

**STATUS OF THE PRAIRIE FALCON
(*Falco mexicanus*)
IN BRITISH COLUMBIA**



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EXECUTIVE SUMMARY

The Prairie Falcon (*Falco mexicanus*) is a rare raptor that occurs in the dry interior parts of southern British Columbia. Recent surveys for nesting Prairie Falcons in British Columbia found 11 active aeries. Considering the number of known active aeries, the extent of suitable habitat, and the records of Prairie Falcons in areas where aeries have not been found, it is estimated that a total of about 20 pairs occur in the province. Populations are likely at, or near, historic lows. Most of the breeding habitat in the Okanagan Valley, and lesser, but significant amounts in the Thompson and Nicola valleys have been lost, alienated or fragmented in recent decades. The Prairie Falcon requires cliffs for nesting, and open grassland and shrub steppe areas to forage in. Foraging habitat must include populations of small mammals, especially ground squirrels, and small to medium-sized birds. The loss, alienation and fragmentation of foraging habitats through urbanization, changing agricultural practices, and forest encroachment are likely the major causes of the lack of recovery of populations in recent decades. It is thought that the reduction in abundance of ground squirrels, a major prey source, through human alterations in the landscape and direct persecution is a major factor in keeping populations small. Disturbance through increasing levels of urbanization and human activities near former nesting cliffs likely have negatively affected populations as well.

Maintenance of populations at existing levels is thought to be possible if conservation measures are undertaken at known breeding localities. Conservation

actions are most critical in the Okanagan Valley, followed by the Thompson Valley, Nicola Valley, Kootenay region, and Chilcotin-Cariboo region. Recommended conservation actions include: establishment of Wildlife Habitat Areas or other reserves at all aeries where land tenure allows, purchase of land that contains active aeries and critical foraging habitat and management for Prairie Falcon habitat, liaison with landowners who have active or potential aeries on their properties with the intention of fostering better management of privately-owned lands for Prairie Falcons, continued surveys for new aeries, control of activities such as rock-climbing at nesting cliffs, excavation of cavities in silt cliffs to create additional nest sites in areas where suitable nest ledges or potholes are low in number, population augmentation through hacking of young falcons at selected sites, and continuation of the ban on taking young for falconry purposes.

It is recommended that the Prairie Falcon remain on the Red List and be designated as a provincially Endangered species. Most of the national Prairie Falcon population is in Alberta, with extremely low numbers in British Columbia, and low numbers in Saskatchewan; these populations overall appear to be declining. It is therefore suggested that the national status of Special Concern may be inappropriate, and it is recommended that the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) readdress the status as soon as possible.

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1 INTRODUCTION

This report is part of an ongoing program within the Ministry of Water, Land and Air Protection to provide status reports for species at risk in British Columbia. This report includes information from the above-mentioned sources but also from available literature on Prairie Falcons in British Columbia and elsewhere.

The Prairie Falcon (*Falco mexicanus*) is a rare diurnal raptor that inhabits the dry grassland ecosystems of southern interior British Columbia. It uses cliffs for nesting and hunts in adjacent grasslands and shrub steppes. The Prairie Falcon is one of the ultimate avian predators, and its continued presence in the landscape is an indicator of a well functioning ecosystem.

In Canada, the Prairie Falcon has been assessed to be Not at Risk by COSEWIC due to stable or expanding populations (Kirk and Banasch 1996). These authors, however, suggested there was cause for long-term concern and recommended continued monitoring. In contrast, the Prairie Falcon is considered to be at risk in British Columbia and is currently on the Red List as a candidate for Threatened or Endangered status (Fraser et al. 1999; CDC 2002). This status reflects its restricted range and habitat, very low population, and extirpation of significant portions of its population in the province.

In recent years, several studies in British Columbia have focused on the Prairie Falcon. Hooper (1997) reviewed the status of the Prairie Falcon in the Cariboo-Chilcotin. Cooper (1998) reported on an inventory of historical aeries throughout southern interior British Columbia. Hobbs (2000, 2001) reported on surveys of known and potential aeries in southern British Columbia, and assessed sites for future habitat reserves.

2 DISTRIBUTION

2.1 Global

The Prairie Falcon breeds from central British Columbia, southern Alberta and Saskatchewan, south to Baja California, Arizona, New Mexico and Texas and Northern Mexico (Figure 1). It winters throughout its breeding range as well as east to the Mississippi and south to Central Mexico (AOU 1957; Steenhof 1998).

2.2 British Columbia

The Prairie Falcon reaches the northern limit of its range in central British Columbia. It breeds locally in the Southern Interior Ecoprovince, and along the Fraser and Chilcotin rivers of the southern Central Interior Ecoprovince (Campbell et al. 1990). Small numbers may also breed in the Boundary region and in the East Kootenay Trench (Cooper 1998; Fraser et al. 1999).

After the breeding season, the population is more widely scattered, although the majority of birds appear to move southward to the USA. The occasional bird may remain in winter in some years (Campbell et al. 1990). Almost all Christmas Counts record less than one Prairie Falcon per count (Figure 2).

3 POPULATION SIZE AND TRENDS

3.1 Population Size

A minimum of about 4,300 breeding pairs was estimated for North America (Steenhof 1998). The Canadian breeding population was estimated to include over 300 breeding pairs (250 in Alberta, 50 in Saskatchewan and six in British Columbia: Kirk and Banasch 1996). Recent surveys in Alberta suggested an estimated 181 breeding pairs (Paton 2002).

The number of Prairie Falcons in British Columbia is, without doubt, quite low, but not as low as reported by Kirk and Banasch (1996). In 1996, 87 aeries reported by various sources to have been used in the past by Prairie Falcons were surveyed for evidence of use and five were found to be active: three in the MWLAP Cariboo Region, one in the Thompson Region, and one in the Okanagan Region (Cooper 1998; Cooper, unpub. map folio and appendices at MWLAP, Victoria, BC.).

Hooper (1997) estimated 12-20 breeding pairs in British Columbia, based on three active aeries in the Cariboo-Chilcotin and potential for additional pairs elsewhere. In 2000, five active aeries were found and four other sites were thought to be active in south central British Columbia (Hobbs 2000). These nine sites were among a group of sites preselected from the 87 sites reported in Cooper's (1998) appendices, and which were thought to be the most likely to be active. In 2001, 27

historically known sites and 90 new cliffs were surveyed in the Cariboo-Chilcotin region and four active aeries were found (Hobbs 2001). Two of these sites were new; therefore, a total of seven active aeries (plus four other suspected active aeries) are documented for the period 2000-2001.

Populations in the Kootenay Region are extremely low and records of nesting have not been confirmed. In 2000-2001, single Prairie Falcons have been observed several times near Wigwam Flats, sometimes carrying prey, which suggests breeding is occurring (T. Antifeau and B. Warkentin, pers. comm.). In 2000 and 2001, a pair of Prairie Falcons was observed performing a “courtship display” near the “China Wall” north of Cranbrook

(B. Turkington, pers. comm.).

In 2001, a single Prairie Falcon was observed three times in May and June at the Creston Valley Wildlife Management Area (T. Antifeau, pers. comm.). Reports of hunting birds during the nesting season in the early 1980s at Wolf Creek and the old Kimberley Airport also suggest breeding may have occurred nearby (B. Warkentin, pers. comm.). Two aeries in the Kootenay Region [reported to Cooper (1998)] that were thought to be active historically were not confirmed to be active during field surveys.

