

COMMITTEE ON THE
STATUS OF ENDANGERED
WILDLIFE IN CANADA

OTTAWA, ONT. K1A 0H3
(819) 997-4991

COMITÉ SUR LE STATUT
DES ESPÈCES MENACÉES
DE DISPARITION AU
CANADA

OTTAWA (ONT.) K1A 0H3
(819) 997-4991

**STATUS REPORT ON THE BOREAL OWL
*AEGOLIUS FUNEREUS***

IN CANADA

BY

DAVID A. KIRK

**STATUS ASSIGNED IN 1995
NOT AT RISK**

**REASON: WIDESPREAD; NO EVIDENCE OF DECLINE; NO OBVIOUS
THREATS [PROBABLY MOST COMMON OWL IN CANADA].**

OCCURRENCE: ALL PROVINCES AND TERRITORIES

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statut national aux espèces canadiennes en péril.**



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IN CANADA



BY

**DAVID A. KIRK
C/O CANADIAN WILDLIFE SERVICE
ENVIRONMENT CANADA
OTTAWA, ONTARIO
K1A 0H3**

**STATUS ASSIGNED IN 1995
NOT AT RISK**

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Executive Summary

Description. The Boreal Owl *Aegolius funereus* (known as Tengmalm's Owl in Europe) is a small forest owl (males 93-193 g, females 132-215 g) with a large head and relatively long wings. Its distinguishing feature is a conspicuous greyish-white facial disc, bordered by blackish-brown feathers and white eyebrows. The olive-brown crown has numerous white round spots or teardrop-shaped droplets (which together with the buff-white bill distinguish the Boreal Owl from the Northern Saw-whet Owl *Aegolius acadicus*), and the hindneck has irregular white spots (some heart-shaped). The underparts are creamy-white with brown and russet streaks. The upperparts are generally umber brown with large white spots and irregular blotches. The primaries have five rows of white spots, and the tail has three rows of white spots. The iris is yellow. Young Boreal Owls have uniform dark brown underparts which distinguishes them from young Northern Saw-whet Owls.

Distribution. The precise distribution of the Boreal Owl in Canada is not known. However, it is assumed to breed from the tree line south to the north shore of Lake Superior, from central Yukon to southern New Brunswick and the Madeleine Islands in Québec. In the United States, Boreal Owls breed in Alaska and they probably also breed in the northern lake States of Michigan, Minnesota and Wisconsin, as well as in Maine. A southern extension of range occurs through the Cascade Ranges, Blue and Rocky mountains to Utah and Colorado. Boreal Owls have a holarctic distribution and are also found in the taiga belt through Eurasia to Siberia.

Population size and trends. Extremely little is known of the Boreal Owl's population status in Canada, although it is presumed to be common because of the extensive habitat available. Few Boreal Owls are counted on the Breeding Bird Survey, which takes place in June, well after the main calling period for the species. Also, Boreal Owls were counted on too few Christmas Bird Counts to estimate population trends. There are also few records of confirmed breeding in the species from Breeding Bird Atlases and most authors suggest that the species is under-recorded because of timing of surveys or lack of coverage. Migration counts, particularly at Whitefish Point Bird Observatory (WPBO), Michigan, probably include many birds of Canadian origin and indicate that some owls move southwards each year. There are irruptive movements on a cyclic basis (3-4 years) probably coinciding with crashes in microtine vole populations. A nocturnal volunteer owl survey, initiated in Manitoba in 1991 provides new density estimates and may give the first trend estimates for Canadian boreal forest in the future.

Habitat. Preferred habitat of Boreal Owls in northern Ontario are mixed wood forests of black and white spruce *Picea mariana* and *P. glauca*, balsam fir *Abies balsamea*, trembling aspen *Populus tremuloides*, balsam poplar *Populus balsamea* and white birch *Betula papyrifera*. Generally, however, Boreal Owls prefer old mixed forests, with large trees for cavity nesting.

General biology

Although thought to be monogamous and single-brooded in North America, the Boreal Owl may be polygamous and raise multiple broods when prey populations peak, as in Europe. Polygamy and multiple broods enable owls to achieve peak reproductive success during years when vole prey populations are abundant. Boreal Owls nest in cavity nests previously excavated by Pileated

Woodpeckers *Dryocopus pileatus* and Northern Flicker *Colaptes auratus*. Normally resident year-round in some parts of their range, Boreal Owls migrate from areas where vole populations cycle and disperse south of their breeding range. Because Boreal Owls are banded each year at bird observatories in the northern United States, it appears that southward movements from Canada may occur each year.

Limiting factors. The main factors limiting Boreal Owl populations are probably the availability of cavities for nesting and food supply. The latter affects populations through its effects on clutch size and movements. When prey are scarce, nomadism of owls may increase their susceptibility to mortality. In Europe, another factor limiting population size is the lack of natural cavities for breeding. This is not likely to be a factor limiting Canadian populations of Boreal Owls although this may change with the trend in forest management to decrease rotation age and remove 'overmature' mixed wood forests. Southern distribution of Boreal Owls may be limited by temperature (heat stress).

Special significance of the species. The Boreal Owl has special significance because it may be extremely widespread, possibly one of the most common owls in Canada and yet very little is known about the species. Because it requires large diameter aspen for nesting, forest management for Boreal Owls might include retention of snags or areas of old forest, or provision of nestboxes. In Europe intensive research on Boreal Owls since 1966 has identified several unique adaptations to fluctuating prey populations, as well as determining the lifetime reproductive success of individual owls. Research on Boreal Owls in North America has focused mostly in their southern range - subalpine mountains and their ecology in these regions may not be typical of that in their main range.

Conclusions. There is insufficient information on the Boreal Owl in Canada to determine population status and trends for the species. There has been only one study of the species in Canada, although several ongoing studies include investigations of Boreal Owls as part of research on raptor communities in boreal forest.

