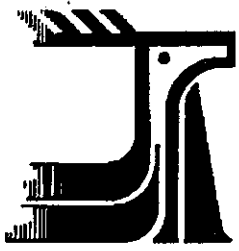


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COMMITTEE ON THE
STATUS OF ENDANGERED
WILDLIFE IN CANADA

COMITÉ SUR LE STATUT
DES ESPÈCES MENACÉES
DE DISPARITION AU
CANADA

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STATUS REPORT ON THE SHORT-EARED OWL

ASIO FLAMMEUS

IN CANADA

BY

MICHAEL D. CADMAN

STATUS ASSIGNED IN 1994
VULNERABLE

REASON: LONG-TERM DECLINE DOCUMENTED THAT REQUIRES WATCHING, BUT POPULATION NOT APPARENTLY SMALL ENOUGH YET TO BE THREATENED.

OCCURRENCE: ALL PROVINCES AND TERRITORIES.

COSEWIC - A committee of representatives from federal, provincial and private agencies which assigns national status to species at risk in Canada.

CSEMDC - Un comité de représentants d'organismes fédéraux, provinciaux et privés qui attribue un statut national aux espèces canadiennes en péril.

QL
88
573
Vol. 7



Committee
on the Status
of Endangered
Wildlife
in Canada

Comité sur le
statut des espèces
menacées
de disparition
au Canada

JUNE 1990

Ottawa, Ont. K1A 0B3 (819)
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- SPECIES:** "Species" means any species, subspecies, or geographically separate population.
- VULNERABLE SPECIES:** Any indigenous species of fauna or flora that is particularly at risk because of low or declining numbers, occurrence at the fringe of its range or in restricted areas, or for some other reason, but is not a threatened species.
- THREATENED SPECIES:** Any indigenous species of fauna or flora that is likely to become endangered in Canada if the factors affecting its vulnerability do not become reversed.
- ENDANGERED SPECIES:** Any indigenous species of fauna or flora that is threatened with imminent extinction or extirpation throughout all or a significant portion of its Canadian range.
- EXTIRPATED SPECIES:** Any indigenous species of fauna or flora no longer known to exist in the wild in Canada but occurring elsewhere.
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UPDATED STATUS REPORT ON THE SHORT-EARED OWL

ASIO FLAMMEUS

IN CANADA

BY

**MICHAEL D. CADMAN
CANADIAN WILDLIFE SERVICE
70 FOUNTAIN STREET EAST
GUELPH, ONTARIO
N1H 3N6**

STATUS ASSIGNED IN 1994

VULNERABLE

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ABSTRACT

The Short-eared Owl has a nearly cosmopolitan range, being found as a breeding and/or wintering bird in North and South America, Middle America, Europe, Asia, and Africa. The species breeds in every province and territory in Canada, from the southern border to the low arctic, but it is absent from the Boreal Forest Region and other heavily forested areas. Its winter range extends north only to the southern parts of most provinces. Throughout its range in Canada, the Short-eared Owl occurs in small numbers as both a breeding and wintering bird, although the actual population size is extremely difficult to determine, primarily because of a lack of knowledge of the northern population. The species is irruptive and cyclic in nature, particularly during winter, making population trends somewhat difficult to determine. This is particularly true in remote northern Canada, where an unknown portion of the population breeds. However, Breeding Bird Survey data suggest that the species has undergone a significant long-term, non-cyclical population decline during this century in Canada, largely due to a decline in the prairie population. Christmas Bird Count data also indicate that wintering Short-eared Owl populations declined significantly throughout North America and Canada between 1960 and 1989. Available information suggests that populations this past century have declined in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec, and have remained stable in Newfoundland, Labrador, and the Maritime provinces.