Prairie Falcons are solitary breeders although they may occur in higher densities in areas with abundant food supplies and nest sites. The densest known breeding



Figure 1. Distribution of the Prairie Falcon in North America (Steenhof 1998).

concentrations are along the Snake River in southwestern Idaho, where up to 206 breeding pairs have been found along 130 km of river valley (Steenhof et al. 1999). In the Chilcotin-Cariboo region of British Columbia, there was an estimated one pair per 6 linear kilometers of cliff face (Hooper and Cooper 1997), but this estimate was based on very scant data.

3.2 Population Trends

Historic population sizes are not well known, but it is thought that there were less than 100 pairs in British Columbia in the early 1900s. It is generally believed that numbers in British Columbia are now near all-time lows (Cooper 1998; Fraser et al. 1999). Many of the 87 reported aeries are no longer occupied (Cooper 1998; Hobbs 2000, 2001). Although Campbell et al. (1990) suggest that numbers may have been increasing from lows a few decades earlier, if such a recovery is in fact underway, it is extremely slow.

In British Columbia the Prairie Falcon population may have reached a peak in the 1920s when this species began to expand and occupy former Peregrine Falcon (*Falco peregrinus*) aeries. Peregrine Falcons were in decline at that time in southern British Columbia (Campbell et al. 1990). A similar situation occurred to some extent throughout the Prairie Falcon's entire North American range (Beebe 1974).

The numbers of Prairie Falcons in the Okanagan Valley peaked in the 1920s and 1930s when there were

at least six active aeries (Cannings et al. 1987). By the 1940s the Prairie Falcon population in the Okanagan was declining (Cannings et al. 1987) and, although data are limited, it seems likely that the same was happening across the province (Campbell et al. 1990). By the 1980s, the Okanagan Valley population appeared to be increasing (Cannings et al. 1987), perhaps in response to better wildlife management practices and positive effects from the ban on DDT use; however, this increase was not sustained through the late 1990s and the number of active aeries appeared to be reduced to just one. The population in British Columbia may now have stabilized at an historic low (Cooper 1998; Hobbs 2001). In the rest of Canada, populations were thought to be increasing or stable up to the mid 1990s (Kirk and Banasch 1996). Paton (2002), however, suggests recent population trends are downward in Alberta.

In general, population trends are difficult to determine because densities are too low for breeding bird survey results to yield significant data. In the USA, Christmas bird count data indicate that wintering populations are stable (Platt and Enderson 1989). Nest area surveys are considered the only effective monitoring technique, but are expensive and labour intensive (see Hobbs 2000, 2001), and therefore have not been done on a large scale across the species' range. One well studied breeding population, in the Snake River of southwestern Idaho, however, is known to have declined significantly from 1976-1997 (Steenhof et al. 1999). In Alberta and Saskatchewan, declines of 34% occurred between 1958

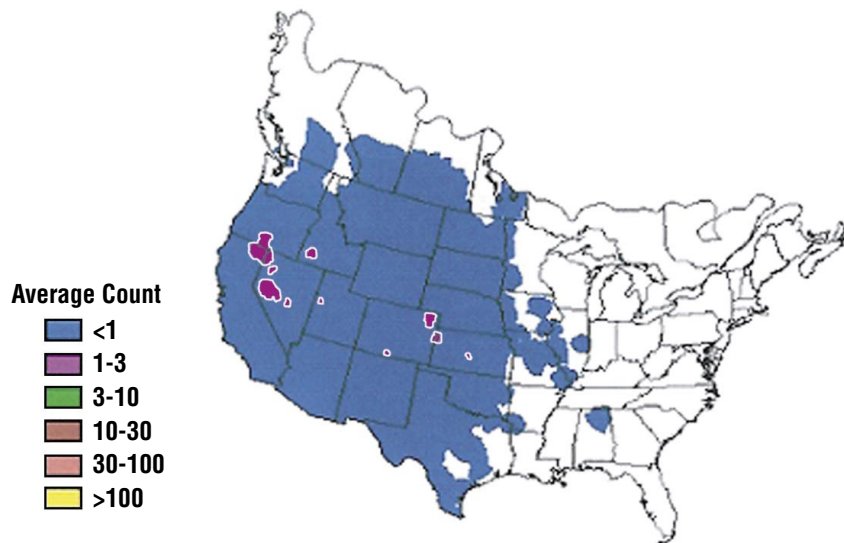


Figure 2. Winter distribution of the Prairie Falcon in North America based on Christmas Bird Count data (USGS 2002).

and 1968 (Fyfe et al. 1969). Along the Bow River of Alberta, the number of active aeries declined from 18 in 1974 to 13 in 1989 (Hunt 1993). Declines in other Alberta drainages have also been noted (Paton 2002).

4 GENERAL BIOLOGY

4.1 Reproductive Capability

In the spring, Prairie Falcons return to their breeding grounds and pairs are typically reunited although, in areas with high densities, mate switching has been documented (Beebe 1974). Following a courting period involving aerial displays by the male, nesting may begin as early as the end of March. However, late April is more common in British Columbia (Beebe 1974; Campbell et al. 1990). Three clutches from British Columbia had 3 or 4 eggs (Campbell et al. 1990). Elsewhere, clutches of 3-6 eggs have been recorded, with 4-5 being most common (Baicich and Harrison 1997).

The female performs most of the incubation of eggs, while the male feeds her, although the male may occasionally relieve her while she hunts (Beebe 1974; Call 1978). Incubation begins with the first egg laid and lasts from 29-33 days (Campbell et al. 1990; Baicich and Harrison 1997). Nestlings leave the nest after about 40 days. Young are fed by adults and may remain in the vicinity of the nest site for a variable amount of time after fledging (Beebe 1974; Cannings et al. 1987).

Prairie Falcons typically begin breeding at two years of age although there are records of breeding in one year-old birds. One brood is raised annually (Steenhof 1998). In 2000, there were four known successful nests in British Columbia and each fledged two young (Hobbs 2000).

4.2 Species Movement

There are no data for Prairie Falcon home range sizes in British Columbia. Home ranges elsewhere in North America have ranged from 59 to 315 km² (Steenhof 1998), with an estimate of 72 km² in southern Alberta (Hunt 1993). It is thought home ranges in British Columbia would be larger rather than smaller, as limiting resources, especially food, are likely much scarcer at the northern edge of a species range.

Migration is not well defined with some birds remaining in breeding areas year round; however, Prairie Falcons appear to leave areas with low food supply in the winter (Campbell et al. 1990). Young birds may also wander more extensively than mature adults (Beebe 1974).

There may be seasonal altitudinal movement, with falcons moving to higher altitudes in the late summer, post-fledging period, where prey may be more accessible relative to their breeding areas (Beebe 1974). Compared to other seasons, there are relatively numerous records in British Columbia of Prairie Falcons in alpine areas during August and September (Campbell et al. 1990; Cooper 1991). Any southward movements to wintering areas in the USA are expected to occur west of the Rocky Mountains (Schmutz et al. 1991).

4.3 Behaviour/Adaptability

The Prairie Falcon has been described as “hardy” because it inhabits a harsh landscape, it suffers less from the effects of the pesticide era than the Peregrine Falcon, and it persists in other jurisdictions in the face of human encroachment into its habitat (Steenhof 1998). It is known to have a more specialized diet than other raptors it coexists with, but breeding densities can be quite high in good habitat (Steenhof 1998). The availability of cliffs suitable for nesting and the availability of prey greatly influence presence and breeding success.