A Abstract

The Boreal Owl *Aegolius funereus* is a small, northern forest owl with a holarctic distribution from Alaska through Canada and northern and central Europe and Asia. In Canada it occurs throughout the boreal forest from the tree line to the northern shores of Lake Superior. Little is known of the population status of Boreal Owls but judging by the extensive habitat available and surveys of breeding densities in northern Ontario and Alberta, it could be one of the most common owl species in Canada. Preferred habitats for Boreal Owls in Ontario are mixed boreal forests, with black spruce *Picea mariana*, white spruce *Picea glauca*, balsam fir *Abies balsamea*, trembling aspen *Populus tremuloides*, balsam poplar *Populus balsamea* and white birch *Betula papyrifera*. In North America, Boreal Owls are believed to be monogamous, but studies in Europe demonstrate that polygyny is common. Cavities excavated by Pileated Woodpeckers *Dryocopus pileatus* and Northern Flicker *Colaptes auratus* are used as nest sites. Clutch size is related to prey abundance, principally microtine voles. Asynchronous hatching of eggs is a strategy for ensuring brood reduction in periods of food shortage during breeding. Although populations are resident in areas with diverse prey species and where prey populations fluctuate little, they are partially migratory (males remain on territory, females migrate) where moderate fluctuations in prey populations occur, and completely migratory where microtine vole populations cycle. The link between irruptions and prey populations has been studied in detail in Europe, but data are few for North America, particularly Canada. There are insufficient data on population size and trends in Canada and it is therefore not possible to recommend a COSEWIC status.

B Distribution

The Boreal Owl *Aegolius funereus* (or Tengmalm's Owl in Eurasia) is found throughout the transcontinental Boreal forest zone (Fig. 1). It has a holarctic distribution with a continuous population through the boreal forests of Canada, Alaska and some of the northern United States, as well as northern and central Europe and Asia. South of this zone, populations are more scattered and largely restricted to subalpine forests.

1) Canada. Owing to its nocturnal habits and small size, the precise distribution of the Boreal Owl in Canada is not well documented. However, suitable breeding habitat (see below) in Canadian boreal forest is extremely extensive, from the tree line south to the northern shore of Lake Superior (Godfrey 1986). According to Godfrey (1986) the Boreal Owl "breeds (details of full breeding range not well known) in woodland from central Yukon (Forty Mile; possibly north to Old Crow), Mackenzie (Fort Simpson; probably north to Lake Hardisty and possibly even to Mackenzie Delta where early autumn occurrence has been reported); northern Saskatchewan (Lake Athabasca); northern Manitoba (probably York Factory and Cape Churchill); northern Ontario; central Québec (probably Paul Bay; possibly Lake Aulneau); and Labrador (Hopedale); south to northern British Columbia (Flood Glacier; probably Laurier Pass); central Alberta (Belvedere, Jasper, Banff, and lower Kananaskis valley); central-eastern Saskatchewan (Nipawin); southern Manitoba (near Winnipeg, Shelley); central Ontario (Kenora, Mildred, Kaspuskasing); southern New Brunswick (Grand Manan); and Madeleine Islands, Québec. Probably breeds also in Newfoundland, but evidence is inconclusive.

Winters within breeding range and southward; north at least to northern British Columbia (Atlin); southern Mackenzie (Fort Simpson); central Manitoba (Herb Lake); south-central Québec (Lake Mistassini); and southern Labrador;

south in irregular (occasionally substantial) numbers to southern parts of all the provinces including the Maritimes and Newfoundland.'

2) United States. Alaska has the largest area of suitable habitat in the United States; Boreal Owls also breed in the northern United States such as northeastern Minnesota (Eckert and Savaloja 1979, Lane 1988), and probably in Maine, Michigan and Wisconsin (Hayward and Hayward 1993). Outside this area, which forms the main distribution, there are populations of Boreal Owls in subalpine mountains (Cascades Ranges, Blue and Rocky mountains; in Washington, Idaho, Montana, Wyoming and Colorado (Palmer and Ryder 1984, Hayward et al. 1987, Whelton 1989, Hayward and Hayward 1993). During irruptions, Boreal Owls overwinter in some northern states (New York, Michigan, Minnesota) in relatively large numbers (e.g., Kelley and Roberts 1971, Evans and Rosenfield 1977).

3) Worldwide. The Boreal Owl (Tengmalm's Owl) has a holarctic distribution and in Eurasia is found from northern Scandinavia, northern Russia and northern Siberia, south to mountains in southern Europe, the western Himalayas, western China, Sakhalin and Kamchatka (AOU 1983, Cramp 1985).

C Protection

The Boreal Owl is protected under the Migratory Birds Treaty in the United States, while in Canada the species is afforded limited protection by provincial legislation. Because it inhabits northern regions with low populations for most of the year, as well as being small, inconspicuous and generally roosting at high locations (mean 6 m in northern Rocky Mountains), the Boreal Owl is likely not vulnerable to persecution by humans.

D Population size and trends

There are few data on the population size or trends of Boreal Owls in Canada. Although Taverner (1922) referred to the species as 'the rarest of Canadian owls', Bondrup-Nielsen (1978) believed that in suitable habitat Boreal owls were likely abundant. Even as early as 1903, Nuttall indicated that the species was 'common on the banks of the Saskatchewan', 'common in Manitoba and found throughout the fur country', 'common and found breeding on Magdalen Island' and as common on the north shore of the Gulf of the St. Lawrence, but rare in Québec city. In the Athabasca-Mackenzie region, Boreal Owls were believed to be 'quite generally distributed throughout the wooded portion of the region in the summer - though rather rare and seldom observed (Preble 1908). In his summary of the status of Canadian raptors, Fyfe (1976) considered the Boreal Owl to have a low abundance in the Maritimes, the Prairies, British Columbia and the Northwest Territories and Yukon and rare-low abundance in Ontario and southern Québec (absent from Sault Ste. Marie area). Although there was almost certainly confusion between the Boreal Owl and its close relative the Northern Saw-whet Owl *Aegolius acadicus* in early accounts, given the huge area of potential habitat in the boreal forest, the species may well prove to be the most common of Canadian owls (Shepherd 1992).

