penner, 1981; Slough, 1985). Banci (1989) roughly estimates a density of >1 fisher/200km^2 in B.C., but emphasizes that information is insufficient to estimate densities and populations sizes.

8.2.2 Distribution in the Project Area

Within British Columbia, fisher are considered to be uncommon to common yearlong in the dry, cool BWBS; absent in the moist ESSF and in the wet parkland ESSF, and are considered uncommon to common yearlong in the moist, cool SBS (Weir, pers. comm.). Fisher occurrence within the ecoregions, ecosections, and biogeoclimatic zones of the Klawli study area are summarised in Table 44.

According to a 1992 trapper questionnaire of the Williston Reservoir watershed, fishers are considered to be extremely scarce in the area, and low trapping occurrences indicate that populations are not changing (Becker, 1992). Current research in the area by Weir (1998) has inventoried fisher habitat use within three of the same subzones present within the Klawli study area. Weir's results to date (ongoing 5-year project) were assumed to reflect presence/absence and habitat selection for the same subzones within the Klawli, because no other local research has been completed to date.

Table 44: Expected Fisher Occurrence within the BEC Zones, Subzones and Variant Combinations Found within the Klawli Project Area, Mackenzie FD, B.C.

Ecoprovince	Ecoregions	Ecosections	BEC Variants	Expected Occurrence
Sub-Boreal Interior	Omineca Mountains	Manson Plateau (MAP)	AT	x
			ESSFmvp3	x
			ESSFmv3	x
			SBSmk1	•
		Southern Omineca Mountains (SOM)	BWBSdk1	•

Legend: • = occurs in the variant; •? = probably occurs in the variant; ? = unlikely to occur in the variant; x = essentially absent

8.2.3 Elevational Range

Generally, fishers occur at the lower range of elevations; seasonal movements between different elevations do not often occur (Banci, 1989). Within the study area, fishers are likely to occur in the valley country of the SBS and BWBS, preferring areas of higher canopy closure which are more often associated with lowland forest (Powell, 1982). Trappers reported fishers to most commonly use the ESSF and SBS successional stage 5 habitat types in the Williston reservoir area (Becker, 1992). Fishers are not found in the AT zone due to the lack of forested security cover and prey.

8.3 Ecology and Habitat Requirements

Fishers occur primarily in forested landscapes and often prefer late succession forest to younger seral stages (Jones and Garton, 1994, in Weir and Harestad, 1997). It appears that fishers in western coniferous forests may rely on the structures and ecological process associated with late successional stands to fulfill many of their life requirements (Ruggiero *et al.,* 1994).

During periods of deep snow accumulations fishers will avoid traveling through open areas and soft snow, and will use forests with snow interception (Arthur *et al.,* 1989; Raine, 1983). The types of forests that provide snow interception are generally mature coniferous stands.

Fisher establish home ranges that are used all year, but that may vary seasonally (i.e., larger in the summer and smaller in the winter) Weir (1995). Home range sizes for male fishers are usually larger than for females, because fishers are sexually dimorphic; the males are usually significantly larger than the females, and require a larger area to maintain their body condition (Weir, 1995). Home ranges within the sexes do not overlap, but male and female ranges do overlap. Fishers intrasexual home ranges do not usually overlap, whereas intersexual home ranges do overlap (Weir, 1995). The size of home ranges for male and female fishers varies between studies, likely a reflection of habitat and prey availability (see Table 45). In North-Central B.C., research by Weir (1998) has recorded larger home range sizes than found elsewhere. However, the limited sample size and variation in resource distribution between regions may in part explain the significant variation.

Table 45: Annual Home Range Sizes of Male and Female Fisher From Various Studies in British Columbia.

