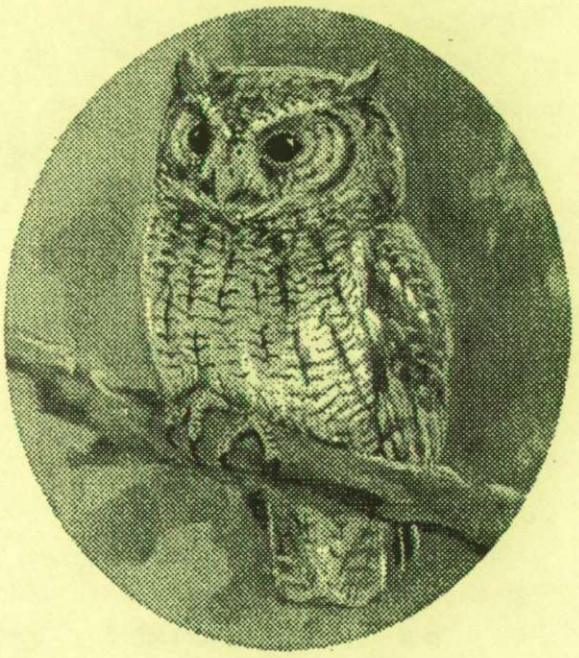
Update
COSEWIC STATUS REPORT
on
Flammulated Owl
(*Otus flammeolus*)



Astrid M. van Woudenberg and David A. Kirk

VULNERABLE
1999

COSEWIC
COMMITTEE ON THE STATUS
OF ENDANGERED WILDLIFE
IN CANADA

COSEPAC
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ESPÈCE EN PÉRIL
AU CANADA

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Cover illustrations:
Flammulated Owl - J. Crosby, *The Birds of Canada*, by W. Earl Godfrey, Canadian Museum of Nature, Ottawa, ON.

Flammulated Owl

Reason for status: The effective population size for this species is thought to be small and patchily distributed. Preferred habitat is Douglas fir and Ponderosa pine forests which are subject to timber harvest. [Designated (rare) vulnerable in 1988 and reconfirmed as vulnerable in 1999.]

Occurrence: British Columbia

NOTES

COSEWIC status reports are working documents used in assigning status. Reports are released in their original form in the interest of making scientific information available to the public.

van Woudenberg, Astrid M. and David A. Kirk. 1999. COSEWIC Status report on the Flammulated Owl, *Otus flammeolus*. Committee on the Status of Endangered Wildlife in Canada. 34 pp.

COSEWIC

A committee of representatives from federal, provincial and private agencies that assigns national status to species at risk in Canada and the chairs of the scientific species specialist groups

COSEPAC

Un comité de représentants d'organismes féderaux, provinciaux et privés qui attribue un statut national aux espèces canadiennes en péril ainsi que des président(e)s des groupes des spécialistes scientifiques.

Update

COSEWIC Status Report

on

Flammulated Owl

(*Otus flammeolus*)

by

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EXECUTIVE SUMMARY

Distribution

Flammulated Owls breed in the montane forests of western North America and their range extends from central Mexico to south-central British Columbia (BC). In Canada, Flammulated Owls occur only in BC; they occur from the United States (US) border to as far north as McLeese Lake, on the west side of the Fraser River north of Williams Lake, and west to Alexis Creek on the south side of the Chilcotin River. Nesting has been confirmed as far north as

Skull Mountain, near Barriere, north of Kamloops. However, two fledglings found in two different years (1995 and 1998) at Williams Lake suggest that Flammulated Owls have nested further north.

Protection

The Flammulated Owl is protected under the BC Provincial Wildlife Act and it is an offence to destroy or damage eggs, nesting adults and active nests. The 1995 Forest Practices Code of BC provides for special management of Flammulated Owl habitat. Upon release, Forest Practices Code Volume 2 of Identified Wildlife Management Strategy will include this species. The Flammulated Owl is on the blue-list in BC.

Population

An approximate population estimate for BC is 1,200 pairs. Estimating population size is difficult because of the lack of information on nesting success, with the exception of a few sites. Apart from nest searches on Wheeler Mountain over three successive breeding seasons, there is no information regarding population size or trends for the province. Furthermore,

information is lacking on the habitat suitability of dry Douglas-fir forests within the species' range, from which population size could be cautiously extrapolated. Since Flammulated Owls are known to respond to spruce budworm outbreaks and successional stage of forests, populations probably fluctuate on a 40-50 year cycle with budworm activity, seral stage development, and forest management..

Habitat

The range of the Flammulated Owl is essentially synchronous with that of Ponderosa pine. However, at the northern limit of its range, the species also occupies the dry Douglas-fir belt. In BC, Flammulated Owls are found primarily in Interior Douglas-fir and secondarily in Ponderosa pine. Most Flammulated Owls are found in the xeric, hot, warm and mild subzones of the Interior Douglas-fir biogeoclimatic zone.

Biology

Flammulated Owls have a low reproductive rate and can live up to 11 years, so low recruitment can be masked for several years. Age at first breeding is unknown, but lack of mates may force some males to breed when > 1 year old. New mates are chosen each year and clutch size ranges from 2-4. Flammulated Owls may breed in loose colonies but this may be more related to clustering of suitable breeding habitat rather than coloniality per se. They compete for cavities with other cavity-using species, including Northern Flying Squirrels. The species is highly migratory, spending the winter months in Mexico and Central America.

Limiting Factors

Since Flammulated Owls depend on commercially-valuable old-growth Ponderosa pine-Douglas-fir forests they are susceptible to habitat change through timber harvest. Timber harvest, together with fire suppression, and livestock grazing have drastically altered western Montane forests. The main effect has been to decrease Ponderosa pine regeneration (decreasing breeding habitat for owls) but increase Douglas-fir thickets (which provide security cover from predators). Fire suppression has produced overcrowded stands with poor crown development and an increase in shade-tolerant species.

Also, cutting trees for firewood can alter breeding habitat structure and have adverse effects on nesting owls, especially between May-August when nest trees may be removed. Silvicultural systems that remove only a few old trees, leave some mature trees and create openings that enhance Ponderosa pine regeneration will provide continued habitat for Flammulated Owls. If Douglas-fir thickets are left in patches, management to produce uneven-aged stands should retain suitable Flammulated Owl habitat at a landscape level.

However, single-species Douglas-fir stands provide limited foraging habitat opportunities for Flammulated Owls and may enhance habitat for Barred Owls, which prey on Flammulated Owls. Other predators include Sharp-shinned Hawks, Northern Flying Squirrels and Black Bears.

Because of the Flammulated Owl' s insectivorous diet it may be vulnerable to aerial spraying of bacteria (Bt) used as a management tool to control Lepidopteran pests.

Evaluation and Status

Despite considerable advancements in our knowledge of the Flammulated Owl over the past decade, information gaps regarding its population size, distribution, and habitat requirements persist. Management for long-term sustainability of the species will require better knowledge of its breeding range and distribution in B.C., availability of suitable habitat, the species' fecundity, areas of high and low productivity (source and sink habitats), and threats to its habitat requirements. Given the owl's small and patchily distributed population, and its dependence on Douglas-fir and Ponderosa Pine forests that are subject to commercial timber harvest and alteration by other activities such as grazing, it is recommended that the 'Vulnerable' status be retained for the Flammulated Owl.