4.4 Site Fidelity

The Prairie Falcon demonstrates a high degree of site fidelity at breeding areas and is often known to reuse the same site for several successive seasons and, possibly, for several generations (Lehman et al. 2000). If nest sites are abundant, it often uses different scrapes in consecutive years (Call 1978; Steenhof 1998). In one study of a Prairie Falcon population in Idaho, the adult males sometimes moved to alternate aeries averaging 1.5 km from previously used aeries (Lehman et al. 2000).

In British Columbia, the Prairie Falcon tends to use the same aerie year after year, perhaps because nest sites are limited. Some aeries in the Chilcotin and Okanagan have probably been used annually for many decades.

4.5 Tolerance to Human Disturbance

The effects of human encroachment have been the focus of several studies on the Prairie Falcon (in Steenhof 1998). Successful nests have been found within 250 m of houses and aggressive defence of nest cliffs towards humans subsides as levels of human activity increase (Steenhof 1998). Other studies have shown that blasting and construction activities greater than 550 m from nests have no effect, and that the Prairie Falcon habituates to low-flying military aircraft and sonic booms (Harmata et al. 1978 cited in Steenhof 1998). This suggests that a moderate degree of tolerance to disturbance is possible. The effects of disturbance depend on the nature, timing and duration of the disturbance, its proximity to nests, and the remoteness of nests. More intense activities close to nests, however, can affect behaviour and reproductive success. Short but intense noise near nests can flush incubating birds, and abandonment of nests can occur if disturbances are severe and of longer duration. Visits to nests by researchers rarely cause abandonment, even when young are banded (Steenhof 1998). Although temporary trapping of nesting adults for banding purposes rarely causes abandonment, it does tend to occur more often when adults are trapped at the nest rather than away from the nest (Steenhof 1998).

Although the Prairie Falcon may show considerable tolerance to indirect disturbance by humans (Steenhof 1998), it is not immune to direct persecution. Clearly in British Columbia, the population was adversely affected early in the 20th century by bounty hunting, capturing of nestlings for falconry, and egg collecting (Cannings et al. 1987; Campbell et al. 1990). S.J. Darcus, one of the early skin and egg collectors in the Okanagan, wrote in a 1966 letter to R.W. Nelson, (a young biologist at the time with an interest in falcons), “*Some of the eyries after the middle thirties brought out no young as the birds were always shot. The Game Board had a man employed to exterminate these birds*” (from Cannings et al. 1987). Cannings et al. (1987) also report that the birds at the Cosens Bay aerie were shot in 1956. Capture of nestlings for falconry and collection of eggs by egg collectors was also not regulated in the early 1900s.

4.6 Food

The Prairie Falcon preys mainly on ground squirrels

(*Spermophilus* spp.) during the breeding season (Steenhof 1998; Paton 2002). In British Columbia, it also preys on small to medium-sized birds, including Mourning Doves (*Zenaida macroura*), Horned Larks (*Eremophila alpestris*), Western Meadowlarks (*Sturnella neglecta*), and Vesper Sparrows (*Pooecetes gramineus*) and small mammals such as Yellow-pine Chipmunks (*Tamias amoenus*), and occasional larger mammals such as young Yellow-bellied Marmots (*Marmota flaviventris*: Cannings et al. 1987; Hunt 1993; Hooper and Cooper 1997). One wintering female in Edmonton took 27 Rock Doves (*Columba livia*) in the vicinity of a granary (Dekker and Lange 2001). Prairie Falcons also take small reptiles and insects, especially grasshoppers, although these likely constitute a smaller percentage of their total diet. Prey is typically caught on the ground, with the falcon using its considerable speed to surprise and subdue its prey (Beebe 1974).

4.7 Response to Sudden Environmental Change

Like other raptors, Prairie Falcons are susceptible to the effects of bio-accumulated organochlorines within their prey. After the use of DDT became common in the mid 20th century, eggshell thinning occurred in this species. The eggshells of unsuccessful pairs were found to be thinner than those of successful pairs (Steenhof 1998), (overall reduction in thickness of shells has been less than 20%). Eggshell thinning has been estimated to have affected less than 20% of eggs laid, which is the level usually associated with declining populations (Anderson and Hickey 1972 cited in Steenhof 1998). Therefore, the Prairie Falcon suffered less from the effects of eggshell thinning than species such as Peregrine Falcon, Osprey (*Pandion haliaetus*), and Bald Eagle (*Haliaeetus leucocephalus*). This is likely related to the Prairie Falcon's preference for herbivorous ground squirrels as prey, rather than birds or fish from higher levels in the food chain.

4.8 Causes of Mortality

Historically, death by shooting was the most commonly reported cause of mortality for Prairie Falcons. It is unlikely that many falcons have been shot in recent decades, as killing of raptors has become unlawful and

public appreciation for the ecological role of raptors has improved markedly. Electrocutation on power lines is relatively uncommon. Death due to collision with wires, fencing and vehicles occurs occasionally. Peregrine Falcons and Great Horned Owls (*Bubo virginianus*) are known to kill adult Prairie Falcons. Other causes of adult mortality include disease, intraspecific aggression, starvation, and drowning.

Nestlings are susceptible to disease, parasite infestations (e.g., ticks, bugs, and flies), pesticide poisoning, starvation, predation, falls from nests. Possible predators include coyotes (*Canis latrans*) and bobcats (*Lynx rufus*), which can sometimes reach aeries, and other raptors such as Peregrine Falcons, Golden Eagles (*Aquila chrysaetos*), and Great Horned Owls. Mammalian predators may also take falcon eggs (Steenhof 1998).

4.9 Protection of Areas of Concentration

There are no significant areas of concentration in British Columbia, but several aeries are within protected areas. Of 14 aeries selected for examination by Hobbs (2000), nine were on Crown Land, two were in provincial parks, two were on private land, and one was on an Indian Reserve. One of the two new aeries found in 2001 was

on Crown Land, the other in a provincial park (Hobbs 2001).

Under the *Forest Practices Code Act of British Columbia*, Wildlife Habitat Areas (WHAs) were established at three sites along the Chilcotin River in 2002, with a fourth to be established in the near future. The average size of these protected areas is 314 ha (J. Hobbs, pers. comm.). This Act was replaced by the *Forest and Range Practices Act and Regulations* in 2003.

5 HABITAT

The Prairie Falcon breeds in dry, open habitats where cliffs provide nest sites, and grasslands and shrub steppes provide foraging habitat (Figure 3 and 5). Nonbreeding habitat is more widespread as falcons use other open areas at higher elevations, such as alpine meadows and peaks.

5.1 Nesting Habitat

Aeries are typically located in cliff faces, usually on a shelf, within a small cave or in a pothole in the cliff face (Baicich and Harrison 1997; Steenhof 1998; Paton 2002). All known aeries in British Columbia are on cliffs,



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Figure 3. Typical Prairie Falcon nesting and foraging habitat in the Okanagan Valley.

although elsewhere the Prairie Falcon very occasionally nests in stick nests made by other species in trees, on power line structures, or on buildings. Cliff types include basalt rimrock, glacial till “hoodoos” (Figure 4), granite faces, sandstone, and limestone (Campbell et al. 1990; Hooper 1997; Cooper 1998; Hobbs 2000, 2001).