Location	Male Range	Female Range	Reference
British Columbia	20-34 km^2	15-19 km^2	Banci, 1989

North-Central B.C. (Williston Reservoir Area)	*281.8 km^2	**43.9 km^2	Weir, 1999
Quesnel, B.C.	15-35 km^2	15-35 km^2	Keystone, 1995
Williams Lake, B.C.	46.5 km^2	26.4 km^2	Weir, 1995 Weir and Harestad, 1997

*= sample size of 1; ** = sample size of 5

8.4 Habitat Use (Life Requisites and Seasons)

In general, fishers prefer a diversity of forest types with a high degree of interspersion (Arthur *et al.,* 1989; Banci, 1989). Fishers use multi-aged stands interspersed with openings, wetlands, edges, or ecotones (Banci, 1989; Powell and Zielinski, 1994). Riparian forests are also important habitat for fishers (Buck *et al.,* 1994; Powell and Zeilinski, 1994), because they tend to select for old-growth habitat elements in riparian stands (Weir, 1995). In the Mackenzie area, high fisher use has also been found in areas with cottonwoods and kettle lake systems (Weir pers. comm., Oct. 1999; Weir, 1999).

A high degree of stand diversity is optimal for fisher habitat. Important stand characteristics include tree height and shape; opening size; associated understorey vegetation; volume, piece size and decay class of coarse woody debris (CWD); density and decay class of snags; and layering of cover (Buskirk and Powell, 1994; Weir, 1995; Weir, 1999). This complexity in forest structure and the associated prey may be essential features in habitat preferences of fishers (Buskirk and Powell, 1994).

Fisher habitat use for the study area is broken down into two seasons – growing and winter. Life requisites that are rated for the fisher include food, security, combined security and thermal, and reproduction (natal and maternal denning security and thermal habitat) as summarised in Table 46.

Table 46: Summary of Rated Life Requisites and Seasons for Fisher in the Klawli Study Area, Mackenzie FD, B.C.

Rated Life Requisites and Seasons	Code	Months of Use
Food - Growing season Security - Growing season	FD_G SH_G	May-October
Food - Winter Security and Thermal - Winter	FD_W ST_W	November-April
Security and Thermal - Den Habitat for Reproducing by birthing	ST_RB	March-May (Natal dens) May-July (Maternal dens)

8.4.1 Food Habitat

Fishers forage in habitat that provides food and cover for their prey (Weir, 1995). Low conifer branches, CWD, abundant low and high shrub cover, rocks, and small trees offer the dense physical structure required by snowshoe hare (Livaitis *et al.,* 1985) which are selected by fishers (Buskirk and Powell, 1994; Powell, 1982; Weir, 1995). Prey availability is the most important factor determining selection of foraging habitat by fishers.

Fishers are generalist feeders, and have diverse diets dominated by snowshoe hare, porcupine, red squirrels, small mammals (particularly red-backed voles), and birds (Banci, 1989; Weir, 1995). Fisher diet and habitat use varies regionally (Douglas and Strickland, 1987), but throughout most of the fishers' range, snowshoe hares are probably the primary food source (Kuehn, 1989). Although literature indicates that fisher numbers may be largely reflective of hare abundance in many areas, Weir (1995) suggests that fisher diets in B.C. may not be as dependent on hare as those in more eastern regions. This is supported by findings of Kuehn (1989). Fishers will switch prey in response to availability (Banci, 1989), and they can thus compensate for decreases in populations of their primary prey by switching to more available prey items (Kuehn, 1989; Weir, 1995). In south central B.C., fishers also tended to use porcupine less than is documented in other study areas, and to use moose carrion rather than deer carrion (Weir, 1995).

As there is an extreme sexual dimorphism in fishers, the smaller females tend to use smaller prey items than males (Holmes and Powell, 1994; Weir, 1995).

Growing Season

There is an increased use of plant material, especially fruits and nuts, during the summer (Powell and Zielinski, 1994).

Although fishers are most often associated with relatively unfragmented, late-successional forests (Powell and Zielinski, 1994), they may be able to utilize earlier successional stages of forest for hunting in the summer (Banci, 1989).

Winter

Winter food values closely reflect security/thermal values. During times of little snow, or when a heavy crust is present, fishers are able to travel extensively and may utilize most site series for hunting.

During the winter, fishers are not limited by access to subnivean hunting or resting sites as the majority, if not all, foraging occurs above the snow (Buskirk and Powell, 1994; Raine, 1983). Stands with no coarse woody debris are avoided and in winter stands with >50 m^3/ha of CWD >20 cm in diameter not resting on the ground, are preferred (Weir, 1995).