RÉSUMÉ

Distribution

Le Petit-duc nain se reproduit dans les forêts alpestres de l'Ouest de l'Amérique du Nord, et son aire de répartition s'étend du centre du Mexique au centre-sud de la Colombie-Britannique (C.-B.). Au Canada, cette espèce est présente seulement en C.-B. On la retrouve de la frontière des États-Unis jusqu'au lac McLeese au nord, à l'ouest du fleuve Fraser au nord de Williams Lake, et à l'ouest jusqu'à Alexis Creek au sud de la rivière Chilcotin. La nidification a été confirmée vers le nord aussi loin que Skull Mountain, près de Barriere, au nord de Kamloops. Toutefois, deux oisillons découverts au cours de deux années différentes (1995 et 1998) à Williams Lake laissent croire que le Petit-duc nain niche encore plus au nord.

Protection

En C.-B., le Petit-duc nain est protégé par la *Provincial Wildlife Act* en vertu de laquelle la destruction ou la déprédation d'oeufs et de nids actifs et la mise à mort d'adultes constituent une infraction. Le *Forest Practices Code* de 1995 de la C.-B. comporte des dispositions relatives à la gestion spéciale de l'habitat du Petit-duc nain. Lorsqu'il paraîtra, le volume 2 du *Forest Practices Code* de la stratégie intitulée *Identified Wildlife Management Strategy* comprendra cette espèce. Le Petit-duc nain figure sur la liste bleue de la C.-B.

Population

En C.-B., la population est estimée à 1 200 couples. Il est difficile d'évaluer la taille de la population en raison du manque de renseignements sur le succès de la nidification, à l'exception de quelques sites. À part la recherche de nids sur Wheeler Mountain effectuée au cours de trois saisons de reproduction successives, il n'existe aucune information concernant la taille ou les tendances de la population dans cette province. De plus, il manque de l'information sur le caractère approprié des forêts de Douglas taxifoliés secs en tant qu'habitat au sein de l'aire de répartition de l'espèce, à partir de laquelle la taille de la population pourrait être prudemment extrapolée. Étant donné la réaction connue du Petit-duc nain aux pullulations des tordeuses des bourgeons de l'épinette et aux différents stades de succession des forêts, les populations varient probablement suivant un cycle s'étendant sur 40 à 50 ans selon l'activité de la tordeuse des bourgeons de l'épinette, le développement du stade biotique et la gestion des forêts.

Habitat

L'aire de répartition du Petit-duc nain correspond sensiblement à celle du pin ponderosa. Toutefois, à la limite nord de son aire de répartition, l'espèce occupe également la zone de Douglas taxifoliés secs. En C.-B., le Petit-duc nain se retrouve principalement dans les forêts intérieures de Douglas taxifoliés, puis dans les forêts de pins ponderosa. La plupart des Petits-ducs nains sont présents dans les sous-zones xériques, chaudes, tempérées et douces de la zone biogéoclimatique intérieure des Douglas taxifoliés.

Biologie

Le Petit-duc nain a un bas taux de reproduction et peut vivre jusqu'à 11 ans; un taux de recrutement peu élevé peut donc être caché pendant plusieurs années. On ne connaît pas l'âge auquel le Petit-duc nain se reproduit pour la première fois, mais un manque de femelles peut obliger certains mâles à se reproduire seulement après avoir atteint l'âge d'un an. Une nouvelle femelle est choisie chaque année, et

la ponte varie entre 2 et 4 oeufs. Le Petit-duc nain peut se reproduire en colonie libre, mais cette situation est peut-être davantage liée au regroupement des habitats appropriés à la reproduction qu'à la vie en colonie en tant que telle. Les Petits-ducs nains rivalisent d'autres espèces se servant de cavités comme abri, y compris les grands polatouches, pour avoir ces cavités. L'espèce est hautement migratrice, passant les mois d'hiver au Mexique et en Amérique centrale.

Facteurs limitants

Étant donné que le Petit-duc nain dépend des vieux peuplements de pins ponderosa et de Douglas taxifoliés, lesquels ont une grande valeur commerciale, il est vulnérable aux changements que son habitat peut subir à cause de la coupe d'arbres. Cette coupe conjointement avec la suppression des feux et le pâturage du bétail ont radicalement modifié les forêts alpestres de l'Ouest. La principale répercussion a été la diminution de la régénération des pins ponderosa (réduisant ainsi l'habitat de reproduction du Petit-duc nain), mais il y a également eu l'augmentation de fourrés de Douglas taxifoliés (lesquels procurent un abri contre les prédateurs). La suppression des feux a entraîné un surpeuplement des arbres résultant en un faible développement de la cime des arbres et en une augmentation des espèces sciaphiles.

La coupe d'arbres comme bois de chauffage peut également modifier la structure de l'habitat de reproduction et avoir des effets néfastes sur les Petits-ducs nains nicheurs, particulièrement entre mai et août, période pendant laquelle les arbres abritant des nids peuvent être enlevés. Les systèmes de régénération qui n'enlèvent que quelques vieux arbres, qui laissent des arbres matures et créent des ouvertures favorisant la régénération des pins ponderosa fourniront des habitats permanents aux Petits-ducs nains. Si les fourrés de Douglas taxifoliés sont laissés regroupés, la gestion visant à produire des peuplements inéquiens devrait maintenir un habitat convenable au Petit-duc nain au niveau du paysage.

Toutefois, les peuplements ne comprenant que des Douglas taxifoliés ne fournissent que des possibilités limitées d'habitat de fourrage au Petit-duc nain et risquent d'améliorer l'habitat de la Chouette rayée qui fait sa proie du Petit-duc nain. D'autres prédateurs comprennent l'Épervier brun, le grand polatouche et l'ours noir.

Le régime insectivore du Petit-duc nain peut le rendre vulnérable à l'épandage aérien de bactéries (Bt) utilisées comme outil de gestion pour lutter contre les lépidoptères nuisibles.

Évaluation et statut

En dépit des connaissances considérables acquises sur le Petit-duc nain au cours de la dernière décennie, on manque encore de renseignements relatifs à la taille de sa population, à sa répartition et aux exigences quant à son habitat. La gestion visant la durabilité à long terme de l'espèce exigera une meilleure connaissance de son aire de reproduction et de sa répartition en C.-B., de la disponibilité d'un habitat convenable, de la fécondité de l'espèce, des zones de haute et de basse productivité (habitats source et souffre) et des menaces aux exigences quant à son habitat. Étant donné la petite population répartie inégalement du Petit-duc nain et sa dépendance des forêts de Douglas taxifoliés et de pins ponderosa, lesquelles sont exposées à la coupe commerciale d'arbres et aux transformations occasionnées par d'autres activité, telles que le pâturage, on recommande que le Petit-duc nain conserve le statut d'espèce « vulnérable ».

Introduction

The Flammulated Owl (*Otus flammeolus*) is a small (55-60 g), insectivorous, secondary cavity-nester that breeds in dry, old Douglas-fir *Pseudotsuga menzienii* - Ponderosa pine (*Pinus ponderosa*) forests (Campbell et al. 1990). The species is migratory and the northern limits of its breeding range extend into south central British Columbia, the only province in Canada in which the owl occurs. The Flammulated Owl has dark eyes that distinguish it from all other small species of owls in B.C., which have yellow eyes (Godfrey 1986).