Boreal Owls are rarely recorded on Breeding Bird Survey routes (Robbins et al. 1986, B. Peterjohn pers. comm.) partly because these are censused after the main calling period in March to April or May (Bondrup-Nielsen 1978) and partly because most routes are too far south to record the

species. Collins and Wendt (1989) reported only 11 BBS routes in the period 1966-1977, and no records of Boreal Owls; between 1978-1983 there were only 5 potential routes and an index of 0.20 Boreal Owls in the Maritime provinces. Too few circles were counted on Christmas Bird Counts for this species between 1959-1988 to analyse population trends statistically (18 records for the whole of North America; B. Hoover pers. comm.). Furthermore, Boreal Owls are an irruptive species and their population densities fluctuate in relation to prey abundance, principally microtine voles; this makes estimates of population trends and status difficult.

There are five possible sources of information on Boreal Owl populations: breeding bird atlases for each province or state, migration counts at Great Lakes bird observatories (Grigg 1990, 1991 a,b, 1992; W. Grigg, Whitefish Point Bird Observatory research, pers. comm.), surveys conducted specifically to detect owl species (Duncan and Duncan 1993), local studies of breeding populations (e.g. Bondrup-Nielsen 1978, Lane et al. 1993) and lastly, Nature Conservancy rankings.

Breeding Bird Atlases. During the Maritime breeding bird atlas there were only 11 records of this species (or 0.7% of the 1,529 squares surveyed), eight of which were probable and three were possible breeding records (Erskine 1992). Except for the one record from Prince Edward Island, all of these records were from northeastern New Brunswick and Cape Breton Island. Although Boreal Owls were undoubtedly under-represented during the atlas, the low number of breeding records is not surprising given that the Maritimes are probably at the southern limit of the Boreal Owl's range (Erskine 1992). Erskine (1992) believed that the total population of the Maritimes could not be more than a few hundred pairs (with under 50 pairs for New Brunswick and Nova Scotia and under five pairs for Prince Edward Island. Breeding records from Grand Manan (1924-1932) are thought by Erskine (1992) to represent only a temporary colonization.

In Québec, there were five confirmed records of breeding for this species; a further four were probable and five possible (a total of 14 squares out of the 2,464 surveyed, or 0.6%; J. Gauthier pers. comm., Gauthier and Aubry in press). The remaining records (n = 9) were of sightings only. Boreal Owls breed on the Madeleine (Magdalen) Islands, and throughout central Québec (between 50° and 54° north). There were reports from Anticosti and Gaspésie (David 1980).

Until Bondrup-Nielsen (1976) discovered a nest in northern Ontario in 1975, there were no breeding records of Boreal Owls in the province of Ontario and only 20 records for the whole of Canada. The breeding range of the species in Ontario is assumed to extend from the treeline to Lake Nipigon and Kapuskasing (Godfrey 1986), but there are few data to document this and breeding may well extend south to Sudbury in some years (see Mills 1987). During the Ontario breeding bird atlas a second nest with young was found in 1984, 13 km west of Atikokan (Mills 1987). Only one other record was of confirmed breeding when fledged young were found near Timmins. Over Ontario as a whole breeding was considered probable in only three (2%) of 137, 10 x 10 km blocks and possible in 12 (9%). In southern Ontario there were only two records of possible breeding (close to Sudbury; Mills 1987). During the Atlas 75% of abundance estimates were of 2-10 pairs, while the rest were of single pairs only (Mills 1987). No further breeding records were reported during the ORBBP between 1989-1991 (ORBBP in prep.), although D. Elder (in pers. comm. to ORBBP in 1991) estimated 50 pairs in the Lake-of-the-Woods region, where there was previously only a possible record from one square in this area (Mills 1987).

In Manitoba, there are only seven breeding records and these are widely distributed from Churchill to South Junction, near Minnesota (Taylor 1983, G. Holland pers. comm.; H. Copland and B. Taylor in pers. comm. to G. Holland, Duncan and Lane unpublished data). G. Holland (pers. comm.) considered the species a 'rare and permanent resident of Manitoba'. Boreal Owls were also recorded during Manitoba's nocturnal owl survey (see special owl surveys; Duncan and Duncan 1993).

In Saskatchewan, there are no records of confirmed breeding of the Boreal Owl (Smith in press). However, there is one probable breeding and 38 possible records (Smith in press). Most of the remaining records were of winter residents ($n = 25$), as well as summer visitants ($n = 2$) and fall transients ($n = 1$; Smith in press). Smith (in press) described the species as an uncommon permanent resident. In winter, heavy snow can force birds south into the parkland region; in 1959-1969, 38 Boreal Owls were reported from as far south as southeastern Saskatchewan (Smith in press).

Semenchuk (1992) described the Boreal Owl as 'uncommon and widely distributed during the Atlas survey period' in Alberta. Only five records were of confirmed breeding over the five-year Atlas period, and the total number of records was 36 (Semenchuk 1992). The remaining breeding records were of probable ($n = 5$) or possible ($n = 21$) status. In relation to habitat types, 14 records were from the boreal forest natural region, 14 from the north Saskatchewan river and the foothills, eight from the Rocky Mountains and the remainder south to Canmore (Semenchuk 1992).

Finally, Campbell et al. (1990) described the Boreal Owl as a 'rare resident in the northern interior (of British Columbia), and probably a rare resident at higher elevations in the southern interior'.