An overhang over the nest seems to be preferred, presumably to protect the nest from sun (Beebe 1974), or rain and hail. Nest height from cliff bases in British Columbia ranges from 15-138 m (Campbell et al. 1990). Nests almost always consist of a simple shallow scrape (Call 1978; Baicich and Harrison 1997; Steenhof 1998), and are usually near (0-6 km) open country.

5.2 Foraging Habitat

During the breeding season, the Prairie Falcon hunts over grassland and sagebrush steppe habitat near the aerie. Prairie Falcons require ample accessible prey near the nest site. Open areas with relatively low-density, patchy vegetation provide habitat for the small mammals and birds that the Prairie Falcon preys upon, as well as opportunities for falcons to access their prey. Native grasslands are likely better foraging habitats than grasslands invaded by exotic species, since these invaded grasslands suffer greater fluctuations in biomass, and subsequently greater fluctuations in densities of grasslands-dependent prey species (Yensen et al. 1992). Foraging habitats must support sizeable populations of prey (i.e., ground squirrels and grassland birds) in order for successful falcon reproduction to occur (Paton 2002).

5.3 Migration

Habitat requirements during migration are probably similar to the breeding season, although smaller open habitats and habitats away from cliffs are used. In British Columbia, alpine areas also appear to be used during the fall migration (Campbell et al. 1990; Cooper 1991).

5.4 Wintering

Open country with a sufficient prey base is required for populations wintering in British Columbia. Very small numbers of wintering Prairie Falcons occur regularly near Kamloops and in the Okanagan Valley (Campbell et al. 1990). Occasional birds also winter in the Fraser

River Delta area (e.g., Elliott and Gardner 1997), where many other species of raptors congregate and there are high concentration of over wintering shorebird as well as other potential prey species.

5.5 Distribution of Habitat

5.5.1 Biogeoclimatic Zones (BGZ)

In British Columbia, the Prairie Falcon breeds in five BGZs and regularly occurs in seven BGZs during non-breeding seasons (Table 1).

5.5.2 Ecoregions

In British Columbia, the Prairie Falcon is currently confirmed to breed in 10 ecosections in two ecoregions and winters in 12 ecosections in three ecoregions (Table 2).

5.5.3 Forest Regions and Districts

The Prairie Falcon occurs in the Southern Interior Forest Region during the breeding and nonbreeding seasons. Forest Districts include: 100 Mile House, Arrow Boundary, Cascades, Central Cariboo, Chilcotin, Kamloops, Kootenay Lake, Okanagan Shuswap, and Rocky Mountains.

5.5.4 Broad Ecosystem Units

In British Columbia, eight Broad Habitat Classes (AB, BS, CF, CL, CR, ME, SM, SS) are used as habitat during the breeding season and 14 (AB, AG, AH, AM, AS, AV, BS, CF, CR, ES, ME, SM, SS, SU) are used during nonbreeding seasons (see Appendix 2).

5.6 Present Habitat Availability

The amount of suitable habitat in British Columbia is small relative to the provincial land base, although no detailed analysis of available habitat has been conducted. Many historically used aeries are unoccupied, and many other cliffs appear suitable as nest sites (Cooper 1998; Hobbs 2000, 2001); therefore, cliff nesting habitat does not appear to be in short supply. Continuing urbanization and changing land use practices, especially in



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Figure 4. Silt cliffs (hoodoos) are often used for nesting in the Cariboo-Chilcotin region of British Columbia.



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Figure 5. Smaller cliffs near good foraging habitat may also be used for nesting by Prairie Falcons in British Columbia.

Table 1. Biogeoclimatic subzones used by the Prairie Falcon during breeding and nonbreeding seasons.

BGZ	Subzone*	Breeding	Nonbreeding
Bunchgrass	BGxh	Yes	Yes
	BGxw	Yes	Yes
Ponderosa Pine	PPxh	Yes	Yes
	PPdh	Yes	Yes
Interior Douglas-fir	IDFxh	Yes	Yes
	IDFxw	Yes	Yes
	IDFxm	Yes	Yes
	IDFdm	Yes	Yes
	IDFdk	Yes	Yes
	IDFmw	Yes	Yes
Interior Cedar Hemlock	ICHxw	No	Yes
	ICHdw	No	Yes
	ICHmw	No	Yes
	ICHmm	No	Yes
Sub-Boreal Pine Spruce	SBPSxc	Yes	Yes
Engleman Spruce Sub-alpine Fir		Yes	Yes
Alpine Tundra		No	Yes

*See Appendix 1 for explanations of BGZ Subzone acronyms.

the Okanagan, Thompson, Kootenay and Nicola valleys suggest that significant effects on foraging habitat have occurred.

5.7 Trends in Habitat

Habitat suitability for Prairie Falcons has obviously declined in British Columbia. This trend is most apparent in the Okanagan Valley and, to a lesser extent, in the Thompson and Nicola valleys. Cannings et al. (1987) discuss the devastating effects on the bird communities of the Okanagan Valley caused by the encroachment of settlements on bird habitat, the effects of agriculture, the changes in agriculture practices, the draining of wetlands, and the increased human use of scarce land and water resources. The Okanagan Valley historically was the centre of the provincial distribution of the Prairie Falcon, and that population has now declined to one known pair. Cliffs remain, but human developments have encroached to the base of some of those cliffs. More importantly, grassland and shrub steppe foraging habitats have been converted to residential,

commercial and industrial developments (Figure 6), pastures, orchards, and, more recently, vineyards. Low elevation grasslands cover about one quarter of the South Okanagan landscape, but 81% of the agricultural and urban developments have taken place there (MWLAP 2003). These developments have altered more than 60% of the grasslands and shrub habitats of this zone, and only 9% are in a relatively undisturbed state (MWLAP 2003). Ground squirrels, the main prey of Prairie Falcons, have been directly persecuted by land owners here, as in other regions, reducing available food sources.

The Thompson Valley has experienced a similar decline of foraging habitat from the effects of increased urbanization, although the rate of change has lagged behind that of the Okanagan. Prairie Falcon population declines in several USA states and in Alberta have been linked with land use changes, especially with the increasing conversion of grassland habitat to agriculture, which results in lower prey abundance (Kirk and Banasch 1996; Steenhof 1998).

It is believed that the loss of grasslands through successional infilling by forests due to fire

Table 2. Ecoregions and ecosections used by the Prairie Falcon during breeding and nonbreeding seasons.

Ecoregions	Ecosections	Breeding	Nonbreeding
Southern Interior	Okanagan Ranges	Yes	Yes
	Northern Thompson Upland	Yes	Yes
	Southern Okanagan Basin	Yes	Yes
	Southern Okanagan Highland	Yes	Yes
	Southern Thompson Upland	Yes	Yes
	Thompson Basin	Yes	Yes
Central Interior	Cariboo Basin	Yes	Yes
	Cariboo Plateau	Yes	Yes
	Chilcotin Plateau	Yes	Yes
	Fraser Basin	Yes	Yes
Southern Interior	East Kootenay Trench	Yes*	Yes
Mountains	MCR	No	Yes
	Southern Columbia Mountains	No	Yes

*historical and indirect evidence only.

suppression is a serious issue for Prairie Falcons, as most of their foraging takes place in these grassland habitats. In the Cariboo-Chilcotin region, grassland habitats are declining through forest infilling at a rate of 30% over 30 years (Hooper and Pitt 1995). In the IDF and PP biogeoclimatic zones in the East Kootenay Trench, grassland habitats are declining by about 3000 ha annually (Gayton 1997).