COSEWIC designated the Flammulated Owl "rare" in 1988; the designation was changed to "vulnerable" in 1990 when the category was replaced. At that time, little was known about Flammulated Owl distribution, habitat requirements, or breeding ecology (van Woudenberg 1992, Howie and Ritcey 1987). A minimum of 30 pairs of Flammulated Owls was estimated for southern B.C., and the population trend was unknown. Flammulated Owls were known to prefer mature forests for foraging and nest sites (Reynolds and Linkhart 1987), and numbers were thought to have been higher before widespread forest harvesting. Limiting factors included habitat loss for nest sites and foraging areas, environmental contamination, human disturbance, interspecific competition, and predation.

In the past decade, several studies have documented Flammulated Owl distribution and habitat preferences in B.C. (Williams and Woodward 1989, St. John 1991, van Woudenberg 1992, van Woudenberg et al. 1995, Christie 1996, Cannings and Booth 1997, D.A. Christie and D.J. Low pers. comm. 1996, M.J. Waterhouse pers. comm. 1997).

Flammulated Owl habitat and population inventories have taken place in the Okanagan, Kamloops-Merritt, and Cariboo-Chilcotin areas. Three distribution surveys have also been conducted in the Okanagan Valley (St. John 1991, Cannings and Booth 1997, Gyug 1998). Similar extensive surveys, including habitat inventories, were conducted in the Kamloops and Merritt Forest Districts (Williams and Woodward 1989, van Woudenberg et al. 1995, Christie and van Woudenberg In prep.). Part of the Boundary Forest District (Cannings and Booth 1997, Gyug 1998) and Similkameen Valley (Cannings and Booth 1997) have also been surveyed.

A three-year (1989-91) investigation of critical foraging and nesting habitat requirements using radio-telemetry was completed on Wheeler Mountain, north of Kamloops, B.C. (van Woudenberg 1992). Breeding habitat inventories and dietary studies were continued at the same site, with the addition of Red Plateau and Skull Mountain (North Thompson Valley), during the 1994-96 breeding seasons (Christie 1994, D.A. Christie and D.J. Low pers. comm. 1995-96). In the 1995-96 season, some post-fledging foraging habitat was also documented (D.A. Christie and D.J. Low pers. comm. 1996).

A habitat prediction model was developed in 1995-97 using existing nest habitat data (Christie and van Woudenberg 1997) and an extensive habitat prediction model is currently being redrafted for the Kamloops and Merritt Forest Districts (Christie and van Woudenberg 1998).

In the Cariboo-Chilcotin district, Flammulated Owl surveys were conducted between 1995-97 (M.J. Waterhouse pers. comm. 1997; Roberts and Roberts 1995) as part of a three year study (Waterhouse 1996). Extensive surveys were used to map the owl's distribution; intensive surveys (repeated visits) were used to quantify abundance of owls in forest cover polygons rated for habitat capability.

Distribution:

The breeding range of the Flammulated Owl extends from central Mexico to south central B.C., occupying montane forests of western North America (McCallum 1994a). The species has been observed from the International Border to as far north as McLeese Lake, on the west side of the Fraser River north of Williams Lake (M.J. Waterhouse pers. comm. 1996), and west to Alexis Creek on the south side of the Chilcotin River. Nesting has been confirmed as far north as Skull Mountain, near Barriere north of Kamloops, B.C. (D.A. Christie and D.J. Low pers. comm. 1996). However, two fledglings found in two different years (1995 and 1998) at Williams Lake suggest that Flammulated Owls have nested even further north (S.L. Howard pers. comm.).

British Columbia

The Flammulated Owl occurs in the elevational band characterised by dry Douglas-fir forests along the major drainages of the southern third of the province. Confirmed records are from the Fraser River (M.J. Waterhouse pers. comm. 1996), North Thompson valley (D.A. Christie and D.J. Low pers. comm. 1996, Christie 1996) South Thompson and Okanagan valleys (Christie and van Woudenberg In prep., Cannings and Booth 1997), and the southern Rocky Mountain Trench to Radium Hot Springs (B.C. Conservation Data Centre 1998).

Flammulated Owls have been confirmed breeding in B.C. predominantly in the Interior Douglas-fir, very dry, hot biogeoclimatic variant (IDFxh2 - Lloyd et al. 1990) on Wheeler Mountain, Red Plateau, Skull Mountain and strongly suspected (evidence of an abandoned nest) in the Tranquille Valley near Kamloops (van Woudenberg et al. 1998, Christie and van Woudenberg 1997, Christie and Low, pers. comm.1994-96). In Penticton nesting has been reported in the Ponderosa pine, very dry, hot subzone (PPxh) (B.C. Conservation Data Centre, Cannings et al. 1978, Cannings and Cannings 1982).

The highest density of nesting Flammulated Owls was found in 1995 on Wheeler Mountain; 14 nests were found in an area of 730 ha, or a density of 0.11 nests/40 ha (Christie 1996). Although nest sites have not been found in the Cariboo-Chilcotin region, a dead fledgling discovered in 1994 and a live one found in the town of Williams Lake in 1998, indicate nesting at the northern periphery of the range (S.L. Howard pers. comm.).

The documented distribution of the Flammulated Owl in B.C. includes the following Ecosections within 4 Ecoprovinces (Demarchi1988):

Ecoprovince:		Ecosection:	Number of Flammulated Owl records
Southern Interior			
	PAR	Pavilion Ranges	81
	SCR	Southern Chilcotin Range	1
	SOB	South Okanagan Basin	18
	SOH	South Okanagan Highland	2
	NOB	Northern Okanagan Basin	32
	NOH	Northern Okanagan Highland	5
	NTU	Northern Thompson Upland	17
	OKR	Okanagan Range	12
	STU	South Thompson Upland	189
	THB	Thompson Basin	92
Southern Interior Mountains			
	EKT	East Kootenay Trench	3
Central Interior			
	CAB	Caribou Basin	47
	CHP	Chilcotin Plateau	7
	FRB	Fraser River Basin	131
	CCR	Central Chilcotin Ranges	2
East Kootenays			
	EPM	Eastern Purcell Mountains	1
	SPK	Southern Park Ranges	2

United States

In the western United States, the species occurs on the east slope of the Cascades, and interior ranges of Washington, Oregon (possibly the Blue Mountains), northeastern California and western Nevada (McCallum 1994a). The Flammulated Owl is widespread in Colorado (Reynolds and Linkhart 1987), New Mexico, and Arizona and breeds in the mountains of Texas (McCallum 1994a). Breeding has also recently been recorded in Utah and Montana (McCallum 1994a).

Nonbreeding Range

Flammulated Owls from B.C. migrate to the neotropics, although little is known of their exact nonbreeding range. Migrants are assumed to overwinter between southern Mexico, where the species is resident year-round (McCallum 1994a, Hubbard and Crossin 1974), and Central America. It is known to be at least a winter resident in Guatemala, Honduras and El Salvador (McCallum 1994a).