8.4.2 Security and Thermal Habitat

Growing Season

Fishers avoid non-forested areas (Jones and Garton, 1994; Powell and Zielinski, 1994; Thomasma *et al.,* 1994; Weir, 1995) and mixed, selectively logged stands (Weir, 1995). Kelsall *et al.* (1977) found fishers to be virtually absent from recently burned or logged stands, but were observed to utilize second-growth stands more than martens. Fishers are generally believed to require closed-canopy habitats, although a portion of the canopy may be comprised of deciduous species (RIC, 1997). Fishers selected sites with >20% canopy closure in south central B.C. (Weir, 1995) and >50% in Michigan (Thomasma *et al.,* 1994); 21% to 41% of the canopy may be deciduous (Weir, 1995). Fishers selected for trees >27 cm diameter at breast height in Michigan (Thomasma *et al.,* 1994).

Resting sites can be quite diverse, including snow dens, hollow logs, holes in the ground, tree cavities, snags, and downed logs (Banci, 1989). Tree species used for resting in the Williams Lake area included aspen, cottonwood, Douglas-fir, and spruce (Weir, 1995). Spruce trees infected with spruce broom rust appear to be important rest sites during all parts of the year (Weir, 1995, 1999). Keisker (1996) suggests that CWD in early decay classes are the most important for resting and denning sites.

Winter

As with the growing season, fishers are believed to require closed-canopy habitats for security cover (see above growing season security habitat description). In the winter, thermal habitat also becomes an important life requisite. Fishers have been observed to select for spruce stands with deciduous components, and to use CWD and slash piles for security as well as thermal protection (Weir, 1995). Fishers tend to select single, large (>30 cm diameter) pieces of early decay class debris for resting during periods of extreme cold (Weir, 1995).

8.4.3 Reproduction (Natal and Maternal Den Security Habitat)

Generally, fishers may give birth as early as January but more commonly in March to April, having 1 to 4 (average of 2 to 3) kits (Banci, 1989; Powell, 1982). Breeding takes place soon after parturition, with the breeding season from late February to mid-April (Banci, 1989). Similar to other mustelids, fishers go through delayed implantation in their reproductive process (Powell, 1982). After a short gestation period (approximately 30 days; Powell, 1982), the kits are born and become independent at four to five months of age (Powell and Zielinski, 1994). Female fishers become sexually mature and can begin breeding at the age of one, but usually have their first litter when they are two years of age (Powell and Zielinski, 1994). Most information on natal dens (where parturition occurs) and maternal dens (dens where young are raised) comes from eastern North America. Fisher kits are generally moved from natal to maternal dens when they are about 8 to 10 weeks old (Powell and Zielinski, 1994). In south central B.C., Weir (1995) found females

moved their kits to different maternal den trees 4 to 6 weeks following parturition. Female fishers use 1 to 3 dens per litter, and will move dens if disturbed (Paragi, 1990, cited in Powell and Zielinski, 1994). Den requirements include thermal protection for kits and security from predators (Banci, 1989). In general, tree cavities are used almost exclusively for natal and maternal dens, and large, dead or living trees are needed to provide suitable den sites (Powell and Zielinski, 1994). Most natal dens found have been in hardwoods – most commonly aspen (Powell and Zielinski, 1994). In south central B.C., Weir (1995) found fishers whelped exclusively in large cottonwood trees (mean diameter 103 cm, n=5) that contained heart rot and branch-hole cavities. These trees were relatively rare, and were frequently found in riparian and riparian-associated habitats (Weir, 1995 and 1998). Dens were located an average of 25.9 m above the ground (Weir, 1995). Weir (pers. comm.) suggested that large diameter cottonwoods could be significant, even possibly limiting, for natal denning and whelping in the North-Central interior (Weir, 1995). Structural stage 6 and 7 forests are probably the only habitats that will consistently provide large trees with suitable den attributes, unless they are left during forest harvesting (isolated patches). In North-Central B.C. (Williston reservoir area), Weir (1998) located 8 natal dens of 6 females and 4 maternal dens of 3 fishers. He recorded fishers denning exclusively in large diameter declining black cottonwood or balsam poplar trees (Weir, 1999). Unique decay characteristics and classes, as well as large diameters supplied the suitable elements for rearing kits (Weir, 1999).