Campbell et al. (1990) suggest that the species is probably a widespread breeder. It is also an 'irregular, but very rare winter visitant to lower elevations in the southern interior' and 'casual in autumn and winter west of the Coast Mountains' (Campbell et al. 1990). There are only three breeding records for British Columbia; two were records of fledged young (one collected at Flood Glacier in 1919 and the other of four young 40 km northwest of Wonowon) (Campbell et al. 1990), while the third was an infertile egg found in a nest box intended for Northern Saw-whet Owls *Aegolius acadicus* (R.J. Cannings in pers. comm. to Campbell et al. 1990).

Migration counts. Migrant Boreal Owls are banded each spring at Whitefish Point Bird Observatory (WPBO) in Michigan (Kelley and Roberts 1971, Wiens 1989), where they are the most abundant owl banded (Grigg, 1993) and at Hawk Ridge Mountain, Minnesota. In 1988, a peak record of 163 owls were banded (Powell 1988, Grigg 1991 a,b, 1992). Many of these owls are almost certainly of Canadian origin, but because they migrated northward so late in the spring (between 1 April and 31 May; personal files of W. Grigg, WPBO research) it is unlikely that they bred in the year of capture. This is also suggested by separating age classes of Boreal Owls at WPBO. Ageing has been done by experienced staff banders since 1988, whereas prior to this there were many inconsistencies with volunteer banders. These data suggest that a large proportion of owls passing through WPBO are second year birds (i.e. those that hatched in the preceeding breeding season) that do not breed in the following summer. When corrected for banding effort, the data also provide strong evidence of cyclic population fluctuations or irruptions on a four-year basis (see Fig. 2; data from personal files of W. Grigg). Fall banding commenced in 1991, and a total of 21 owls were captured in that year. Because migration movements of Boreal Owls through bird observatories are probably related to successful breeding (i.e. dispersing young), banding data provide important information on population status and trends in this species.

Special owl surveys The first survey specifically targeting Boreal Owls and Great Gray Owls *Strix nebulosa* in Canada is being organized by J. and P. Duncan in Manitoba. Based on the use of playback tapes to elicit responses of male owls, these surveys have been conducted for three years. A total of 38 Boreal Owls were recorded in 1991, 20 in 1992 (as well as an additional 19 outside the southeastern Manitoba study area), and 46 in 1993 (in Manitoba and adjacent Minnesota). When corrected for distance surveyed these results gave 0.061 owls/km in 1991, 0.034 owls/km in 1992 and 0.0694 owls/km for the southeastern Manitoba study area in 1993 (Duncan and Duncan 1993). Outside the southeastern Manitoba study area Boreal Owls were detected more frequently in 1992 than 1993 (0.1124 owls/km compared to 0.0081 owls/km). These differences are likely due to normal fluctuations in the population in response to fluctuations in microtine vole prey. More data will enable determination of trends in Boreal Owl densities in the areas surveyed.

Boreal Owls are also heard regularly in northwestern Ontario, in the Thunder Bay and Sibley Peninsula areas (N. Escott and A. Harris in pers. comm. to Shepherd 1992).

A nocturnal survey comparable to the one in Manitoba has been conducted in northeastern Minnesota since 1987 (Lane et al. 1993). Between 1987-1993, 5,550 km were surveyed resulting in counts of 13 in 1987 (four per 160 km), 37 in 1988, 72 in 1989 (9.5 per 160 km), 19 in 1990, 30 in 1991, 31 in 1992 and 21 in 1993 (Lane et al. 1993).

Local studies The most intensive investigation of Boreal Owl populations is in the River of No Return Wilderness (RNRW) and elsewhere in the northern Rocky Mountains of western Montana, Idaho and northwestern Wyoming (Hayward and Hayward 1993, Hayward et al. 1993). However, there are few studies from the boreal forest region of Canada, the first being Bondrup-Nielsen's (1976) study in northern Ontario and central Alberta. Along a 40 km stretch of highway near Kapuskasing, Bondrup-Nielsen (1978) located 11 Boreal Owl territories. During the entire study Bondrup-Nielsen (1978) located 29 Boreal Owls and for six individuals he found the prospective nest sites.

J. Duncan has erected 200 nest boxes in Manitoba designed for use by Boreal Owls but none have been occupied; this may be because natural cavities are not limiting or because boxes have to 'weather' sufficiently to become acceptable to the owls. In G. Bortolotti's American Kestrel *Falco sparverius* nestbox study, four boxes have been occupied by Boreal Owls. By monitoring nest site occupancy and productivity, the response of Boreal Owls to habitat change can be assessed (see Hayward et al. 1992).

A recent 10-year research Boreal Forest Ecosystem Project on raptor communities at Kluane Lake, southwestern Yukon (Krebs et al. 1992), includes work on Boreal Owls but has not been published. Preliminary results suggest highly cyclic fluctuations in Boreal Owl populations, with birds failing to breed at all during low cycles in prey populations (F. Doyle pers. comm., C. Rohner pers. comm.). For example, at a population low (1989-1992), only 0-2 males calling/100 km² were detected, but in 1993-1994 when breeding densities increased in relation to increased vole populations, there were about 15 males calling/100 km² (F. Doyle pers. comm., Kluane Lake Ecosystem Project unpubl. data).

Nature Conservancy Rankings Available provincial Nature Conservancy ranks consider the Boreal Owl as an S4 (i.e. widespread, abundant, and apparently secure in province, with many occurrences, but it

is of long-term concern) in Québec (M. Huot pers. comm.), as an S3 (i.e. rare or uncommon in province [on the order of 21 to 100 occurrences) /S4 in Ontario (this will be updated to an S4 - D. Sutherland pers. comm.); S5 B (demonstrably widespread, abundant and secure in province and essentially ineradicable under present conditions) in Saskatchewan (J. Duncan pers. comm.); and finally S4 in British Columbia (S. Cannings, pers. comm.).