The main reason for these declines is generally agreed to be habitat loss. Although suitable habitat in eastern Canada and North America probably increased with the clearing of forests, it has been decreasing this past century due to succession, wetland drainage, urban expansion, and increasingly intensive farming practices which leave very little land in a grassy state. Massive destruction of prairie habitat has taken place in Canada and the United States since settlement, and old field habitat has been, and continues to be, destroyed throughout the lower mainland of British Columbia, where most of the population in that province resides. As suitable habitat throughout the Short-eared Owl's range in Canada continues to be destroyed or altered, further population declines can be expected.

For all of the above reasons, it is recommended that the Short-eared Owl be designated as "Threatened" in Canada. Recommendations are made for further research into, and management of, the species in Canada.

DISTRIBUTION

Americas

According to the American Ornithologists' Union Checklist (1983), the distribution of the Short-eared Owl is as follows:

Breeds in the Hawaiian Islands (main islands from Kauai eastward), and on Ponape in the Caroline Islands; in North America from northern Alaska, northern Yukon, northern Mackenzie, central Keewatin, southern Baffin Island (probably), northern Quebec, northern Labrador and Newfoundland south to the eastern Aleutian Islands (west to Unalaska), central and (formerly southern) California, northern Nevada, Utah, northeastern Colorado, Kansas, Missouri, southern Illinois, northern Indiana, northern Ohio, Pennsylvania, New Jersey and northern (formerly coastal) Virginia; in the Greater Antilles (Cuba, Hispaniola and Puerto Rico); and in Eurasia from Iceland, the British Isles, Scandinavia, northern Russia and southern Siberia south to southern Europe, Afghanistan, Transbaicalia, northern Mongolia, northern Manchuria, Anadyrland, Sakhalin, the northern Kurile Islands and Kamchatka.

Winters generally in the breeding range, in the Hawaiian Islands ranging casually to the western islands (Kure, Midway, and casually east to French Frigate Shoals); in North America and Middle America mostly from southern Canada south to southern Baja California (casually to Los Coronados Islands and Isla Tiburon), Oaxaca, Puebla, Veracruz, the Gulf coast and southern Florida; and in the Old World south to northwestern Africa, the Mediterranean region, northeastern Africa, Asia Minor, Ceylon, the Malay Peninsula, southern China and Japan, casually to the Azores, eastern Atlantic Islands, Borneo, the Philippines and Ryukyu Islands.

Casual or accidental in the Revillagigedo Islands (Clarion), Guatemala (Volcan de Agua), the Bahamas (Grand Turk), Lesser Antilles (St. Bartholomew), Bermuda and Greenland."

One subspecies, Asio flammeus flammeus, is recognized over most of its global range, including Europe, North America, and Asia. Seven or eight other subspecies have been recognized from the rest of its range, including six endemic island populations (Hawaii, Galapagos, Falklands, Hispaniola, Puerto Rico, and Ponape in the Caroline Islands), and two resident, South American populations (Tate 1992). The Hawaiian subspecies, A. f. sandwichensis, is the only subspecies other than A. f. flammeus found in the United States (Tate 1992).