8.4.4 Seasons of Use

Table 47 summarizes the rated life requisites for fisher for each month of the year within the Klawli study area.

Table 47: Monthly Rated Life Requisites for Fisher in the Klawli study area.

Month	Season*	Rated Life Requisites
January	Winter	Food, Security and Thermal
February	Winter	Food, Security and Thermal
March	Winter	Food, Security and Thermal Reproduction - Security and Thermal (natal dens)
April	Winter	Food, Security and Thermal Reproduction - Security and Thermal (natal dens)
May	Growing	Food and Security Reproduction - Security and Thermal (natal and maternal dens)
June	Growing	Food and Security Reproduction - Security and Thermal (natal and maternal dens)
July	Growing	Food and Security
August	Growing	Food and Security
September	Growing	Food and Security
October	Growing	Food and Security
November	Winter	Food, Security and Thermal
December	Winter	Food, Security and Thermal

*Seasons defined for the Sub-Boreal Interior Ecoprovince per the Chart of Seasons by Ecoprovince (RIC, 1998; Appendix B).

8.5 Ecosystem Attributes

A number of relationships between habitat use and ecosystem attributes can be determined for fisher based on current literature/research and local biologist and trapper knowledge. Often the habitats used most frequently are associated with specific stand structure, age class, vegetation cover, etc. Table 48 lists which ecosystem attributes are considered in the habitat ratings tables.

Table 48: Terrestrial Ecosystem Mapping (TEM) Relationships for each Life Requisite for Fisher.

Life Requisite	Ecosystem Attribute

Food	Structural stages: 4, 5, 6, and 7 Structural elements: volume of CWD(>50 m^3/ha) Stand type: mixed, and coniferous forests, spruce-fir stands, some lodgepole pine use Vegetation: abundant shrub/ground cover, % cover shrubs and trees, canopy cover Site: slope, aspect
Security and Thermal	Structural stages: 4, 5, 6, and 7 Structural elements: size and volume of CWD (>20 cm dbh), CWD quality (class of decay), cavities in large trees for resting Vegetation: % cover of shrubs and trees (>20% canopy closure)
Reproduction	Structural stages: Older forested stands (stage 6 and 7) Stand type: coniferous and mixed forests Structural elements: large diameter (>100 cm dbh) cottonwood trees, or other tree spp. e.g. aspen

8.6 Development of the Habitat Ratings

Habitat ratings were developed through collection of habitat data within the study area over a two-week period, supported by personal communications with local biologists, local trappers, and species experts, and supplemented with a current literature review.

8.6.1 Rating Scheme

A 4-class rating scheme of high (H), moderate (M), low (L), and nil (N) is employed due to the intermediate level of knowledge of fisher habitat use in B.C. This rating scheme is suggested by RIC (1998) for use with fisher at the 1:20,000 map scale and is defined in Table 49.

Table 49: Habitat Capability and Suitability 4-Class Rating Scheme (from RIC, 1998).

% of Provincial Best	Rating	Code
100% - 76%	High	H
75% - 26%	Moderate	M
25% - 1%	Low	L
0%	Nil	N

This rating scheme is used when assigning habitat ratings to the ecosystem units present within the Klawli study area. The habitat ratings express the ability of the units to fulfil habitat requirements for the specific life requisites and seasons rated for the fisher, as previously outlined in Table 47.

8.6.2 Provincial Benchmark

A provincial benchmark has not yet been established for fisher. According to Weir (pers. comm.), fisher abundance in B.C. is likely highest in the SBS and BWBS zones of the North-Central lowland plateau located within the Omineca-Peace region. From 1985 to 1989, The greatest numbers of fisher have been harvested from the Cariboo and Omineca-Peace regions (B.C. Ministry of Environment, 1990).