6 LEGAL PROTECTION

Section 34 of the *Wildlife Act* of British Columbia protects Prairie Falcons, their eggs, nestlings, and nests when the nests are occupied. A “nest” is defined as a structure, or part of a structure, prepared by or used by a bird species to hold its eggs or offspring. A nest is considered occupied from the time it is under construction to when fledglings leave the nest.

Persecution (shooting, trapping, poisoning, egg-collecting or any other measure of killing) of Prairie Falcons in British Columbia is illegal under Section 34 of the *Wildlife Act*, though allowances can be made when domestic animals are being defended. Current penalties for conviction for offences under Section 34 include a fine of up to \$50,000 and six months in jail for a first offence.

The harvesting of Prairie Falcons for falconry purposes has been closed for several decades. Under the *Wildlife Harvest Strategy – Improving BCs Wildlife Harvest Regulations* (MoELP 1996), Red-listed species are not harvested.

Under the *Forest and Range Practices Act* (FRPA), the Prairie Falcon is an Identified Wildlife and is subject to special provisions for conservation of habitat in the form of Wildlife Habitat Areas (WHAs). The Ministry of Water, Land and Air Protection can establish these areas on Crown Lands and prescribe boundaries and limitations on human use.

7 LIMITING FACTORS

7.1 Nesting Habitat Availability

In British Columbia, there is a finite supply of nest habitat (cliffs) but the number of cliffs that seem to be suitable for nesting are numerous. About 12% of the historically reported aeries (Cooper 1998) have been recently occupied, and many other cliffs seem to have some potential. Although many cliffs may not be suitable because of the proximity to and level of human disturbance and the encroachment of settlements, nesting habitat is not likely a significant limiting factor in British Columbia.

7.2 Foraging Habitat Availability

No species can survive without adequate food supplies. It seems apparent that the lack and decline of foraging habitat and its associated prey base significantly limit populations of the Prairie Falcon in some areas of British Columbia. In the Okanagan, Prairie Falcon populations were substantially reduced in the early 20th century by shooting, egg collecting, and the decline in habitat suitability as grasslands were converted to orchards and farms. It would seem logical to expect the Okanagan population to have recovered, at least partially, in recent decades, since shooting and collecting have largely been eliminated. The Okanagan population, however, has not recovered during this time. The severe loss of critical grassland and shrub steppe foraging habitat supporting a sufficient prey base is the most plausible explanation for the lack of recovery. This loss is combined with an ever increasing amount of human activity and subsequent potential disturbance at nest sites in the valley. Foraging habitat loss through conversion to vineyards

and other developments has occurred from the 1980s to the present, and seriously threatens the last active aerie in the south Okanagan, and any potential for recovery of this species.

In the Thompson and Nicola valleys, foraging habitat has declined over recent decades, but to a lesser extent than in the Okanagan. Even so, active aeries are reduced to only a few. Increasing human use at some sites may preclude use by Prairie Falcons. An additional source of habitat loss is encroachment of forest into grasslands caused by intensive fire suppression. In the Cariboo-Chilcotin and Kootenay, much less habitat has been lost proportionally to urbanization and agriculture but fire suppression has led to significant reductions of grassland habitats. This trend does not bode well for Prairie Falcons.

The loss, alienation and fragmentation of foraging habitat are likely the most important causes for the lack of recovery, after severe declines in the early to mid-1900s, of the Prairie Falcon in most of its range in British Columbia.



Figure 6. Land development near suitable nesting cliffs removes foraging habitat for nesting Prairie Falcons.

7.3 Agriculture

Most of the natural grassland habitat in the Okanagan Valley has been converted to agricultural in one form or another, although some types of agriculture are less negative for the Prairie Falcon than others. Pastures and grazed lands usually support at least some small mammals and birds that can be preyed upon by the Prairie Falcon. Fields cultivated for vegetables or hay provide inadequate foraging habitat during the breeding season. Orchards, once common uses of valley bottoms and benchlands in the Okanagan, are of limited value to breeding Prairie Falcons. Many orchards are now being converted to urban areas, or to vineyards. Vineyards provide even less habitat for prey species than orchards, and urban areas are of little use during any season. An increasing amount of land suitable for falcon foraging habitat is being converted into vineyards. The last known pair of south Okanagan Valley Prairie Falcons has recently (1999) had foraging habitat near their aerie significantly reduced by the conversion to a vineyard of a large portion of the remaining shrub steppe landscape.

In the Thompson and Nicola valleys, many grassland habitats have been converted into hayfields, pastures, or ginseng operations. More intensive agricultural practices such as converting pastures into ginseng farms alienate foraging habitat for Prairie Falcons. If the trend towards more intensive agricultural practices continues, recovery of the regional population of Prairie Falcon will be much less likely.

In the Kootenays, agriculture has taken up some foraging habitat but most activities are associated with livestock grazing. Infilling of some open areas with hobby farms may be incrementally reducing suitable falcon foraging habitat.

Effects of agriculture are probably least significant in the Cariboo-Chilcotin as human populations are low and agricultural activity is mainly related to beef production (grazing and hay production). Grazed areas seem to provide suitable foraging habitat, but irrigated hay fields are likely less useful to the Prairie Falcon. Although falcon densities are lower in the Cariboo-Chilcotin than they were historically in the Okanagan, because the impact of human population growth in the region is expected to be minimal, the Cariboo-Chilcotin region may prove to be the last stronghold for the Prairie Falcon in British Columbia.

7.4 Pesticide Poisoning

Some scientists believe the main factor for the disappearance of Prairie Falcons in areas of the Okanagan is contamination from organochlorine pesticides (R.W. Nelson in Cannings et al. 1987). These pesticides were commonly used after the late 1940s, at about the time declines were underway (Cannings et al. 1987). However this species was generally not as negatively affected as Peregrine Falcons were (Steenhof 1998). Even so, it seems possible that pesticide contamination may have been a factor in the relatively small and intensively farmed area of the Okanagan Valley. Organochlorine pesticide residues continue to persist in the Okanagan (Elliott et al. 1994) and may affect recovery of populations there.

7.5 Silviculture

Concerns have been raised about the effects of silvicultural practices as possible threats to the Prairie Falcon (Hooper 1997; Hobbs 2001). These threats are mainly related to timing of cutting, nearness of cutblocks to nesting cliffs, disturbance, and removal of trees used for perching by adults and fledglings. Hooper (1997) noted that though logging took place on a slope directly below an active Chilcotin aerie in 1995, young were seen being fed later when logging had ceased. This aerie remained active in 1996 (Cooper 1998), and in 2000 and 2001 (Hobbs 2000, 2001); therefore, there did not appear to be long term effects.

Silvicultural activities are not likely a significant limiting factor in British Columbia, unless overt disturbance occurs near aeries during the courtship, egg-laying and incubation periods.