Figure 1: Winter and Breeding Range of the Short-eared Owl in North America

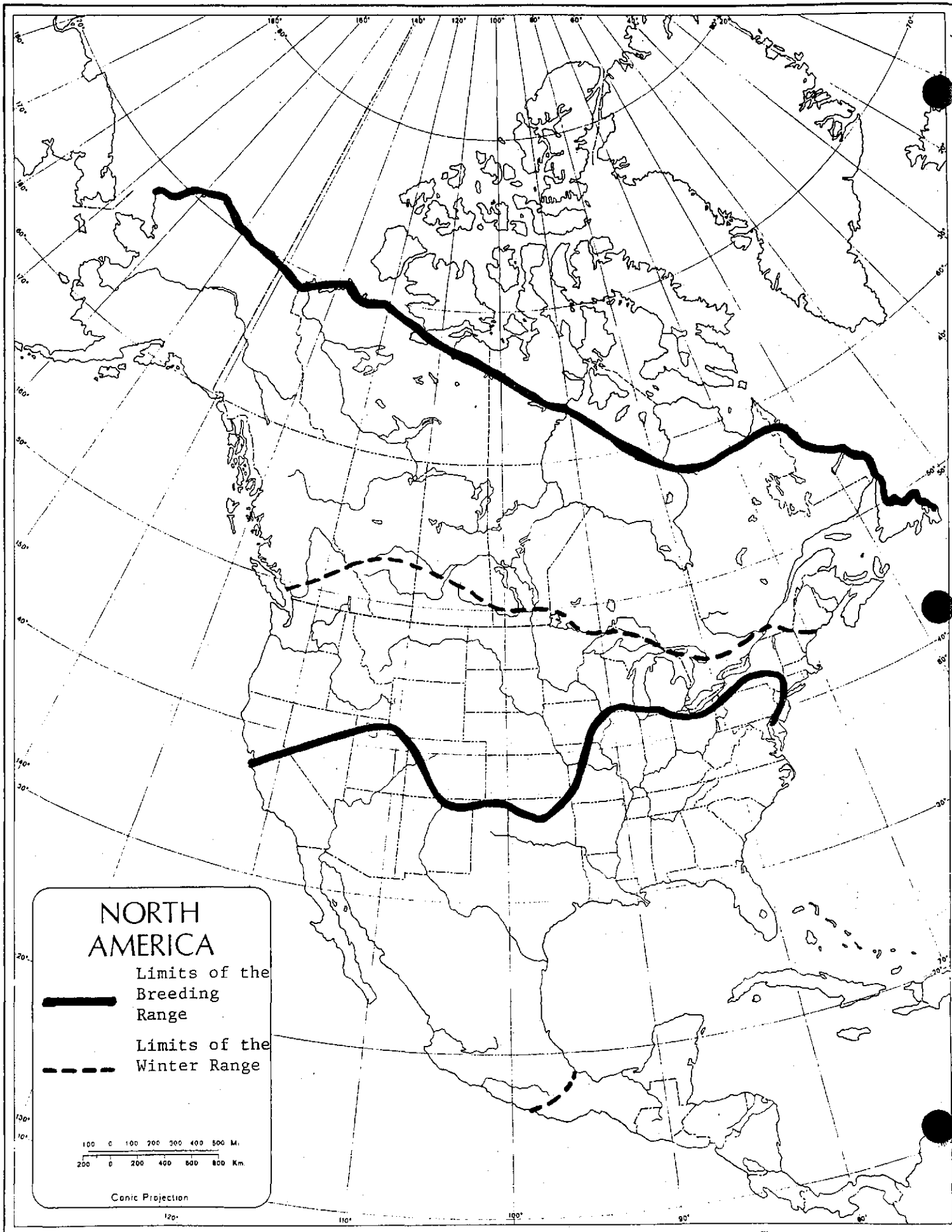


Figure 1 shows the general limits of the breeding and winter range of the Short-eared Owl in North America. Locally, within the area of overlap between the winter and breeding range, the species can be found at any time of year.

Canada

The species has a widespread breeding range in Canada, but its winter range reaches north only into the southern parts of most provinces (Figure 2). Godfrey (1986) provides the following summary of the Short-eared Owl's breeding distribution in Canada:

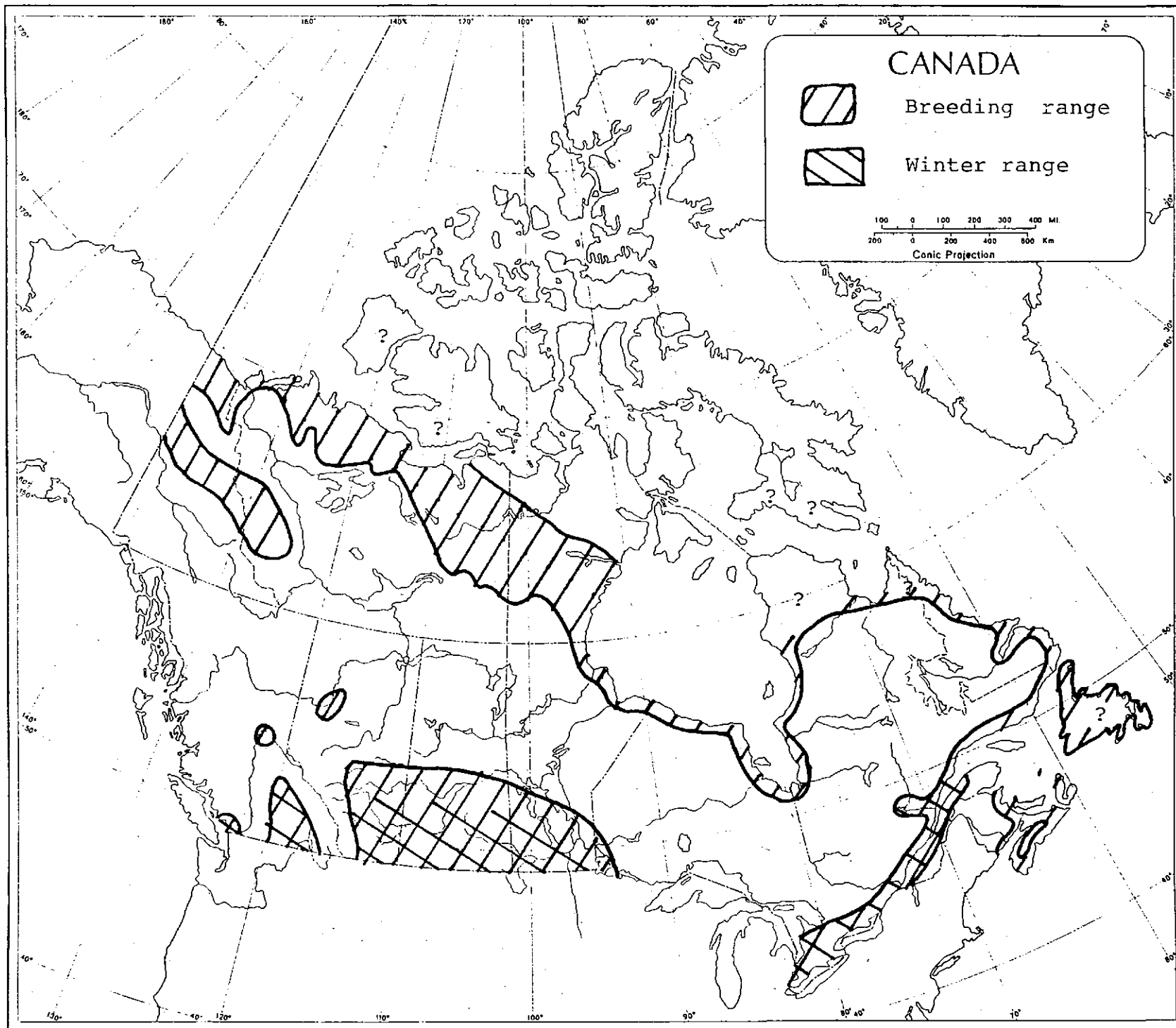
"Breeds from northern Mackenzie (Franklin Bay, Coronation Gulf), central Keewatin (Schulz Lake), southern coasts of Hudson Bay, James Bay, northern Quebec (Feuilles River, Kuujuaq), and northern Labrador (Ramah), south through southern Yukon to southern British Columbia (except Queen Charlotte and Vancouver Islands), Alberta, Saskatchewan, Manitoba, Ontario, Quebec, the Maritimes, and Newfoundland. Perhaps breeds north to northern Yukon, southern Banks Island, and southern Victoria Island, where the species has been reliably reported in summer. Perhaps also on southern Baffin Island (old breeding reports at Greater Kingwah and Kingnait Fiord require confirmation)."