Population Numbers, Size and Trends

The Flammulated Owl was first discovered in Canada in 1901, when a dead female was found on Okanagan Beach in Penticton, B.C. in October (Campbell et al. 1990). Prior to 1980, there were only six records of nesting Flammulated Owls in British Columbia. The lack of sightings and nest records up until the early 1980's were due to the secretive, nocturnal nature of the species. Since then, a few experienced observers have become proficient at locating nests.

An approximate population estimate for B.C. is 1200 pairs (reported in Kirk and Hyslop 1998), but this will likely fluctuate on a 40-50 year cycle with budworm activity, seral stage development, and the effects of management (D. Low pers. comm., van Woudenberg 1992, van Woudenberg et al. 1998). The difficulty in estimating population numbers lies in part with the absence of information about nesting or its success outside of a few specific sites in the province. Furthermore, the state or suitability of dry Douglas-fir forests within the species' range beyond the detail of forest cover inventory data does not allow for an estimate of true habitat availability, from which population size may be estimated, however cautiously. Aside from standardised nest searches of Wheeler Mountain replicated in three successive breeding seasons (Christie 1994, 1996), there is no information regarding population size or trends for the province.

Several records of the species (Table 1) have been reported within the past decade for the Rocky Mountain Trench (B.C. Conservation Data Centre 1998), west of Lillooet to Cayoosh Creek (van Woudenberg 1998), and north to Williams Lake, (M.J. Waterhouse pers. comm. 1997). Although many of these areas have been surveyed more than once, population densities cannot be extrapolated from the results (van Woudenberg and Christie 1997), because the goal of these surveys was to determine species distribution and range in B.C., not absolute abundance.

Table 2 shows estimated numbers of nesting pairs of Flammulated Owls for some regions of the province where they are known to occur. Although the Flammulated Owl may be abundant locally throughout its range (including B.C.), its long-term population trends in other parts of North America are uncertain (McCallum 1994b). While large tracts of contiguous habitat are likely not a landscape requisite for such a mobile species, local populations must retain a critical minimum size to be sustainable (Soule 1993).

In order to make population estimates with greater confidence, further sampling effort is required to confirm nesting. Owls that call spontaneously in May and early June and are quiet thereafter are indicative of nesting activity (van Woudenberg and Christie 1997). However, in Colorado 17 years of breeding information has shown that unmated males continue calling late into the breeding season (B.D. Linkhart pers. comm.). Thus, nesting information cannot be extrapolated from records of calling owls (McCallum 1994b). Owls that continue to call readily or respond to playback tapes late into the nesting season (mid-June to July) are likely unmated males (van Woudenberg and Christie1997, McCallum 1994b, B. Linkhart pers. comm.). The only unequivocal evidence of breeding activity and nesting habitat suitability is the presence of a nesting pair.

North American population status also depends on winter habitat availability. Habitat status and conservation in Mexico, and particularly in Central America, is largely unknown (McCallum 1994b). The effects of habitat management in North America may be difficult to monitor without understanding habitat suitability and mortality rates in the Flammulated Owl's winter range.

Information to estimate population parameters with reasonable confidence is very limited. Although the results of auditory surveys may suggest that the species is common in western montane forests (McCallum 1994a), the numbers of calling birds alone can be very misleading as an indicator of species abundance (van Woudenberg and Christie 1997). Replicated nesting surveys over successive years

overlaid on a map with similarly replicated auditory survey results showed that clusters of calling birds typically represented a single nest site location (van Woudenberg and Christie 1997). Throughout the Flammulated Owl's range, detected birds are commonly reported as clusters (McCallum 1994a). Data from Wheeler Mountain and a few surrounding study sites have indicated that either a single male may be moving around his territory or a few conspecifics are competing for suitable habitat that will result in occupancy of a single nest (D.A. Christie and D.J. Low pers. comm. 1994-96, Christie pers. comm.).

The species' global rank is a G4 (apparently secure; B. C. Conservation Data Centre). Its provincial rank in B.C. is S3/S4 (S3 is rare or uncommon in the province, in the order of 21 to 100 occurrences; S4 is apparently secure in the province, with many occurrences) (B.C. Conservation Data Centre).

Habitat

The range of the Flammulated Owl is essentially synchronous with that of Ponderosa pine. However, at the northern limit of its range, it also occupies the dry Douglas-fir belt. The grey and red colour phases of Flammulated Owls appear to be adaptations to the bark colour of the dominant tree species (Phillips 1942). The reddish phase tends to predominate the south (where pine is most abundant) and the greyish phase tends to occupy the north (where Douglas-fir predominates).

In B.C., Flammulated Owls have been detected in two principal biogeoclimatic zones: primarily in Interior Douglas-fir (IDF) and secondarily in Ponderosa pine (PP) (Lloyd et al. 1990) (see Table 1). Records from the Bunchgrass (BG) zone were incidental observations made only in the Cariboo-Chilcotin region on north aspect, forested slopes (M.J. Waterhouse pers. comm. 1997). The BG zone records occurred where forest patches in the grassland were contiguous and in transition with the IDFxm zone (M.J. Waterhouse pers. comm.). Most Flammulated Owl detections were in the xeric, hot, warm and mild subzones (xh, xw, and xm, respectively) of the IDF biogeoclimatic zone (Table1).

Breeding Habitat

Suitable breeding habitat for Flammulated Owls must contain specific critical features for foraging, security and nesting. Breeding habitat is characterized by a heterogeneous forest structure with a multi-layered canopy and old-growth components, including snags containing cavities (Reynolds and Linkhart 1992, van Woudenberg 1992, Bull et al. 1990, Reynolds and Linkhart 1987). The understory is typically comprised of grasses and low shrubs. Flammulated Owls select old-growth stands (>200 years in Colorado, >141 years in B.C.) over younger forests (Christie and van Woudenberg 1997). Stands where trees were >50 cm dbh (diameter at breast height) were selected by nesting owls in Oregon (Bull et al. 1990).

Generally stand density is much higher in Flammulated Owl breeding habitat in B.C. than in the southern parts of the species' range. For example mean stem density was 504/ha in New Mexico (McCallum and Gehlbach 1988), and 589/ha (Goggans 1986) and 330/ha (Bull et al. 1990) in Oregon. In comparison, mean stem density in B.C. was 2472/ha in breeding habitat and 2837/ha in foraging habitat (van Woudenberg 1992). Denser stands in B.C. are attributed to regenerating Douglas-fir thickets, which provide security cover for owls around nest and foraging sites. The spatial occurrence of these thickets is patchy. In the coldest and wettest season of field investigation, owls used warmer, drier sites at lower elevation that were more open. Mean stem density at foraging sites was 667/ha (D.A. Christie and D.J. Low pers. comm. 1996).

In B.C., two types of breeding habitat have been identified on Wheeler Mountain, near Kamloops (van Woudenberg 1992) within the IDFxh2 biogeoclimatic variant:

1) Stands dominated almost exclusively by Douglas-fir with a pine grass (*Calamagrostis rubescens*) understory. Thickets of Douglas-fir regeneration are abundant. Ponderosa pine is rare, except as occasional snags or veteran trees which are commonly used as nest trees. The habitat type is mesic and cooler than habitat type 2 (Lloyd et al. 1990). The understory tends to be less diverse than the drier habitat type, although stand structure is heterogeneous. Aspects tend to be north-west and north-east; no nests were found that faced due north (Christie 1996). Slopes were moderate (10-20%). During spruce budworm outbreaks, nest densities may be higher in mesic habitat types than in drier types.