One way in which to estimate total population size is to use breeding densities at sampling sites and extrapolate to the total area of available habitat, although this can be highly misleading because of patchy distribution. Using the density estimates given above and given that boreal forest in Canada covers an area of about 3.3 million km² this suggests that the population of Boreal Owls may be quite large. However, there are few breeding density estimates for Canada and there are also few reliable estimates from elsewhere in the species' range. Also, numbers of calling males varies greatly from year to year (Reynolds et al. 1990) which introduces more biases into this method for estimating population size.

E Habitat

General Boreal owls prefer forests dominated by black spruce *Picea mariana*, white spruce *Picea glauca*, balsam fir *Abies balsamea*, balsam poplar *Populus balsamea*, trembling aspen *Populus tremuloides* and white birch *Betula papyrifera* (Bondrup-Nielsen 1976, Meehan and Ritchie 1982) - tree species typical of a large area of Boreal forest in Canada and Alaska (Rowe 1972). Few data are available on habitat associations of Boreal Owls from eastern Canada. Bondrup-Nielsen (1978) suggested that Boreal Owls required lowland conifer forests for foraging and roosting and upland deciduous (aspen) forests for nesting. In Ontario, Boreal Owls occur in mesic, mature forests with deep litter, and forest edges close to cutover areas, bogs, and beaver meadows (Shepherd 1992). Semenchuk (1992) described the habitat of Boreal Owls as coniferous and mixed wood forests, and stated that they avoided large stands of pine. In British Columbia, Campbell et al. (1990) considered white spruce and trembling aspen as preferred habitat. Boreal Owls have also been recorded in Engelmann spruce *Picea engelmannii* in the Kamloops region, as well as Douglas fir *Pseudotsuga menziesii* - lodgepole pine *Pinus contorta* and subalpine fir *Abies lasiocarpa* - Engelman spruce forest types in the southern interior and in Douglas fir - western red cedar *Thuja plicata* at Lillooet Lake (Campbell et al. 1990). The association of Boreal Owls with these forest types in British Columbia is comparable to the situation in the southern part of their North American range (see below).

In northern Minnesota and Michigan, old aspen and mixed forests are preferred (Eckert and Savaloja 1979, Lane 1988). In the southern parts of its North American range, in the subalpine mountains, forests of subalpine fir *Abies lasiocarpa* and Engelmann spruce *Picea engelmannii* as well as transition zone forests are preferred by Boreal Owls (Palmer 1986, Hayward et al. 1987). Mature forests are favoured for foraging since in winter their microclimate allows easier access to prey (snow without a crust and shallower snow depth) and in summer easier prey location due to lack of ground vegetation (Hayward and Hayward 1993).

Nesting Locations of nest sites and roosts suggest that in their main range Boreal Owls prefer mixed woods, particularly those with aspen. Of the six probable nests located in Ontario by Bondrup-Nielsen (1978), three were in live trees and three were in snags; all were in aspen. A further six possible nests

included two in live trembling aspens, and four in dead aspens (Bondrup-Nielsen 1978). The site reported by Peck and James (1983) was one of the six probable nests found by Bondrup-Nielsen (1976) in a cavity formed by a branch scar in a trembling aspen at a height of 16.6 m. Height of all nest cavities ranged from 11-17 m and entrance holes ranged from 6 by 6 cm to 14 by 7 cm (Bondrup-Nielsen 1978). Another nest in Edmonton was situated in a rotten trembling aspen stump at a height of 7 m, with 9.5 cm high by 7.5 cm wide entrance hole (Bondrup-Nielsen 1978). Eckert (1974) recorded nests at 3-8 m height in Alberta.

Likewise, in Minnesota, nests were in clumps of old aspen interspersed with conifers (Eckert and Savaloja 1979). Also, Meehan and Ritchie (1982) found eight nests in closed deciduous or mixed forests and none in pure coniferous forests in interior Alaska (Fairbanks). In the northern Rocky Mountains, when nest boxes were made available in different forest types, old forests were preferred (Hayward et al. 1993). Given that Pileated Woodpeckers *Dryocopus pileatus* require trees of a minimum diameter at breast height (dbh) of 35.5 cm or greater (Peck and James 1983), and that they are one of species providing cavity nests for Boreal Owls, Boreal Owls may well prefer old forests with large trees in Canada. Hayward et al. (1993) indicated that Boreal Owls required aspen of 33 cm dbh for nesting in the northern Rocky Mountains.

Interestingly, although Boreal Owls readily use nest boxes in Europe and in G. Hayward's study area (western Montana, Idaho and northwestern Wyoming), there are few records of using nest boxes in Canada. For example, J. Duncan has erected 200 nest boxes suitable for Northern Saw-whet Owls or Boreal Owls and none of these have been occupied (J. Duncan pers. comm.). Similarly, G. Bortolotti has had only four nest boxes occupied by Boreal Owls despite hundreds of boxes being erected for studies of American Kestrels *Falco sparverius* in the boreal forest region, albeit often in habitats often too open for Boreal Owls. This suggests that cavities might not be limiting for Boreal Owls (S. Bondrup-Nielsen pers. comm.).

Roosting sites Bondrup-Nielsen (1978) suggested that balsam fir is an important roost tree, although of 30 roost sites examined by him, 30% were in aspen or birch. However, in both Colorado and Idaho, all roosts were in conifers (Palmer 1986, Hayward et al. 1993), which may reflect differences in availability of roost trees; the species does not show any evidence for roost choice.

During nomadic movements Boreal Owls may be found in atypical habitat (Anweiler 1960).