7.6 Disturbance

Overt disturbance at aeries is likely less of a problem today than in past decades when falcons were “controlled” by government and ranchers because they were viewed as livestock predators. Public awareness and appreciation for wildlife continues to grow and most people would not knowingly harm nesting Prairie Falcons. However, the effects of increasing amounts of indirect disturbance are worrisome as aeries may become unsuitable if the disturbance becomes too great. This may have happened

already at numerous aeries in the Okanagan. Although there are records of successful aeries in other jurisdictions at locations where nearby human activities are noisy and numerous, it is more likely that increased disturbance from human recreational activities such as rock climbing could add sufficient negative effects as to render a breeding territory unsuitable. Unlike for Peregrine Falcons (Cooper and Beauchesne, in press), there are no reports of Prairie Falcon aeries that are threatened by recreational use of cliffs.

7.7 Grazing

Livestock graze throughout the range of the Prairie Falcon but effects are not known (Steenhof 1998). It seems reasonable to conclude that if grazing negatively affects prey densities or availability, then negative effects to Prairie Falcons would occur. Persecution of ground squirrels on rangelands also likely occurred to some extent in the past.

7.8 Urban Development

In British Columbia, urban development along valley bottoms, and benchlands above the valley bottom, has removed enormous proportions of foraging habitat from use by the Prairie Falcon. This trend is expected to continue in the Okanagan Valley, Thompson Valley, East Kootenay Trench, near Creston and, to a lesser extent, the Nicola Valley. Urban development has encroached up to the bases of some former nesting cliffs in the Okanagan, rendering the sites unsuitable. Urbanization of habitat around existing and potential aeries and foraging areas is an important limiting factor in British Columbia.

7.9 Winter Habitat

Very few Prairie Falcons winter in British Columbia. Contrary to the negative effect of large-scale agriculture on breeding habitat, farms provide beneficial habitat for wintering bird prey species (Steenhof 1998). Avian prey is vital to Prairie Falcons in winter as ground squirrels and other mammalian prey are not available. As there are large amounts of open wintering habitats in the western USA, and most British Columbia birds migrate to the USA, it is unlikely that the status of the Prairie Falcon is

Table 3. Status of the Prairie Falcon in various jurisdictions.

Jurisdiction	Natural Heritage Rank	Status
Canada		Not at Risk
British Columbia	S2B SZN	Red List
Alberta	S3B	Sensitive
Saskatchewan	S4B S2N	
USA		Not at Risk
Washington	S3B S3N	

much affected by factors associated with winter habitat in British Columbia.

8 SPECIAL SIGNIFICANCE OF THE SPECIES

8.1 Status

The Prairie Falcon is on the provincial Red List (CDC 2002), mainly because the number of known breeding pairs in British Columbia is very small, populations appear to be at historic lows, and there are increasing threats to habitat through urbanization and changing agricultural practices (Cooper 1998; Fraser et. al. 1999; Table 3). In Alberta, it is ranked as Sensitive because of long- and short-term declines and the need for special management (Paton 2002). In Saskatchewan, where there are less than 50 breeding pairs, its ranking of S4B (i.e., widespread, abundant and demonstrably secure) (Kirk and Banasch 1996) does not seem to correlate with its rarity.

Nationally, it is considered to be Not At Risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Kirk and Banasch 1996) because of a lack of evidence of overall decline. COSEWIC acknowledges there are management concerns related to lack of data on productivity, possible effects of harvesting for falconry purposes, and its status as a peripheral species (Kirk and Banasch 1996). Because of these and other concerns, it is recommended that the national status be reassessed, and that the Prairie Falcon be listed as Threatened in Canada.

Across most of its range in the United States, the

Prairie Falcon is not considered to be of management concern.

8.2 Degree of Public Interest

The Prairie Falcon is generally not well known amongst the public. Some bird watchers, wildlife biologists and landowners are aware of the Prairie Falcon's ecological role, its status as a rare species, and the reasons for its long term population decline. Birders in particular hold this falcon in high esteem and many birders attempt to observe it every year. Some of these enthusiasts travel great distances annually from the coast and elsewhere to look for the Prairie Falcon and other rare grassland birds. Several landowners contacted by Hooper (1997), Cooper (1998) and Hobbs (2000, 2001) have shown great interest in the stewardship of this falcon. Their increased awareness provides some potential for future public involvement with the recovery of British Columbia populations.

8.3 Related Species

The Prairie Falcon is a member of the *Falconidae*, along with caracaras, forest falcons and other true falcons (Sibley 2001). In British Columbia, this family is represented by five species of true falcons (genus *Falco*) including: American Kestrel (*Falco sparverius*), Merlin (*Falco columbarius*), Peregrine Falcon (*Falco peregrinus*), Gyrfalcon (*Falco rusticolus*), and Prairie Falcon (Campbell et al. 1990). There are no recognized subspecies of Prairie Falcon (AOU 1957; Cannings 1998).

9 MANAGEMENT RECOMMENDATIONS

The following management options are listed in order of priority.

9.1 Wildlife Habitat Areas, Wildlife Habitat Features and Other Reserves

Under the *Forest and Range Practices Act* (FRPA) (MOF and MWLAP 2004), Wildlife Habitat Areas (WHAs) and Wildlife Habitat Features (WHFs) can be established on Crown land to conserve habitat of Identified Wildlife (MWLAP 2004). WHFs would protect the nest site only, while WHAs are large enough to also protect

the surrounding foraging habitat. As of 2002, several WHAs have been established for this species (J. Hobbs, pers. comm.). Where land tenure allows, all known active Prairie Falcon aeries should have WHAs or WHFs established around them. WHAs or WHFs should also be established around a selection of historically used aeries, especially those with the highest likelihood of re-occupancy. WHAs and WHFs should be established in all Wildlife Regions where the Prairie Falcon is known to breed.

Restrictions on human use of the WHAs or WHFs should be established as appropriate within limitations of the *Forest and Range Practices Act*. Some of these restrictions could include seasonal closures on rock climbing (see below), camping, off-road vehicle use, livestock herding, road building, and blasting.

Other reserves such as Ecological Reserves or provincial parks set up to conserve grassland habitat should be considered.

9.2 Species At Risk Act

The federal *Species At Risk Act* (SARA) provides for management of species designated as nationally Threatened or Endangered. Provisions of this Act will not be useful for conservation of Prairie Falcons because of its national Not At Risk status. However, it would be useful to follow SARA/RENEW recovery planning protocols for Red-listed wildlife in British Columbia.

9.3 Wildlife Act

The Prairie Falcon should be officially designated as an Endangered species in British Columbia under the provincial *Wildlife Act*. Given the low population and continued threats to its habitat, there is no doubt that it warrants inclusion. Designation as Endangered under the *Wildlife Act* enables the creation of Critical Wildlife Management Areas by the minister, and increases fines for offenses related to listed species.

9.4 Public Stewardship

The best stewards of rare wildlife may be the landowners upon whose land the species depend. Many landowners wish to conserve special resource values on their land. Landowners that control nesting cliffs or foraging habitat

should be approached and informed about the importance of their land for Prairie Falcons. Landowners' concerns should be heard, and if they show an inclination to support conservation efforts, they should be encouraged to manage their operations to reduce effects on breeding Prairie Falcons. This could include entering into stewardship covenants, and being made aware of the potential for restrictive land covenants to protect valuable habitat in the future (Stewardship Centre 2003). This type of program requires a very reasoned implementation involving highly skilled personnel.