8.6.3 Ratings Assumptions

Each combination of ecosystem unit and structural stage was individually assessed for its ability to meet the seasonal requirements for food, security, and reproduction. As fishers are generalist hunters and may use prey in relation to availability, it is relatively difficult to assess habitat in terms of food quality. Habitat assessments for food values are therefore extremely generalized. The following assumptions were made:

Life Requisite and Season	Assumptions
Food Habitat	During the growing season, most forested units within the study area have some foraging

During the Growing Season FD_G	values because fisher prey can be found in a variety of seral stages and forest types during that time. **Structural Stage** • Fishers avoid non-forested areas; therefore, structural stages 1 and 2 are given poor foraging and security/thermal values in both the winter and growing seasons. • Stage 3, 3a, and 3b units may receive some low use for hunting in summer when some overhead cover from brush and saplings is provided and mature stands are adjacent. Values can be relatively high at times – especially in dense spruce, birch, aspen, cottonwood, pine regen. • Stage 4 and 5 can also provide moderate to high values because they often provide excellent food sites for snowshoe hare (a favored prey species) as well as moderate habitat for some other small mammals. • Structural stage 6 and 7 habitats provide optimal foraging attributes, because small mammal prey populations are greater in areas with good security and thermal cover. **Structural Elements** • Fishers forage in habitat that provides food and cover for their prey, primarily snowshoe hares, squirrels, and small mammals (Weir, 1995). CWD, abundant low and high shrub cover, rocks, and small trees offer the dense physical structure required by snowshoe hare, which are selected by fishers. **Vegetation Characteristics** • Edges and ecotones between units have high foraging value, because they are usually very diverse and should have good abundance of several different prey items. **Soil Moisture and Nutrient Regime** • Riparian and riparian-associated units provide many of the attributes that support abundant small mammals populations, and receive high foraging ratings. **Elevation** • Ecosystems in the AT and ESSFmvp zones generally have nil or low food value during the growing season due to a lack of security habitat at these higher elevations. All ecosystem units in these zones are given nil values for food.

Life Requisite and Season	Assumptions
Food Habitat During the Winter FD_W	Winter food values closely reflect security/thermal values. **Structural Stage** • Same as during the growing season. • In an average winter, prey is assumed present, yet often not accessible to fishers in these younger structural stages (1 to 4) due to restrictive snow depths. Therefore, these structural stages will be rated low or nil. **Structural Elements** • As for the growing season, forest stands with greater structural diversity have higher food values due to presence of more prey and more opportunities for hunting. **Vegetation Characteristics** • Same as requirements for food in the growing season. **Soil Moisture and Nutrient Regime** • Same as requirements for food in the growing season. **Elevation** • Ecosystem units in the AT and ESSFmvp3 zones have no food value (rated nil) in the winter due to the lack of food.
Security Habitat During the Growing Season SH_G	**Structural Stage** • Fishers avoid non-forested areas, because they lack security/thermal cover. Therefore, structural stages 1 and 2 are given nil and security/thermal values in both the winter and growing seasons. • Some stage 3 units with dense overhead shrub cover can provide moderate security/thermal values during the growing season. • Stage 5 forests are generally less structurally complex and will have lower security/thermal values, and stage 4 generally have poor values. • In both the growing and winter seasons, structural stage 6 and 7 provide optimal security/thermal habitat. **Structural Elements** • Structurally complex habitats with abundant shrub layers and CWD will enhance security and thermal values for fishers and are given higher ratings. **Vegetation Characteristics** • Stands with <20% canopy closure receive low security/thermal ratings because fishers selected for sites with >20% canopy closure in south central B.C. (Weir, 1995). • Units with large spruce trees may support resting sites and are rated up to moderate. **Elevation** • Due to the lack of suitable forested habitat, all units in the AT are given nil values for security/thermal.