F General Biology

1) Reproductive. In North America, the Boreal Owl is thought to be monogamous and single-brooded (Hayward and Hayward 1993). However, polygamy occurs in peak vole years in Europe (e.g., Korpimäki 1991) and it probably also occurs in North America, but has not been investigated (Hayward and Hayward 1993). The courtship period is very short (1-2 weeks; Bondrup-Nielsen 1978) which is another reason why Boreal Owls are so difficult to detect (Mills 1987). Most female owls breed in their first year, whereas most males breed in their second year (Johnsgard 1988). To attract females, males advertise their territories which may contain from one to five cavity nests. Once a female is attracted, she selects one nest site (Carlsson 1991). Secondary nest cavities (i.e. those excavated by other species) are used, mainly of Pileated Woodpecker and Northern Flicker *Colaptes auratus*. In Alaska, Meehan and Ritchie (1982) found four nests in flicker holes, three in nest boxes

and one in a natural cavity. At the northern limits of the Boreal Owl's range, old nests of Rusty Blackbird *Euphagus carolinus* or Gray-cheeked Thrush *Catharus minimus* may be used (Eckert 1974). Many Boreal Owl populations in Europe use nestboxes because of the scarcity of natural cavities (e.g., Korpimäki 1981, Lofgren et al. 1986). For Ontario, the only laying date recorded is 14 May (Peck and James 1983) and this was probably a late nest (Shepherd 1992). The nest found in British Columbia by R.J. Cannings had an infertile egg on 4 May 1988 (Campbell et al. 1990). From back-calculations of known young or eggs in British Columbia, Campbell et al. (1990) suggested that eggs could be found in April or earlier, and young in May to mid-July. The only clutch recorded from Ontario contained three eggs (Peck and James 1983). Mean clutch size varied from 3.25 in Idaho (Hayward 1989) to 3.8 in Germany (Konig 1969) and 5.6 in Finland (Korpimäki 1981, 1985). Median laying dates for Idaho were 1 May, for Colorado 10 May (Palmer 1986) and for Finland 3 April (Korpimäki 1987).

2) Movements. Although the Boreal Owl is considered a resident species that disperses in years when prey are scarce (e.g. Catling 1972, Lofgren et al. 1986), regular annual movements (perhaps mainly of females and juvenile cohorts) of some populations do occur. This is demonstrated by banding data from WPBO (e.g. Fig. 2). Certainly, there are irruption years when large numbers of owls disperse south of their breeding range. These irruptions typically coincide with southward movements of other owl species which become nomadic when their microtine prey populations crash (e.g., Northern Saw-Whet Owl, Great Gray Owl *Strix nebulosa* and Northern Hawk Owl *Surnia ulula*; e.g., Evans and Rosenfield 1977, Erdman 1979, Yunick 1979). This strongly suggests that irruptive movements in Boreal Owls in North America are also related to prey populations, as in Europe. Hayward et al. (1993) suggested that there were differences in movements of Boreal Owls depending on whether populations were resident (with diverse prey species having stable populations), partially migratory (some cohort of the population disperse - usually females and juveniles - in response to moderate fluctuations in prey) or fully migratory in some years (all birds disperse in response to pronounced prey population fluctuations. Available data suggest that northern populations (e.g. Kluane Lake; F. Doyle pers. comm.) follow the third movement pattern, whereas southern populations are resident (e.g. northern Rocky Mountains; Hayward et al. 1993). Thus, ecology of Boreal Owls likely differs in Canadian boreal forest from that of owls living in subalpine ranges.

These periodic irruptive movements have been documented by Catling (1972) for eastern North America, and they are also indicated by banding data at Whitefish Point Bird Observatory in Michigan (Kelley and Roberts 1971, Carpenter 1987). Fig. 2 shows the total numbers of Boreal Owls banded at Whitefish Point between 1978-1993. In Ontario southward movements of Boreal Owls occurred during the winters of 1922-23, 1954-55, 1962-63, 1965-66 and 1968-69 (Catling 1972) and invasions were also recorded in Minnesota (Evans and Rosenfield 1977), Wisconsin (Erdman 1979) and New York (Yunick 1979). Generally, these movements peaked in late winter (February-March) suggesting that the owls involved were non-breeding adults. Also, Catling (1972) suggested that both sexes were involved in these irruptions, although he did not sex owls (Boreal Owls have not been sexed to date at banding stations; W. Grigg, pers. comm.). Once sexing techniques are established it would be interesting to test if a preponderance of females (and juveniles) migrated, and whether males remain year-round on their territories to defend their cavity nests, as in Scandinavia (Korpimäki 1986, Lofgren et al. 1986); the same may well apply to some North American populations (e.g. Hayward et

al. 1993). However, at least in Ontario, some individuals were recaptured several times during the winter in irruption years suggesting that they were males defending winter territories (Catling 1972).

3) Behaviour/Adaptability. Long-term studies in Finland, by Korpimäki (1981, 1985), show some remarkable breeding adaptations in Boreal Owls relation to prey abundance. These include both polygyny (one male with several females) and polyandry (one females and several males), as well as multiple broods. Neither has been documented in North America (Hayward and Hayward 1993). In addition, Boreal Owls show a unique pattern of residency and nomadism in response to the conflicting constraints of nest site scarcity and food availability (Mysterud 1970).

By far the most important prey species in dietary studies is the Red-backed vole *Clethrionomys gapperi* and meadow vole *Microtus* spp. (Hayward et al. 1993). In Ontario, Catling (1972) found that the meadow mouse *Microtus pennsylvanicus* was the most important prey (90.7% contribution by weight to overall diet), followed by deer mice *Peromyscus* spp. and star-nosed mole *Condylura cristata*. A review of four dietary studies in North America (Marti et al. 1993) showed that food niche varies geographically (20 prey species were taken in east-central North America and 66 in western North America), whereas the reverse is true in Europe (20 studies). Average prey weight was also greater in western North America (231.8 g) than east-central North America (197.8 g) (Marti et al. 1993).