2) The second type of habitat is considerably drier, dominated by Douglas-fir, with Ponderosa pine co-dominating in multiple canopy layers (van Woudenberg et al. in prep). The understory is more species-rich than mesic habitat type 1, and includes pine grass, bunch grass (*Elymus spicatum*), and rough fescue (*Festuca scabrella*). In contrast to type 1, these stands have a more developed shrub layer, characterized by kinnickinnick (*Arctostaphylos uva-urse*), saskatoon (*Amelanchier alnifolia*), rose (*Rosa nutkensis*), snowberry (*Symphoricarpos albus*), and soopolallie (*Shepherdia canadensis*). In drier habitat types slopes tend to be steeper (20-50%) than at mesic types, with south, south-east, south-west, and east aspects (Christie 1996). Nests are often located on ridges.

In the Cariboo-Chilcotin region, owls were detected during auditory surveys on steep upper slopes associated with the terrain break between the river valley below and plateau above (M.J. Waterhouse pers. comm. 1997). Aspects varied between north and south in the Chilcotin River Valley and east and west along the Fraser River Valley. Calling birds were detected in mesic to dry sites, frequently in the Interior Douglas-fir very dry, mild subzone (IDFxm) and occasionally in the IDF dry, cool (IDFdk3-4) variants.

Flammulated Owls appeared to prefer west and south-west aspects for nesting on Wheeler Mountain (Christie and van Woudenberg 1997). Insect abundance and activity may be optimal at these aspects since they are associated with greater understory development and have heat-retaining abilities with late-day sun exposure (west). Old-growth forest located on west and south-west aspects may provide some of the most productive habitats available to nesting Flammulated Owls throughout the species' range.

Nests also required nearby security cover (McCallum 1994b, van Woudenberg 1992). Nest trees or snags in mesic habitat types were typically surrounded by Douglas-fir thickets (Christie 1994, van Woudenberg 1992). In dry sites, less crowded, multi-layered canopies and openings were associated with nests. Access to the cavity entrance may be a more important selection criteria in dry habitats while security cover is likely a critical feature at mesic habitat types.

Flammulated Owls nest in Pileated Woodpecker (*Dryocopus pileatus*) and Northern flicker (*Colaptes auratus*) cavities in Douglas-fir and Ponderosa pine snags and veteran and/or decadent trees (McCallum 1994b). In Oregon, Ponderosa pine snags with Pileated Woodpecker cavities were selected by owls (Bull et al. 1990). Owls preferred Ponderosa pine to Douglas-fir as a species for nesting in British Columbia (Christie 1996, van Woudenberg 1992) and in Oregon (Bull et al. 1990). Also, 91% of the nests found in Oregon were in dead trees; the remaining nest trees were live (Bull et al. 1990). In B.C. between 1989-91, 75% of the nests found on Wheeler Mountain were in dead trees; 25% were found in live trees with dead tops (van Woudenberg 1992). In 1996, 67% of nests were in Ponderosa pine and 28% were in Douglas-fir snags; 1 nest was in a nest box (D.A. Christie and D.J. Low pers. comm. 1996).

Foraging Habitat Features

Critical foraging habitat required by nesting owls was identified to be small forest openings adjacent to thickets of regenerating Douglas-fir (van Woudenberg et al. in prep, D.A. Christie and D.J.

Low pers. comm. 1996, van Woudenberg 1992). Owls generally forage in openings (van Woudenberg 1992, pers. obs., Kamloops unpubl. data 1995-96), although they will glean budworm larvae from the canopies of Douglas-fir thickets during an outbreak (van Woudenberg 1992). Insect prey is caught on the wing from the understory as owls fly quickly through an opening into an adjacent tree or thicket. Flammulated Owls also glean insects from large, multi-branched mature and old trees.

Species composition and structure of forests in dry, south-aspect habitat types documented near Kamloops were more comparable with habitats in Colorado than mesic, north-aspect types (van Woudenberg 1992). However, foraging habitats documented in the more southerly parts of the species' range (McCallum 1994b) were more open than habitats in B.C. (Christie 1996). In particular, foraging habitat in Colorado had greater canopy development with more open stand structure than mesic habitat types in Kamloops, B.C. (van Woudenberg 1992, pers. obs.).

The understory characteristics of Ponderosa pine-Douglas-fir forests are particularly important for insect prey (Reynolds and Linkhart 1987). If insect abundance increases with shrub complexity, and sloped terrain enhances the amount of shrubs within a given horizontal distance, slopes may be selected by foraging owls (6-30%, Christie and van Woudenberg 1998). Steeper terrain may also facilitate escape from predators and accessibility to shrub and ground insects by shortening horizontal distances between habitat structures.

Indeed topography may be an increasingly important habitat feature at the northern limits of the Flammulated Owl's range. Foraging habitat may be restricted to areas conducive to warm air currents since air temperature influences nocturnal insect activity. For example, in the Cariboo-Chilcotin region, the valley slopes characterized by the IDFxm biogeoclimatic subzone are warmed by air currents that sweep up from the lower grasslands (Roberts and Roberts 1995). Similarly, warmer air trapped in the Fraser and Chilcotin River canyons travels upslope in the evening, potentially transporting insects. Micro-topographic features, such as ridges and gullies that bisect the major river canyon slopes, may facilitate favourable micro-climates for insects.

Open-canopy, old-growth pine forests may dry faster than other forest types following precipitation (Reynolds and Linkhart 1987). If this stand structure facilitates insect activity, Flammulated Owls may begin foraging sooner in old-growth pine forest after a storm than they could in other forest types (Reynolds and Linkhart 1987). Furniss and Carolin (1980) reported a higher diversity of Lepidoptera species in Ponderosa pine - Douglas-fir forests than any other coniferous forest type. Lepidoptera species tend to be associated with specific shrub species or communities (Reynolds and Linkhart 1987). Thus, the close link of the Flammulated Owl to Ponderosa pine-Douglas-fir forests may be through its food supply.

Photographs of nest sites near Kamloops showed that prey deliveries in dry habitat types included a variety of Lepidoptera and Orthoptera. At nests in mesic habitat types where there was little or no Ponderosa pine, Orthoptera were the most common prey item delivered (at least 50%) (van Woudenberg, Kamloops unpub. data 1995-96). In Oregon, Orthoptera were also found to be the most common type of prey foraging adults delivered to nests (Goggans 1986). Availability of large-bodied Lepidoptera species with high biomass may depend on the openness and understory development that is associated with Ponderosa pine. Orthoptera species may become an increasingly important type of prey to Flammulated Owls as the amount of Ponderosa pine in breeding habitat decreases northward, and particularly in mesic habitat types.

Security Habitat Features

Regenerating Douglas-fir thickets (D.A. Christie and D.J. Low pers. comm. 1996, van Woudenberg 1992) and large old trees with heavy branching (McCallum 1994b) provide security cover to Flammulated Owls. Immediately after capturing an insect on the wing in an opening, Flammulated Owls will fly into an adjacent thicket or veteran tree for hiding cover (van Woudenberg 1992).