Life Requisite and Season	Assumptions
Security/Thermal Habitat During the Winter ST_W	**Structural Stage** • See growing season assumptions. • Structural stages 1 to 4 are rated as having minimal security habitat value in a winter of average snowfall. • In the winter, excessive snow depth may restrict fisher movements (Raine, 1983). During severe winters, mature (stage 5 and 6), closed canopy, coniferous-dominated stands are probably important habitat for travelling by fishers, providing thermal cover and relatively shallow snow depths that will not hinder fisher movement. **Structural Elements** • Stands with no CWD are avoided. In winter, stands with >50 m3/ha of CWD >20 cm in diameter, which is not resting on the ground, are preferred (Weir, 1995). **Vegetation Characteristics** • See growing season assumptions for security habitat. **Elevation** • All ecosystem units in the AT and ESSFmvp zones are given nil values for ST habitat in the winter due to deep snow depths and a lack of tree cover at these higher elevations. • Habitats at lower elevations are rated up to high in winter.
Security and Thermal Habitat for Reproduction (natal and maternal dens) ST_RB	**Structural Stage** • Structural stages 6 and 7 are the only stages that will consistently provide suitable trees for natal and maternal dens within the study area, because they are limited to structures such as large trees, CWD, and snags found in late-successional forests (Powell and Zielinski, 1994). **Structural Elements** • Stands with no CWD are avoided. **Vegetation Characteristics** • Units that supply large diameter (>100 cm dbh) cottonwood and aspen are given the highest reproducing ratings. **Soil Moisture and Nutrient Regime** • Riparian units often have a deciduous component and are rated up to high (Subhygric-rich site series rated high, mesic rich rated medium). **Elevation** • High elevation sites in the AT and ESSFmvp zones do not support large trees, which provide security/thermal habitat needed for reproducing, and are therefore given a value of nil.

8.6.4 Limitations

Fisher-prey relationships are not well known in North-Central B.C. As prey availability and abundance may be an important factor influencing fisher habitat use, continued research on fisher prey in North-Central B.C. is important to habitat ratings. Food habits, denning requirements, and habitat use should be further identified before habitat relationships can be reliably determined.

8.6.5 Rating Adjustment Considerations

Landscape fragmentation will reduce the quality of habitats. Fishers generally avoid non-forested or open areas with little overhead cover when travelling (Powell and Zielinski, 1994; Weir, 1995); and highly fragmented areas will have little connectivity between mature habitats, making travelling between units difficult.

In the aspen parklands of Alberta, fishers were found to prefer continuous forests and were rarely found in stands less than 100 ha in size (Badry *et al.,* 1997). Therefore, stand size may also be an important factor in determining habitat quality, with small patches of forest having reduced value.

Post logging practices (herbicide and pesticide treatments) can also reduce abundance of prey for fishers (Ritchie and Sullivan, 1989), also resulting in reduced habitat ratings.

8.7 References

Arthur, S. M. W. B. Krohn, and J. A. Gilbert. 1989. Habitat Use and Diet of Fishers. J. Wildlife Manage. 53:680-688.

Badry, M. J. G. Proulx, and P. M. Woodward. 1997. Home-Range and Habitat Use by Fishers Translocated to the Aspen Parkland of Alberta. pp 233-251 in G. Pruolx, H. N. Bryant, and P. M. Woodard (eds.) Martes: Taxonomy, Ecology, Techniques, and Management. Provincial Museum of Alberta, Edmonton, Alberta.

Banci, V. 1989. A Fisher Management Strategy for British Columbia. Wildlife Bulletin No. B-63. Prepared for Ministry of Environment, Wildlife Branch, Victoria, B.C.

B.C. Conservation Data Centre. 1997. Rare Vertebrate Animal Tracking List (Sorted Phylogenetically Within Each Taxonomic Group). March 10, 1997.

B.C. Ministry of Environment. 1991. B.C.'s Environment Planning for the Future. Managing Wildlife to 2001: A Discussion Paper.

B.C. Ministry of Environment, Lands and Parks. 1997. Draft. Managing Identified Wildlife Guidebook. B.C. Ministry of Environment, Lands and Parks, B.C. Ministry of Forests, Victoria, B.C.

B.C. Ministry of Environment, Lands and Parks. 1996. Vertebrate Red and Blue Lists. Wildlife Branch, Victoria, B.C.

B.C. Ministry of Environment, Lands and Parks. 1990. Management Guidelines for British Columbia: Fisher. Wildlife Branch, Victoria, B.C.

Becker, D. 1992. Upland Furbearer Problem Analysis. Prepared for Williston Wildlife Compensation Program, B.C. Environment and B.C. Hydro, Prince George, B.C.