G Limiting factors

The main factors limiting populations of Boreal Owls are probably the availability of nest cavities and food supply. In Europe, the availability of nesting cavities is the main factor limiting Boreal Owl populations; dramatic declines in Black Woodpeckers *Dryocopus martius*, which previously provided many nest cavities for owls in Fenno-Scandia, have been attributed to modern forestry which has removed most old forests. The availability of cavities might be a limiting factor in Canada. Although the two woodpecker species that provide cavity nests for Boreal Owls are widespread, decreased habitat suitability as a result of intensive timber management (removal of snags, or large diameter living trees) might be occurring. Numerous authors have demonstrated that removal of snags and dying trees through logging is detrimental to cavity-nesting birds (e.g. Thomas et al. 1976, Evans and Conner 1979, Zarnowitz and Manuwal 1985; Bull et al. 1992, Bull and Holthausen 1993, see Newton 1994). Guidelines have been produced for forest managers to maintain populations of cavity-nesters (e.g. James 1984, Anderson and Rice 1993, Backhouse and Louisier 1991, Naylor 1994) but these have not been tested for secondary cavity nesters such as Boreal Owls; there is also little on site implementation of guidelines in many areas. It is highly likely that the extensive cutting of boreal forest mixed woods is having an effect on Boreal Owl populations, but there are no data available to support this. For example, between 1987-88 the Alberta government leased more than 220,000 km² of mixed wood boreal forest to pulp and paper companies; there has been no adequate inventory of wildlife in this area, nor environmental assessments or public hearings (Nikiforuk and Struzik 1989, Schmiegelow and Hannon 1993). Little is known of the abundance of Boreal Owls in this area, or what effects cutting may have on their populations. R. Cannings (pers. comm. 1994) believes that logging in British Columbia and planting of lodgepole pine *Pinus contorta* is reducing available habitat for Boreal Owls. Little is known in Canada of the effects of fluctuations in prey abundance on breeding success of

Boreal Owls. Climate (increasing temperature) may limit the southern range of Boreal Owls (Hayward et al. 1993).

H Special significance of the species

The Boreal Owl has evolved remarkable reproductive and migratory strategies in response to its food supply; these vary geographically. It is probably a widespread owl species in Canada and may be the most common (but least well known) owl species. If it requires uneven-aged or old forests in Canadian boreal forest, as elsewhere in its North American range, special forest management may be required for this species. The species also exemplifies the challenge faced by biologists in monitoring populations of secretive small, nocturnal species that live at low densities. Consequently, there is a lack of information on the species in Canada.

I Evaluation and proposed status

There is probably insufficient information on the Boreal Owl in Canada to recommend a COSEWIC status for the species. However, members of the COSEWIC committee voted that this species be considered 'NOT AT RISK'. Currently there are no data on population trends or adequate density estimates; although data may become available from unpublished studies (e.g. Kluane Lake, Yukon; W. Harris pers. comm., Duncan and Duncan 1993). In other parts of its North American range, the Boreal Owl is considered a 'sensitive' species and it depends on old or mature forests (Hayward et al. 1993). Nothing is known in Canada about the effect of timber harvest on Boreal Owl populations in Canada; this is an important area for future research.

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Figure 1.

Year-round range of the Boreal Owl in North America.
Some populations show nomadic/migratory/irruptive
movement in years of food scarcity. See text for details.

(Sohnsgard 1983)