Thickets used for security cover are denser in mesic habitat types than in dry types. The Barred Owl (*Strix varia*) an important predator of the Flammulated Owl - see Predation) is more common in mesic habitat types and appears to effect greater caution in Flammulated Owl behaviour than observed in dry habitat types (van Woudenberg 1992). Flammulated Owls were far less likely to be visible in habitats with a northerly aspect and remained hidden within dense thickets.

Roost and Song Trees

Douglas-fir is apparently preferred over pine for roosting because it provides greater cover (Linkhart et al. in press). However, the presence of dwarf mistletoe may enhance security cover in Ponderosa pine (Reynolds in pers. comm. to McCallum 1994b). In B.C., radio-telemetry has shown that owls preferred to roost in Douglas-fir trees (D.A. Christie pers. comm., van Woudenberg pers. obs.) close to nest sites, particularly when young were close to fledging (mean distance from nest=27m, n=5, SD=26.3; D.A. Christie and D.J. Low pers. comm. 1996). In Colorado, adult owls also roosted closer to the nest tree immediately prior to fledging (<100 to <20 m) (Linkhart in McCallum 1994b).

Hiding cover is also a feature of song trees (Reynolds and Linkhart 1992). In Colorado, radio-telemetry showed that old Ponderosa pine and Douglas-fir trees (> 289 years of age, on average) were selected for singing. In the Cariboo-Chilcotin region, large diameter (mean=67cm dbh, range=30-153.2, SD=22.5), tall, old Douglas-fir trees were associated with calling Flammulated Owls during auditory surveys (M.J. Waterhouse pers. comm. 1997). Song trees were identified usually by seeing the calling owl (M.J. Waterhouse pers. comm.).

Post-fledging Habitats

Little is known of post-fledging habitat other than radio-telemetry studies in Colorado (Reynolds and Linkhart 1992). Fledglings tended to disperse concentrically outward from their nest sites until they left their parents' territories (Linkhart and Reynolds 1992). Using radio-telemetry in Kamloops in 1996, three fledglings observed for at least 10 nights moved away from their nests but always remained in thickets of Douglas-fir near large openings (D.A. Christie and D.J. Low pers. comm. 1996).

Limiting factors :

Timber harvest

Since the last century, the species composition and structure of montane forests in western North America have been altered by timber harvest, fire suppression, and livestock grazing (Covington and Moore 1992, Harrington and Sackett 1992, Madany and West 1983, van Wagtendonk 1985, Skovlin et al. 1976).

The Flammulated Owl depends on commercially-valuable old-growth Ponderosa pine - Douglas-fir forests for breeding habitat. Dry Douglas-fir forests in B.C. have been affected by alternating management objectives, administrative changes, and economic demands. In the 1950 and 1960s, diameter limit cutting regimes in the Kamloops Forest Region tended to maintain and enhance Flammulated Owl habitat (van Woudenberg 1992). Larger trees were left, particularly in the 1950's (B. Olsen and D. Piggin pers. comm.). Until 1969 throughout the B.C. south-central interior, logs were processed on site using 'bush mills' (Vyse et al. 1990), which had an upper diameter limit log that could be processed (B. Olsen pers. comm.). In addition to large diameter trees, poorer quality trees were retained. The trees that were retained on site likely became some of the snags and broken-top nest trees that are currently used by nesting birds.

By the 1970's, "faller selection" was implemented in Kamloops (Vyse et al. 1990). Trees were cut from several age and size classes, enhancing an uneven-age class distribution and multi-layered canopy structure. All nest sites in the Kamloops area showed signs of past selective timber harvest (Christie pers. comm., van Woudenberg 1992). Flammulated Owl habitat was eliminated at these sites. In the mid-1980's, the silvicultural system changed to single tree selection throughout the dry-belt Douglas-fir. Although the system retained some large trees, their numbers will decline with repeated cutting. However, Flammulated owls overlap with some of the mapped mule deer winter range in the dry-belt Douglas-fir in the Cariboo. Single tree selection harvesting has been modified in these stands to accommodate winter habitat requirements for mule deer (Armleder et al. 1986), which will also benefit owl habitat.

Currently used single tree selection silvicultural systems retain 30-75% of the volume of wood overall, and maintain the distribution of diameter classes present on the site. Usually, 15-20% volume removal occurs every 50 years, with an objective to retain clumps of old trees, particularly wildlife trees. If Douglas-fir thickets are left in patches, uneven-aged management should retain suitable Flammulated Owl habitat at a landscape level. Habitat regeneration will be enhanced by silvicultural systems that remove only a few old trees and retain some mature trees so that openings are created that can promote Ponderosa pine regeneration.

Cutting trees for firewood can alter breeding habitat structure and have adverse effects on nesting owls. For example, decadent old trees or snags are frequently cut in the Kamloops and Cariboo Forest Regions (van Woudenberg pers. obs., M.J. Waterhouse pers. comm.). Firewood cutting can eliminate actual and potential nest trees as well as owl nests, if cutting occurs between May – early August.

Following clear-cut harvesting, Flammulated Owls were absent from areas in California where they had been documented several decades earlier (Marshall 1988). However, Flammulated Owls appear to return to stands after disturbances such as selective timber harvest (van Woudenberg 1992) and spring or summer grazing (Christie pers. comm., D.A. Christie and D.J. Low pers. comm. 1994-96). Large-diameter stumps were observed at all nest sites found on Wheeler Mountain, indicating that owls will use selectively harvested stands. Flammulated Owls avoided extensively spaced even-aged stands with a single canopy layer and no thicket component.

Fire Suppression

Over a century of fire suppression in the United States has changed the stand structure and species composition of coniferous forests that were once dominated and co-dominated by Ponderosa pine (van Wagtendonk 1983). Fire suppression has encouraged regeneration of shade-tolerant tree species (e.g., Douglas fir, Abies, Picea glauca) and resulted in overcrowded stands with poor crown and understory development (Harrington and Sackett 1992). Poor growth conditions that result from severe competition among crowded stems for limited nutrients (Covington and Moore 1992) combined with lack of species diversity (monoculture) encourages forest insect pests and diseases (Smith 1986).

Suppression of the natural fire cycle in dry Douglas-fir-Ponderosa pine forests since the early 1900's has contributed to similar stand conditions in British Columbia (Vyse et al. 1990). Regeneration of suitable nest trees is threatened in these stands due to the high risk of tree mortality prior to maturation. In particular, the lack of Ponderosa pine snags may have serious long-term consequences as these are the preferred nest trees of breeding owls (McCallum 1994b).

Single-species Douglas-fir stands provide limited habitat opportunities to Flammulated Owls. Foraging habitat suitability is low due to poor understory development and a cooler, moister micro-climate will depress insect availability. Douglas-fir monocultures may also indirectly increase the risk to Flammulated Owls of predation from Barred Owls (van Woudenberg 1992). The higher incidence of pest and disease in overcrowded Douglas-fir stands results in a considerable amount of coarse woody debris accumulation, which can enhance ground cover for rodents, the main source of prey for Barred Owls.

Barred Owls were often observed to be associated with this stand structure on Wheeler Mountain (van Woudenberg pers. obs., D.A. Christie pers. comm.).