Buck, S. G. C., Mullis, A.S., Mossman, I. Show, and C. Coolahan. 1994. Habitat Use by Fishers in Adjoining Heavily and Lightly Harvested Forest. pp 368-376 in S. W. Buskirk, A. S. Harestad, M. G. Raphael, and R. A. Powell. (eds.) Martens, Sables, and Fishers: Biology and Conservation. Comstock. Publishing Associates, Cornell University Press, Ithaca and London, Ontario.

Buskirk, S. W. and R. A. Powell. 1994. Habitat Ecology of Fishers and American Martens. pp 283-296 in S. W. Buskirk, A. S Harestad, M. G. Raphael, and R. A. Powell. (eds.) Martens, Sables, and Fishers: Biology and Conservation. Comstock Publishing Associates, Cornell University Press, Ithaca and London, Ontario.

Coulter, M. W. 1960. The Status and Distribution of Fisher in Maine. J. Mammal. 41:1-9.

Douglas, C. W. and M. A. Strickland. 1987. Fisher. pp 511-529 in M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, (eds.) Wild Fur-Bearer Management and Conservation in North America. Ontario Ministry of Natural Resources, Ontario.

Gibilisco, C.J. 1994. Distribution Dynamics of Modern Martes in North America. pp 59-71 In: Buskirk, S.W. A.S. Harestad, M.G. Raphael, R.A. Powell. (eds.). Martens, Sables, and Fishers: Biology and Conservation. Comstock Publishing Associates, Cornell University Press, Ithaca and London.

Hagmeier, E. M. 1956. Distribution of Marten and Fisher in North America. The Canadian Field Naturalist. 70(4):149-168.

Holmes, T, and R. A. Powell. 1994. Morphology, Ecology, and the Evolution of Sexual Dimorphism in North American Martes. pp 72-84 In: Buskirk, S.W. A.S. Harestad, M.G. Raphael, R.A. Powell. (eds.). Martens, Sables, and Fishers: Biology and Conservation. Comstock Publishing Associates, Cornell University Press, Ithaca and London.

Jones, J. L. and E. O. Garton. 1994. Selection of Successional Stages by Fishers in North-Central Idaho. pp 377-387 in S. W Buskirk, A. S. Harestad, M. G. Raphael, R. A. Powell. (eds.) Martens, Sables, and Fishers: Biology and Conservation. Comstock Publishing Associates, Cornell University Press, Ithaca and London, Ontario.

Keisker, D. G. 1996. Information Base on Habitat Requirements of Forest-Using Wildlife in the Sub-Boreal-Spruce Biogeoclimatic Zone. Draft. Prepared for Wildlife Branch, Ministry of Environment, Lands and Parks, Williams Lake, B.C.

Kelsall, J. P., E. S. Telfer and T. D. Wright. 1977. The Effects of Fire on the Ecology of the Boreal Forest with Particular Reference to the Canadian North: a Review and Selected Bibliography. Canadian Wildlife Service; Occasional Paper, Number 323.

Keystone Wildlife Research. 1995. Fish, Forest and Wildlife Management Plan for TFL 5. Prepared for Weldwood Canada Ltd. Quesnel, B.C.

Kuehn, D. W. 1989. Winter Foods of Fishers during a Snowshoe Hare Decline. Journal of Wildlife Management, 53:588-692.

Livaitis, J. A., J. A. Sherburne, J. A. Bissonette. 1985. Influence of Understory Characteristics on Snowshoe Hare Habitat Use and Density. Journal of Wildlife Management, 49(4): 866-873.

Martin, S.K. 1994. Feeding Ecology of American Martens and Fishers. pp: 297-315. In: Buskirk, S.W. A.S. Harestad, M.G. Raphael, R.A. Powell. (eds.). Martens, Sables, and Fishers: Biology and Conservation. Comstock Publishing Associates, Cornell University Press, Ithaca and London.

Paragi, T. F. 1990. Reproductive Biology of Female Fishers in South-central Maine. Orono, ME: University of Maine.