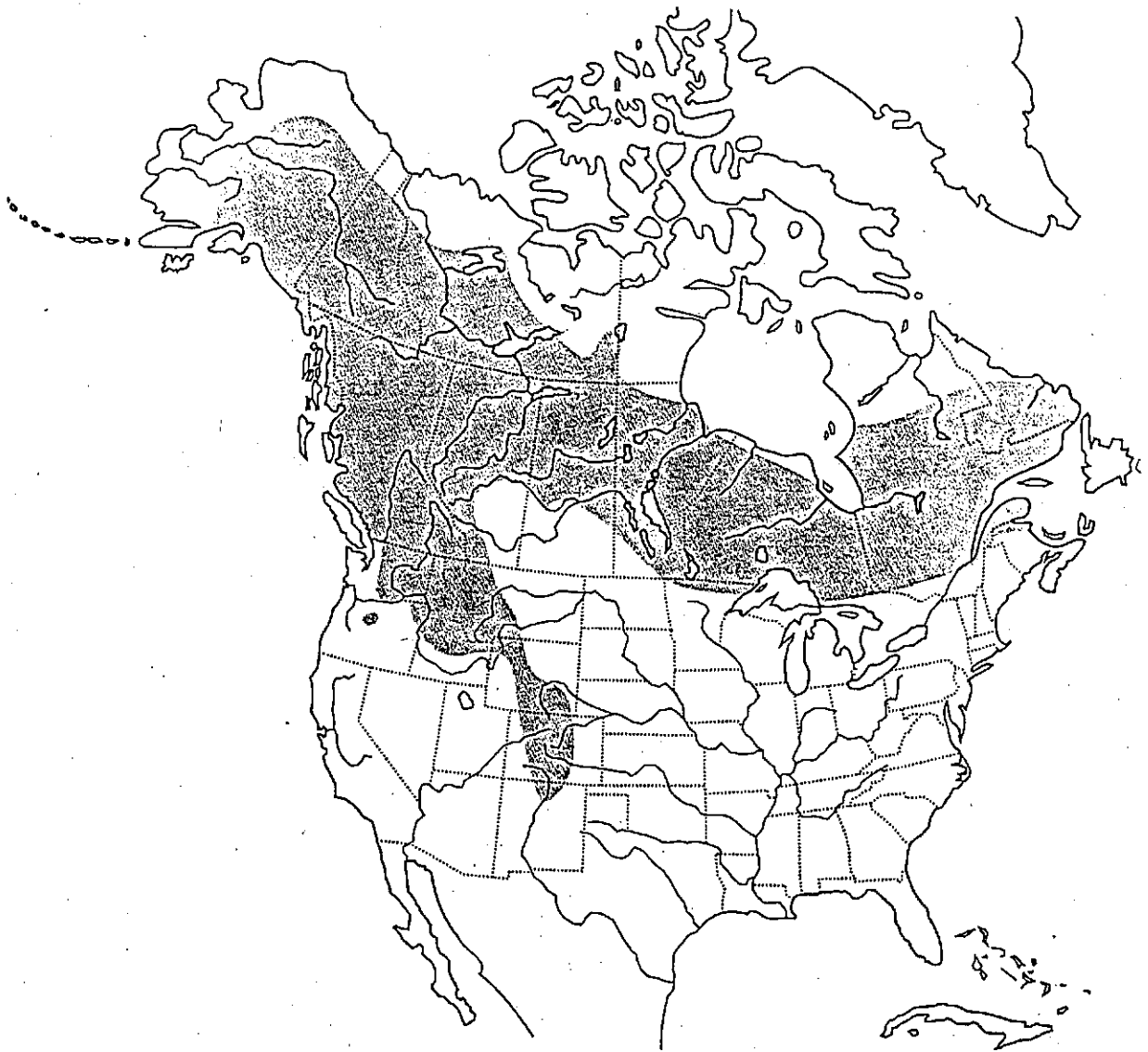
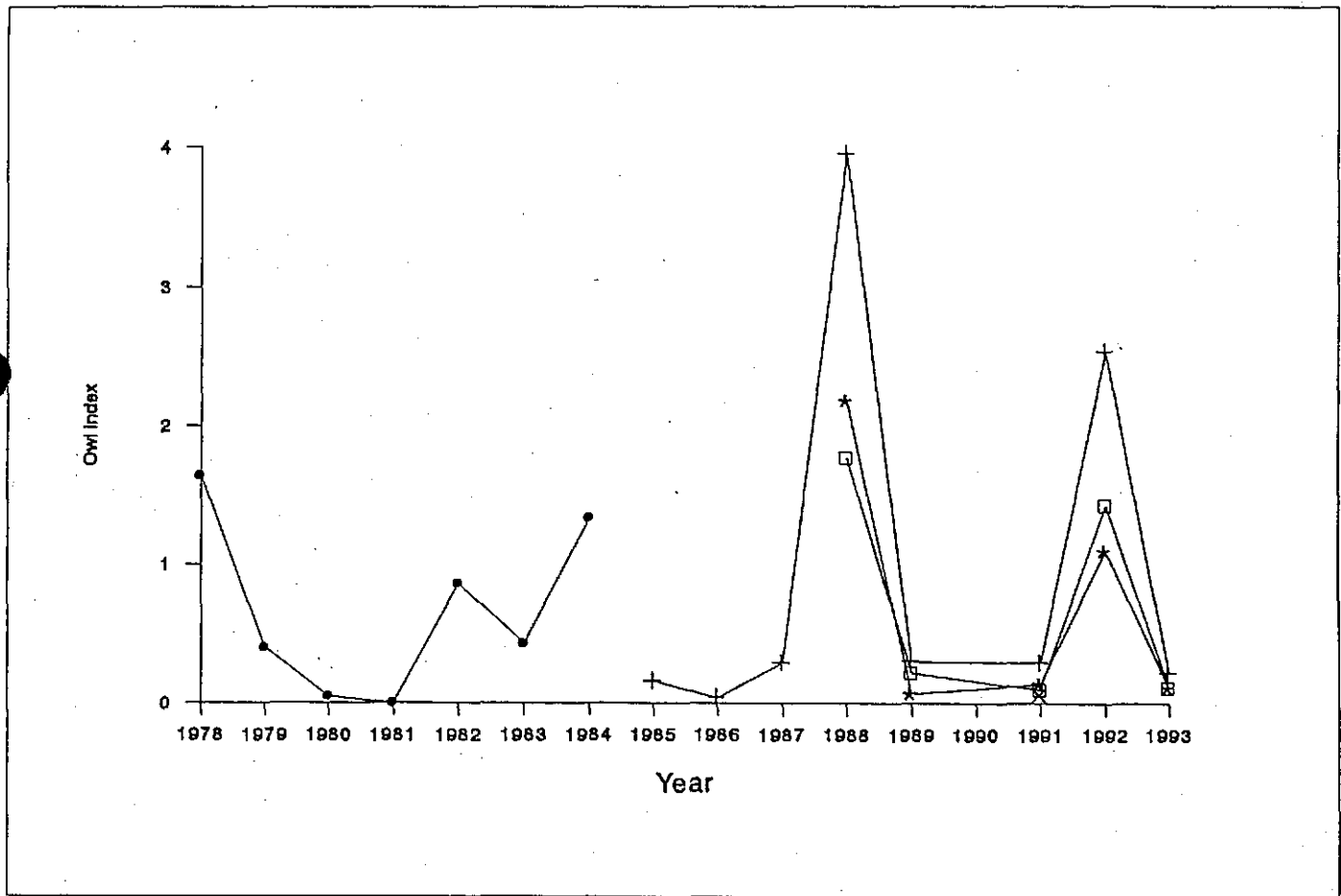


Fig. 2 Index of owls banded at Whitefish Point Bird Observatory between 1978-1993. Note that for period 1978-1985 owl index was total owls banded corrected for numbers of days banding (weeks multiplied by 7). Following 1985 owl index is number of owls banded corrected for net hours. After 1988 qualified staff banded birds into second year, after second year or after hatch year (source W. Grigg, pers. comm., Grigg 1990, 1991 ab, 1992, 1993, Carpenter 1987)



Appendix 1. Authorities on Boreal Owls

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