Livestock Grazing

Grazing is common in the montane forests of western North America (Skovlin et al. 1976), including the dry Ponderosa pine - Douglas-fir forests in B.C. (Vyse et al. 1990). Livestock activity since European settlement has contributed to changing Ponderosa pine forest structure and species composition (Madany and West 1983). Grazing has altered the understory by reducing the herbaceous layer and increasing woody vegetation development. The loss of ground fuels in the herbaceous layer has resulted in reduction of the natural fire cycle, facilitating the dominance of Douglas-fir. In B.C., the combined effects of livestock grazing and fire suppression have reduced Ponderosa pine regeneration, decreasing owl nesting habitat, but increased regeneration of Douglas-fir thickets, enhancing owl security cover (van Woudenberg 1992).

Over the short-term, grazing may impact foraging habitat suitability. On Wheeler Mountain, owl nests were present in pastures only in seasons when they were rested from spring grazing (D.A. Christie pers. comm., van Woudenberg pers. obs.). Spring grazing reduced ground cover and habitat suitability for large insects, including Orthoptera. Light grazing had no impact on vegetation or owls. In the Cariboo Forest Region, owls were detected in grazed forests where many sites were too steep for cattle to use.

Food supply

The Flammulated Owl's insectivorous diet may make it potentially vulnerable to aerial spraying of bacteria (*Bacillus thuringiensis*, or Bt) as a management tool used to control Lepidopteran pests. The major cyclical defoliator species of dry Douglas-fir forests in B.C. are the Douglas-fir tussock moth (*Orgyia pseudotsugata* McD.) and western spruce budworm. Western spruce budworm tends to occupy the elevational band in which Flammulated Owl habitat occurs. The aerial spray is targeted at Lepidopteran larvae (Furniss and Carolin 1980) and the impact on Flammulated Owl food supply is unknown.

Increases in insect pest species, such as the Mountain pine beetle *(Dendroctonus ponderosae* Hopkins) in Ponderosa pine forests of the United States (Barrett 1979), suggest the potential for dramatic changes in the insect community. The consequences of species and structural changes in dry Douglas-fir – Ponderosa pine forests on insect ecology are unknown in B.C. The potential subsequent impact on owl diet composition is also unknown and may deserve investigation.

Predation

In Kamloops, Flammulated Owls are susceptible to predation by Barred Owls (van Woudenberg 1992). Radio-telemetry studies and nest site observations suggest that Barred Owls may prey on fledglings (D.A. Christie and D.J. Low pers. comm. 1994-96, van Woudenberg pers. obs.). Adult Flammulated Owls behaved more cautiously in habitats where Barred Owls were encountered by remaining concealed in thickets of Douglas-fir. Adult male Flammulated Owls have been observed to leave what appeared to be potential nesting territories after Barred Owls came into the area (van Woudenberg pers. obs.).

In Colorado, predation risk to Flammulated Owls was highest during the day (Linkhart and Reynolds 1987). Important predators included the Sharp-shinned hawks (*Accipiter striatus*) (B. Linkhart pers. comm. to van Woudenberg). Black bears *(Ursus americanus*) have also been known to prey on Flammulated Owls, particularly nestlings (R. Reynolds, pers. comm.) and there are records of bears mutilating nest cavities (Reynolds and Linkhart 1987). Richmond et al. (1980) reported nest predation by either bobcat (*Lynx rufus*) or black bear.

Northern flying squirrels (*Glaucomys sabrinus columbiensis*) in B.C. (van Woudenberg 1992) and Abert's squirrels (*Sciurus aberti*) in New Mexico (McCallum and Gehlbach 1988) may prey on owl eggs, nestlings, or females. They may also compete with owls for cavities. Northern flying squirrels have been seen in cavities previously used by nesting owls (van Woudenberg 1992) and in Flammulated Owl nest boxes on Wheeler Mountain (D.A. Christie pers. comm.). In Penticton, a flying squirrel apparently killed a female owl in a nest box (Cannings and Cannings 1982).

Other reported causes of mortality include a Flammulated Owl found in California with a large long-horned grasshopper (family Tettogoniidae) lodged in its throat (Kenyon 1947).

The fact that dead adult Flammulated Owls have been found in northern breeding habitat outside the breeding season (McCallum 1996, Cannings 1994) suggests that significant mortality may occur during migration. Owls that are trapped in inclement weather en route may be susceptible to injury or starvation.

Human disturbance

Disturbance by researchers making observations at nest sites early in the nesting period apparently prevented males from making prey deliveries to brooding females (van Woudenberg pers. obs). For example, after a male had made several repeated attempts to deliver prey but failed to enter the cavity, he would eventually habituate to an observer's presence, and, suddenly, enter the cavity quickly and feed the female (van Woudenberg pers. obs.). On other occasions males would remain hidden and call to the female; later the begging female would often leave the cavity and join her mate in a thicket of Douglas-fir. The female risks predation by leaving the cavity, and the eggs or young, if they are already present, will cool.

These observations emphasize the importance of minimizing disturbance to nests and breeding owls. For the same reasons, forest operations or other management activities should be minimized in areas where owl nests are known to occur. If disturbance is extensive or continuous, the nest can be abandoned.

Special significance:

The Flammulated Owl's adaptation to dry Douglas-fir – Ponderosa pine forest in western North America make it both vulnerable to forest change (McCallum 1994b) and a possible indicator species of mature old-growth montane forests. Occupancy by breeding Flammulated owls suggests that a forest has a mixed-age class with some old-growth features. There is a growing interest and concern among the general public about the conservation of old-growth dwelling species such as the Flammulated Owl (Vyse et al. 1990). Naturalist groups and wildlife viewing tours often 'target' the Flammulated Owl as a features species (D. Fraser pers. comm.). There is also interest for the species among public groups that include school children, university students, tourists, and large urban community groups.

Protection:

The Flammulated Owl is protected under the B.C. Provincial Wildlife Act (Section 34, 1982). It is an offence to destroy or mutilate eggs, nesting adults and active nests. The 1995 Forest Practices Code of British Columbia has some provisions for special management of Flammulated Owl habitat. Upon release, Forest Practices Code Volume 2 of Identified Wildlife Management Strategy will include the Flammulated Owl. The Flammulated Owl is on the B.C. provincial blue-list.

Evaluation and proposed status:

Despite considerable advancements in our knowledge of the Flammulated Owl over the past decade, information gaps regarding its population size, distribution, and habitat requirements persist. Management for long-term sustainability of the species will require better knowledge of its breeding range and distribution in B.C., availability of suitable habitat, the species' fecundity, areas of high and low productivity (source and sink habitats), and threats to its habitat requirements.

The Flammulated Owl is inherently vulnerable because of its life history strategy (relatively K-selected - long lived with low fecundity) and dependence on commercially valuable western montane forests (McCallum 1994b). Owls are long-lived (up to 11 years, B.D. Linkhart pers. comm.) which can mask low recruitment for several years.

Given the owl's small and patchily distributed population, and its dependence on Douglas-fir and Ponderosa Pine forests that are subject to commercial timber harvest and alteration by other activities such as grazing, it is recommended that the 'Vulnerable' status be retained for the Flammulated Owl.

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David A. Kirk obtained his Masters degree in conservation from University College London in England in 1983 and his Ph. D. in zoology from the University of Glasgow (Scotland) in 1989. He has 16 years experience as a research ecologist designing and conducting fieldwork and scientific writing. He has a special interest in applied ecological research and has worked the last nine years as a consulting research ecologist. He has provided recommendations on forest management or farmland management to enhance and conserve wildlife, especially birds. More specifically, he has a long-standing interest in raptor conservation and management and for nine years he rehabilitated raptors to the wild that were orphaned or were incapacitated (1969-1978).