Penner, D. F. 1981. Fur-bearer Studies in the Liard River Valley British Columbia, 1980 Winter Survey. McCourt Management Ltd. B.C. Prepared for British Columbia Hydro and Power Authority.

Powell, R. A. 1982. The Fisher: Life History, Ecology, and Behaviour. University of Minnesota Press, Minneapolis, Minnesota. 217pp.

Powell, R.A. 1979. Fishers, Populations Models, and Trapping. Wildl. Soc. Bull. 7:149-154.

Powell, R. A. and W. J. Zielinski. 1994. Fisher. pp 38-73 in L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, L. J. Lyon and W. J. Zielinski, tech. eds. The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States. General Technical Report RM-254. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado.

Raine, R. M. 1987. Winter Food Habits and Foraging Behaviour of Fishers (*Martes pennanti*) and (*Martes americana*) in Southeastern Manitoba. Canadian Journal of Zoology, 65:745-747.

Raine, R. M. 1986. Winter Food Habits and Foraging Behaviour of Fishers (*Martes pennanti*) and Martens (*Martes americana*) in Southeastern Manitoba. Canadian Journal of Zoology. 65:745-747.

Raine, R. M. 1983. Winter Habitat Use and Responses to Snow Cover of Fisher (*Martes pennanti*) and Marten (*Martes americana*) in Southeastern Manitoba. Canadian Journal Zoology. 61:25-34.

Resources Inventory Committee. 1998. British Columbia Wildlife Habitat Rating Standards. Review Draft, April 1998. Wildlife Interpretations Subcommittee, Wildlife Branch, Ministry of Environment Lands and Parks, Victoria, B.C.

Resources Inventory Committee. 1997. Standardized Inventory Methodologies for Components of British Columbia's Biodiversity: Medium Sized Territorial Carnivores - Coyote, Red Fox, Lynx, Bobcat, Fisher, and Badger. Draft - January 1997. Wildlife Branch, Ministry of Environment, Lands and Parks, Victoria, B.C.

Ritchie C. and T. P. Sullivan. 1989. Monitoring Methodology for Assessing the impact of Forest Herbicide Use on Small Mammal Populations in British Columbia. Can. For. Ser. and B.C. Ministry of Forests, FRDA Report 081.

Ruggiero, L. F. K. B. Aubry, S. W. Buskirk, L. J. Lyon and W. J. Zielinski (eds.). 1994. The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States. General Technical Report RM-254. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado.

Slough, B. G. 1985. Report on the Status of Fur-Bearers in the Yukon Territory. Fish and Wildlife Branch, Yukon Department of Renewable Resources, Whitehorse, Yukon.

Strickland M.A. and C.W. Douglas. 1981. The Status of Fisher in North America and Its Management in Southern Ontario. pp: 1443-1458 In: J.A. Chapman and D. Pursley (eds.) Proc. Worldwide Furbearer Conf. Frostburg, Md.

Thomasma, L. E., T. D. Drummer and R. O. Peterson. 1994. Modelling Habitat Selection by Fishers. pp 316-325 in S. W Buskirk, A. S. Harestad, M. G. Raphael, R. A. Powell. (eds.) Martens, Sables, and Fishers: Biology and Conservation. Comstock Publishing Associates, Cornell University Press, Ithaca and London, Ontario.

Weir, R. D. Personal communication. October 1999. Biologist. Artemis Wildlife Consultants Ltd. Westwold, B.C.

Weir, R. D. 1999. Ecology of Fishers in the Sub-boreal Forests of North-Central British Columbia—Year III (1998-99) Progress Report: Radiotelemetry Monitoring. Artemis Wildlife Consultants Ltd. Westwold, B.C.

Weir, R. D. 1995. Diet, Spatial Organization, and Habitat Relationships of Fishers in South-Central British Columbia. Master's thesis, Simon Fraser University, Vancouver, B.C.

Weir, R. D. and A. S. Harestad. 1997. Landscape-Level Selectivity by Fishers in South-Central British Columbia. pp 252-264 in G. Proulx, H. N. Bryant, and P. M. Woodard (eds) Martes: Taxonomy, Ecology, Techniques, and Management. Provincial Museum of Alberta, Edmonton, Alberta.