9.5 Land Acquisition

In locations where WHAs, other protected areas, stewardship agreements and additional initiatives prove to be ineffective at conserving habitat for Prairie Falcons, opportunities to protect privately-owned land (the nesting cliff and approaches to it) where active aeries exist. This should also include the purchase and protection of any good foraging grassland or shrub steppe habitat in the nearby vicinity that is identified as critical by professional biologists. Non-governmental organizations (NGOs) should be encouraged to become partners in purchasing and managing such lands.

9.6 Forest Encroachment

Grassland habitat is declining at an alarming rate through urbanization, conversion to agriculture and encroachment through forest succession. Prescribed fire, mowing, or other deforestation techniques could be used as management tools to reduce forest ingrowth and increase amounts of open foraging habitat in the vicinity of active aeries, wherever land tenure would allow.

9.7 Nest Surveys

Surveying for new, unknown aeries is recommended so that the size of the provincial Prairie Falcon population and the extent of its range may be more accurately estimated. These surveys should concentrate in the Cariboo-Chilcotin region along the Chilcotin River and Fraser River, in remote side drainages of the Thompson River between Lytton and Chase, along the Nicola River, along the Columbia River in the East Kootenay Trench between Canal Flats and Golden, and near the Wigwam Flats.

Regular, periodic monitoring of known and historical aeries should continue. It seems ironic that there are national surveys for Peregrine Falcons every five years, but there are fewer Prairie Falcons in Canada than Peregrines. All known active aeries in the Okanagan and Thompson valleys should be monitored annually. Survey methodology should include methods described in Hobbs (2001), such as the use of Prairie Falcon call playbacks to elicit responses from nesting birds.

9.8 Public Education

More information is needed on the occurrence and nesting of Prairie Falcons in British Columbia. The public should be encouraged to report sightings of birds or nests to MWLAP. Requests for information could be put out in the form of newspaper articles, posters displayed in certain forums, or signs erected at likely locations.

9.9 Population Augmentation

The Prairie Falcon population in British Columbia may be too low for natural re-occupancy of abandoned aeries to occur in the near future. Re-establishment of breeding pairs of Peregrine Falcons has been successfully implemented in many areas of North America, and a similar approach could be taken with Prairie Falcons. Hacking of young Prairie Falcons has been attempted in Alberta and California (Steenhof 1998). Hacking of young seems most feasible in the Thompson-Nicola, East Kootenay Trench and Cariboo-Chilcotin regions, where habitat seems more suitable than in the Okanagan, where there is less chance of human disturbance, and where numerous aeries are unoccupied.

Public partnerships in hacking programs, such as has occurred with Peregrine Falcons in Kelowna (Cooper and Beauchesne, in press) should be encouraged. However, before hacking is attempted, a careful assessment of habitat availability and suitability is needed. Population augmentation should only occur at sites where suitable nesting habitat and sufficient prey are present. Cliffs for nesting are numerous but foraging habitat is declining in all regions. Sites with a high probability of success that would not add competitive pressure to existing breeding pairs should be chosen. Sources of young falcons would need to be found and these birds would have to have similar genetics to British Columbia birds.

9.10 Rock Climbing

Some jurisdictions in the USA have closed all or parts of certain cliffs to rock climbing if raptors nest on the cliffs. This approach has been done at one nest location of the Peregrine Falcon in British Columbia where conflict with climbers was an issue (M. Chutter pers comm.). Due to the rarity of Prairie Falcons and their active aeries in British Columbia, it seems reasonable to use this approach where conflicts occur. Closures to recreational use of cliffs used for nesting during the breeding season seem to be warranted (Colorado 1998).

9.11 Artificial Nest Sites

In Alberta, artificial nest sites have been excavated in sand and silt cliffs to replace nest sites lost through natural causes or human disturbance. These artificial sites were used frequently by nesting Prairie Falcons (Paton 2002), suggesting that artificial sites could be useful where nest sites are limited in number. In British Columbia, numerous silt cliffs occur in remote areas along the Chilcotin River, and along the Fraser River upstream and downstream of its confluence with the Chilcotin River. Smaller amounts of silt cliff habitat occur along the South Thompson River, Nicola River, in the Okanagan valley, and in the East Kootenay Trench. Nest sites in soft cliffs are susceptible to collapse as the banks erode, and therefore there is a lack of suitable "potholes" for nesting falcons. Although nest sites do not seem to be limiting, it seems that creation of artificial nest sites in soft cliffs is one of the more feasible management actions that could be undertaken to enhance habitat.

9.12 Falconry

The population of Prairie Falcons in British Columbia is so low that the current closure on harvesting of birds for falconry purposes should be continued. Re-opening a harvest should not be considered unless the species is upgraded to the Blue List, at which point the situation could be reassessed.

10 EVALUATION

The Prairie Falcon is extremely rare in British Columbia. Recent surveys have discovered perhaps 11 active aeries

in the province. It is thought that there may be at least twice as many breeding pairs in the province, but that number is still very low. Habitat in key areas (Okanagan and Thompson valleys) of the province, where numbers were much higher historically, is likely lost forever. The remainder of that habitat is under severe threat from future human development. Recovery of the populations in the Okanagan and Thompson valleys is unlikely as habitat continues to be lost or reduced in suitability. The last stronghold, by virtue of remoteness from human population centres, is in the Cariboo-Chilcotin. This region, at the northernmost extremity of the species range, currently has very limited potential for population increase due to natural limiting factors that constrain populations at the periphery of their range, however, the overall effects of climate change are unknown.

It is recommended that the Prairie Falcon remain on the provincial Red List, and that it also be designated as Endangered in British Columbia under the provincial *Wildlife Act*. It is further suggested that the current national status is inappropriate, and that the status of Not at Risk based on no evidence of population declines is inaccurate. Therefore it is recommended that COSEWIC reevaluate this species as soon as possible.

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12 PERSONAL COMMUNICATIONS

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Appendix 1. Biogeoclimatic Zones (BGZ) and Subzones in British Columbia (Stevens 1995).

Zonal Group	Biogeoclimatic Zone	Subzone	Subzone Code	Subzone group for wildlife	Wildlife subzone code	
Coastal	Coastal Douglas-fir	CDF	CDF	Coastal Douglas-fir	c	
		Coastal Western Hemlock	Wet Hypermaritime Very Wet Hypermaritime Very Dry Maritime Dry Maritime Moist Maritime Wet Maritime Very Wet Maritime Dry Submaritime Moist Submaritime Wet	CWHwh CWHvh CWHxm CWHdm CWHmm CWHwm CWHvm CWHds CWHms CWHws	hypermaritime maritime submaritime	h m s
	Mountain Hemlock	Mountain Hemlock	Wet Hypermaritime Parkland	MHwhp	hypermaritime	h
			Wet Hypermaritime Moist Maritime Parkland	MHwh MHmmp	windward maritime and leeward maritime	w & l
			Moist Maritime	MHmm		
	Dry Interior	Bunchgrass	Very Dry Hot	BGxh	very dry hot	h
			Very Dry Warm	BGxw	very dry warm	w
		Ponderosa Pine	Very Dry Hot	PPxh	very dry hot	x
			Dry Hot	PPdh	dry hot	d
		Interior Douglas-fir	Interior Douglas-fir	Very Dry Hot	IDFxh	very dry
Very Dry Warm				IDFxw		
Very Dry Mild				IDFxm		
Dry Mild				IDFdm	dry	d
Dry Cool				IDFdk		
Moist Warm				IDFmw	moist	m
Wet Warm				IDFww	wet	w
Montane Spruce		Montane Spruce	Very Dry Very Cold	MSxv	very dry very cold	v
			Very Dry Cool	MSxk	very dry cool	x
	Dry Cold		MSdc			
	Dry Cool		MSdk	dry cool	k	
Interior Cedar-Hemlock	Interior Cedar-Hemlock	Dry Warm	MSdm	dry mild	m	
		Very Dry Warm	ICHxw	dry warm	d	
		Dry Warm	ICHdw			
		Moist Warm	ICHmw	moist warm	m	
		Moist Mild	ICHmm			
		Wet Cool	ICHwk	wet cool	w	
		Very Wet Cool	ICHxk			
		Dry Cool	ICHdk	dry-moist cool	k	
Interior Cedar-Hemlock	Interior Cedar-Hemlock	Moist Cool	ICHmk			
		Moist Cold	ICHmc	moist cold	c	
		Very Wet Cold	ICHvc	very wet cold	x	

Appendix 1. cont.