Although Godfrey describes the outer edges of the species' breeding range in Canada, the species' requirement for relatively open habitats means that breeding is patchy within that range, with very few breeding records in forested regions. Figure 2 shows the breeding range of the species as compiled from recent scientific literature and information from correspondents. The map reflects the absence of breeding in the Boreal Forest. The northern edge of the range is still much in doubt, as is any clear indication of abundance north of the tree-line.

Clark (1975) points out that certain large areas, such as the Boreal Forest, are unsuitable for breeding. Records from the interior of the Labrador Peninsula are few, and none involve breeding (Todd 1963). In Nova Scotia, virtually all nesting has been reported only from Grand Pre, Kings County and the New Brunswick border area (Tufts 1986). More recent information from the Maritimes Breeding Bird Atlas (1986-1990) shows breeding restricted to a few coastal areas in Nova Scotia, New Brunswick and Prince Edward Island (Erskine 1992).

Information from the Atlas des oiseaux nicheurs du Quebec (Y. Aubry pers. comm.) (covering the area north to 52°N) indicates all but four confirmed breeding records are in the St. Lawrence River valley, with a concentration of confirmed breeding records near Montreal; the bulk of the inland portion of the province has no

Figure 2. Winter and breeding range of the Short-eared Owl in Canada



confirmed breeding records. The remaining confirmed breeding records in Quebec are on the north shore of the Gulf of St. Lawrence, and on the Madeleine Islands. Maps from the Etude des populations d'oiseaux du Quebec (EPOQ) (A. Cyr and J. Larivee pers. comm.) indicate that most migrants are also reported in the St. Lawrence River valley.

The breeding distribution of the Short-eared Owl in Ontario was described by Snyder (1951) as "about the marshes and flats of the lower Great Lakes in southern Ontario, in the farmland of Rainy River District of western Ontario and about the tidal flats of Hudson and James Bay in the far north." The same is essentially true today. The Breeding Bird Atlas project (1981-1985) (Cadman et al. 1987) revealed a concentration of records at the eastern end of Lake Ontario, notably on Wolfe and Amherst Islands near Kingston. Otherwise, records were dispersed thinly throughout the area to the south and east of the Canadian Shield, except in the southwestern extreme of the province. The concentration around the eastern end of Lake Ontario is consistent with records from New York (Bull 1974; Andriele and Carroll 1988), suggesting that the habitats available in that area are particularly suitable to the species.

In total, Short-eared Owl breeding evidence was reported in 63 (3%) of 1824 squares surveyed in southern Ontario during the Atlas (Cadman et al. 1987). Breeding was "confirmed" during the Atlas in the counties and R.Ms. of Huron, Durham, Ottawa-Carleton, and Stormont-Dundas-Glengarry, and "possible" and "probable" breeding evidence were reported in Simcoe, Durham, Prince Edward, Hastings, Lennox-Addington, and Prescott-Russell where the ONRS shows no previous records. These apparent extensions of the breeding range are probably the result of the unprecedented coverage provided by the Atlas rather than of actual extensions of the breeding range. Some of these extensions may be irregular in nature, and breeding might not occur again for many years. Additionally, breeding was "confirmed" in the Ottawa area (seven pairs) in 1987 (Weir 1987a), and in both Huron and Bruce Cos. in 1988 (ORBBP files), and there is one historical (1977) "confirmed" breeding record from Wellington Co. (ORBBP files).

Despite extensive field work during the Atlas project (Cadman et al. 1987), breeding has not been reported from the Boreal Forest Region in northern Ontario. However, Short-eared Owl breeding evidence was reported in 11 of 12 100 X 100 km UTM blocks along the shores of Hudson and James Bays (including "confirmed" breeding in three blocks), indicating that the species was a widespread breeder in that area between 1981 and 1985. More recently, Wilson and McRae (1993) stated that the species' centre of abundance in Ontario is the coastal strip of the Hudson Bay Lowlands. In addition, a few "possible" or "probable" breeding records were reported during the Atlas in the Sudbury, North Bay, Timmins, and Pickle Lake areas, suggesting that a few birds might breed in the central part of the province, as has been intimated by previous authors (i.e. James et

al. 1976). In northwestern Ontario, one "possible" breeding record was reported to the Atlas from the Rainy River area, and "probable" breeding (a pair observed doing a courtship display) was reported from the same area in 1987 (ORBBP files).