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Figure 1. Distribution of the Flammulated Owl in British Columbia (From Fraser et al. 1999.)

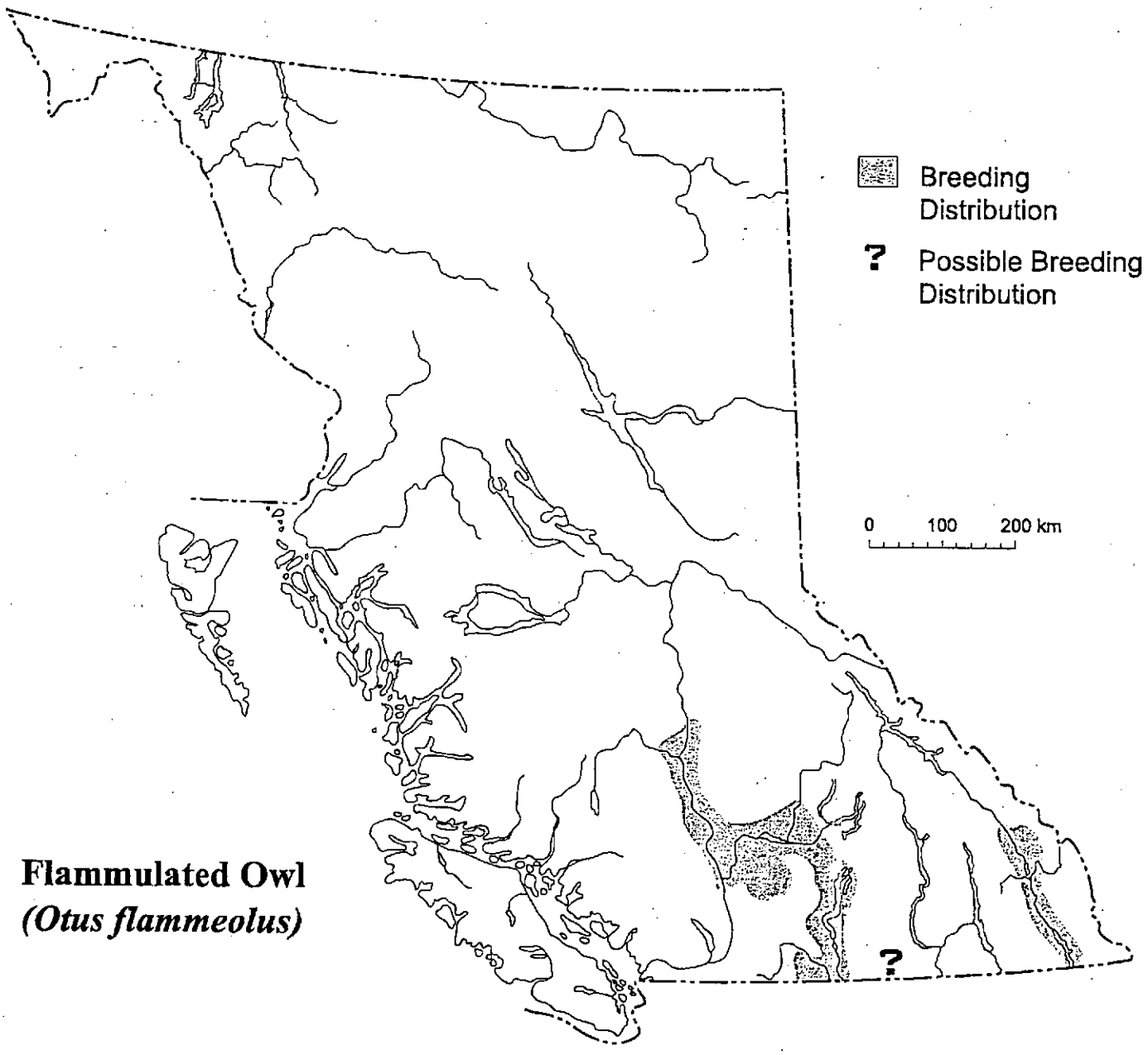
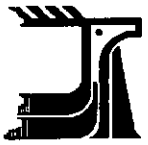


Table 1 Biogeoclimatic records of Flammulated Owl distribution in B.C.

Provincial Region	Subzone/Variant	No. FLOW records	Proportion of observations	No. of stations/km surveyed	No. of FLOW / linear km	Source
Okanagan	PPxh1	>6	<12%			St. John 1991
	IDFxh1	21,>34	54%,<69%			Cannings and Booth 1997; St. John 1991
	PP/IDFxh1	9	18%			St. John 1991
	PP/IDFxh2	12	31%			Cannings and Booth 1997
	IDFdk2	6	15%			
Kamloops and Merritt	PPxh2	1	<1%	123/62.5 km	.02	van Woudenberg et al. 1995
	IDFxh2	42	55%	298/150km	.28	
	IDFxw	10	13%	45/23.5 km	.43	
	IDFdk1	14	18%	148/75 km	.19	
	IDFdk2	6	<1%	80/41 km	.15	
	IDFdk3	3	<1%	29/15.5km	.19	
Cariboo-Chilcotin	BGxw2	3	6%			CFR unpub. data 1996
	IDFxm	6	13%			
	IDFdk3 and dk4	38	81%			
Kootenays (Rocky Mountain Trench)	IDFdm2	1	N/A			B.C. Conservation Data Centre 1998

Table 2 Estimated numbers of nesting pairs of Flammulated Owls in B.C.

Region	Estimated numbers of FLOW pairs	Observer
Okanagan	100	R.J. Cannings pers. comm.
Merritt Forest District	Pending model results	Christie and van Woudenberg 1998
Lillooet Forest District	50-100	From Williams and Woodward 1989 and pers. obs.
Kamloops Forest District	Pending model results	Christie and van Woudenberg 1998
Cariboo-Chilcotin Region	100-200	M. Waterhouse pers. comm.



MANDATE

COSEWIC determines the national status of wild species, subspecies, varieties and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following groups: fish, amphibians, reptiles, birds, mammals, molluscs, lepidoptera, vascular plants, mosses and lichens.

MEMBERSHIP

COSEWIC is comprised of representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada, Fisheries and Oceans, Canadian Museum of Nature), three national conservation organizations (Canadian Nature Federation, Canadian Wildlife Federation, and World Wildlife Fund Canada) and the chairs of the scientific species specialist groups. The Committee meets annually in April to consider status reports on candidate species.

DEFINITIONS

Species	- Any indigenous species, subspecies, variety or geographically defined population of wild fauna and flora.
Extinct (X)	- A species that no longer exists.
Extirpated (XT)	- A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	- A species facing imminent extirpation or extinction.
Threatened (T)	- A species likely to become endangered if limiting factors are not reversed.
Vulnerable (V)	- A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)	- A species that has been evaluated and found to be not at risk.
Indeterminate (I)	- A species for which there is insufficient scientific information to support status designation.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. COSEWIC meets annually in April each year. Species designated at this meeting are added to the list.

Environment Canada
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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.