Zonal Group	Biogeoclimatic Zone	Subzone	Subzone Code	Subzone group for wildlife	Wildlife subzone code
Central Plateau	Sub-boreal Pine–Spruce	Very Dry Cold	SBPSxc	very dry cold	v
		Dry Cold	SBPSdc	dry cold	d
		Moist Cool	SBPSmk	moist cool	k
		Moist Cold	SBPSmc	moist cold	c
	Sub-boreal Spruce	Dry Hot	SBSdh	dry hot –warm	d
		Dry Warm	SBSdw		
		Dry Cool	SBSdk	dry cool	k
		Moist Hot	SBSmh	moist hot–warm	h
		Moist Warm	SBSmw		
		Moist Mild	SBSmm	moist mild–cool	c
		Moist Cool	SBSmk	–cold	
		Moist Cold	SBSmc		
		Wet Cool	SBSwk	wet cool	x
		Very Wet Cool	SBSvk		
		Engelmann Spruce - Subalpine Fir ^a	Engelmann Spruce–Subalpine Fir	Very Dry Cold	ESSFxc
Dry Cool	ESSFdk			dry	d
Dry Cold	ESSFdc				
Dry Very Cold	ESSFdv				
Moist Warm	ESSFmw			moist	m
Moist Mild	ESSFmm				
Moist Cool	ESSFmk				
Moist Cold	ESSFwc				
Moist Very Cold	ESSFmv				
Wet Mild	ESSFwm			wet	w
Wet Cool	ESSFwk				
Wet Cold	ESSFwc				
Wet Very Cold	ESSFwv				
Very Wet Cold	ESSFvc				
Very Wet Very Cold	ESSFvv				
Boreal	Boreal White and Black Spruce Spruce - Willow - Birch	Dry Cool	BWBSdk	dry cool	d
		Moist Warm	BWBSmw	moist warm	m
		Wet Cool	BWBSwk	wet cool	k
		Dry Cool	SWBdk	forested	s
		Moist Cool	SWBmk		
		Dry Cool Scrub	SWBdks	scrub	b
Alpine Tundra	Alpine Tundra		AT	above MH above ESSF above SWB	m e s

^aEach ESSF subgroup has a parallel parkland subgroup and subzone group for wildlife.

Appendix 2. Broad Ecosystem Units (RIC 2000).

List of Units

AB Antelope-brush Shrub/Grassland
AC Trembling Aspen Copse
AD Sitka Alder - Devil's Club Shrub
AG Alpine Grassland
AH Alpine Heath
AM Alpine Meadow
AN Alpine Sparsely Vegetated
AS Alpine Shrubland
AT Alpine Tundra
AU Alpine Unvegetated
AV Avalanche Track
BA Boreal White Spruce - Trembling Aspen
BB Black Spruce Bog
BG Sphagnum Bog
BK Subalpine Fir - Scrub Birch Krummholz
BL Black Spruce - Lodgepole Pine
BP Boreal White Spruce - Lodgepole Pine
BS Bunchgrass Grassland
CB Cedars - Shore Pine Bog
CD Coastal Douglas-fir
CF Cultivated Field
CG Coastal Western Redcedar - Grand Fir
CH Coastal Western Hemlock - Western Redcedar
CL Cliff
CP Coastal Douglas-fir - Shore Pine
CR Black Cottonwood Riparian Habitat Class
CS Coastal Western Hemlock - Subalpine Fir
CW Coastal Western Hemlock - Douglas-fir
DA Douglas-fir - Arbutus
DF Interior Douglas-fir Forest
DL Douglas-fir - Lodgepole Pine
DP Douglas-fir - Ponderosa Pine
EF Engelmann Spruce - Sub-alpine Fir Dry Forested
ER Engelmann Spruce Riparian
ES Estuary
EW Subalpine Fir - Mountain Hemlock Wet Forested
FB Subalpine Fir - Scrub Birch Forested
FE Sedge Fen
FP Engelmann Spruce - Subalpine Fir Parkland
FR Amabilis Fir - Western Hemlock
FS Fast Perennial Stream
GB Gravel Bar
GL Glacier
GO Garry Oak
HB Coastal Western Hemlock - Paper Birch
HL Coastal Western Hemlock - Lodgepole Pine

List of Units

HP Mountain Hemlock Parkland
HS Western Hemlock - Sitka Spruce
IG Interior Western Redcedar
IH Interior Western Hemlock - Douglas-fir
IM Intertidal Marine
IN Intermittent Stream
IS Interior Western Hemlock - White Spruce
LL Large Lake
LP Lodgepole Pine
LS Small Lake
ME Meadow
MF Mountain Hemlock - Amabilis Fir
MI Mine
MR Marsh
MS Montane Shrub/Grassland
OA Garry Oak - Arbutus
OV Orchard/Vineyard
OW Shallow Open Water
PB Lodgepole/Shore Pine Bog
PO Lodgepole Pine Outcrop
PP Ponderosa Pine
PR White Spruce - Balsam Poplar Riparian
RB Western Redcedar - Paper Birch
RD Western Redcedar - Douglas-fir
RE Reservoir
RM Reclaimed Mine
RO Rock
RR Western Redcedar - Black Cottonwood Riparian
RS Western Redcedar Swamp
SB White Spruce - Paper Birch
SC Shrub-Carr
SD Spruce - Douglas-fir
SF White Spruce - Subalpine Fir
SG Subalpine Grassland
SH Shrub Fen
SK Spruce - Swamp
SL Subboreal White Spruce - Lodgepole Pine
SM Subalpine Meadow
SP Slow Perennial Stream
SR Sitka Spruce - Black Cottonwood Riparian
SS Big Sagebrush Shrub/Grassland
ST Subtidal Marine
SU Subalpine Shrub/Grassland
SW Shrub Swamp
TA Talus
TB Trembling Aspen - Balsam Poplar

Appendix 2. cont.

List of Units

TC	Transportation Corridor
TF	Tamarack Wetland
TR	Transmission Corridor
UR	Urban
UV	Unvegetated
WB	Whitebark Pine Subalpine
WG	Hybrid White Spruce Bog Forest
WL	Wetland
WP	Subalpine fir - Mountain Hemlock Wet Parkland
WR	Hybrid White Spruce - Black Cottonwood Riparian
YB	Yellow Cedar Bog Forest
YM	Yellow-cedar - Mountain Hemlock Forest
YS	Yellow-cedar Skunk Cabbage Swamp Forest