In Saskatchewan, breeding has only been confirmed on the prairies and not in the Boreal Forest Region (unpublished data from the Saskatchewan Bird Atlas, A. Smith pers. comm.). Data from the Alberta Breeding Bird Atlas project (1987-1991) revealed breeding in the south and central parts of the province, with the northern limits of breeding being Peace River, Lesser Slave Lake, and Cold Lake (Semenchuk 1992). Most atlas records were from the Grassland and Parkland Natural Regions of Alberta, but a few (including four "confirmed" breeding records) were from the Boreal Forest Natural Region, and two "possible" breeding records were reported from the Foothills Natural Region (Semenchuk 1992). In British Columbia, the species is a local breeder on the extreme south mainland coast through the Fraser River delta east to Fort Langley, and in the south and central interior from Creston and the southern Okanagan valley north through the Thompson and Chilcotin-Cariboo basins to Prince George (Campbell et al. 1990). It is probably more widespread in B.C. than records indicate, but breeding has not been documented for Vancouver Island, the Gulf Islands, the mainland coast north of Vancouver or the Queen Charlotte Islands (Campbell et al. 1990).

The Short-eared Owl winters in southern British Columbia and southern Ontario, and occasionally in the Maritimes, Newfoundland, and the Madeleine Islands in Quebec (Godfrey 1986). It also winters sporadically in the Prairie Provinces, sometimes in fairly large numbers (Belcher 1980; M. McNicholl pers. comm.). The Fraser Valley in British Columbia is among the most important wintering areas for raptors in Canada, and includes a relatively large Short-eared Owl population. Christmas Bird Count data, which may reflect late fall migrants rather than wintering birds, show birds in varying numbers in most years in the Prairie Provinces, with birds often as far north as Edmonton. The species is reported throughout Nova Scotia in late fall, but is found only in small numbers in the winter, mostly in the southwestern counties (Tufts 1986). Information from the Etude des populations d'oiseaux du Quebec (EPOQ) indicates that Short-eared Owls winter in extreme southern Quebec and occasionally farther downstream on the shores of the St. Lawrence River (A. Cyr pers. comm.).

Before settlement and extensive land clearing by Europeans, the Short-eared Owl probably had a general distribution quite similar to today's in most of Canada; it likely occurred in the natural open habitats and marshlands of southern Ontario, Quebec, British Columbia, Newfoundland and the Maritimes, and had larger populations on the prairies and across the north. The clearing of forests in eastern Canada created new habitat and probably led to a limited expansion of the population from natural habitats to

agricultural areas. However, the destruction of marshes and natural grassland, and the intensive agricultural practices of recent years, have probably caused reduction of range and populations in agricultural and developed areas. It seems likely that numbers and range increased in the east with initial forest clearing and have declined with continued habitat destruction.

Given the large scale destruction of natural prairie grassland, the species is probably considerably reduced from presettlement populations on the prairies. There was probably a population in the prairie habitats of southwestern Ontario, but it has largely disappeared along with the natural prairie. Much of the decline in that area would have occurred before records were kept. A comparison of historical records from this century compiled by the Ontario Nest Records Scheme (ONRS) (Peck and James 1983) with Atlas data collected from 1981 to 1985 (Cadman *et al.* 1987) suggests that the species' breeding range in southwestern Ontario has been reduced. The comparison reveals that a few breeding records were reported to the atlas in other counties where breeding was not reported previously. These new breeding records likely reflect increased coverage during the Atlas years (1981-1985) rather than an expanded breeding range.

PROTECTION

The Short-eared Owl is not protected by the joint Canada - United States Migratory Birds Convention of 1916, but protection from hunting, possession or selling is provided through Wildlife Acts in most provinces. Under regulations of Ontario's Game and Fish Act the use of pole traps to catch birds is prohibited except with the written permission of the Minister. Robinson (1986) indicates that legislating against pole traps is not necessarily successful in preventing the taking of Short-eared Owls and other raptors in pole traps. Despite increased fines in Britain, 90 of 655 recent incidents of raptors caught in pole traps involved Short-eared Owls.

POPULATION SIZE AND TREND

Determining the population size and trend for the Short-eared Owl is more difficult than for most birds because the species is irruptive and nomadic (Clark 1975). Fluctuations from year to year make longer-term changes in population difficult to discern. Nevertheless, there are indications of a decline in much of the North American population. In this section, population trends and abundance of the Short-eared Owl are regularly compared to those of the Northern Harrier, a raptorial species with similar range and habitat requirements. These comparisons show that although the two species inhabit similar areas, their population trends differ.

Global

The Nature Conservancy has assigned the Short-eared Owl a rank of 5 globally, meaning that the species is "demonstrably secure globally, though it may be quite rare in parts of its range". Voous (1989) states that the breeding population in central Europe and eastern North America has been reduced through habitat destruction. The population in Britain is thought to have increased while that of the Netherlands has decreased (Cramp 1985). The Short-eared Owl was once thought to be extinct on Puerto Rico, but is now recovering (Voous 1989).

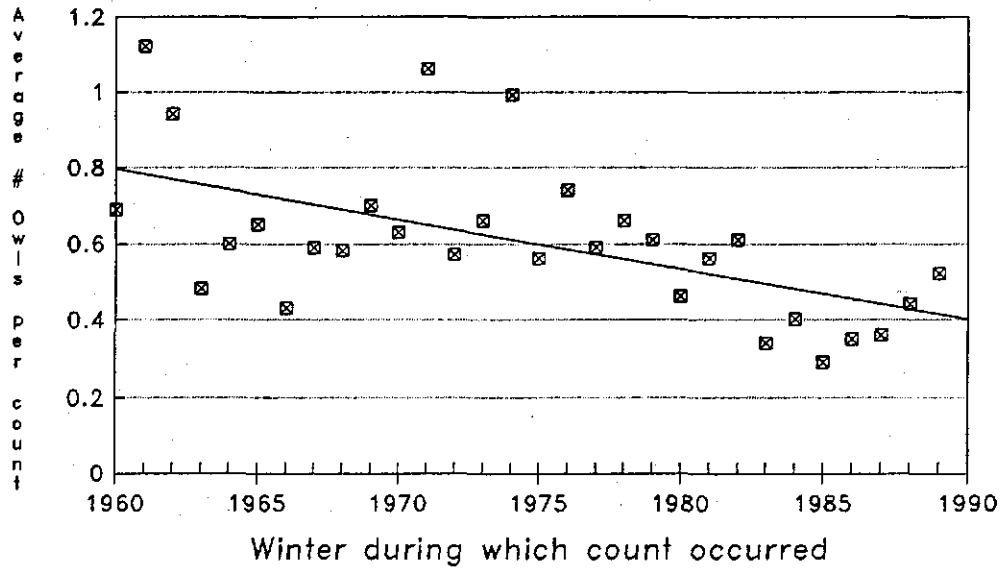
North America

Breeding Bird Survey (BBS) data are collected systematically continent-wide and provide the best indication of the population trend of the species in road-accessible areas since 1966. For the BBS, North America is divided into three regions: Central region consisting of the Great Plains, and the Eastern and Western regions on either side. BBS data (B. Peterjohn pers. comm.) indicate that in the breeding season the species is more numerous in the Western and Central regions of the continent (0.24 and 0.21 birds per route, respectively) than it is in the Eastern region (0.01 birds per route). On average it is more numerous in the U.S. (0.19 birds per route) than it is in Canada (0.12 birds per route). The size of the breeding population in remote northern Canada is unknown.

BBS data show that the species is declining in much of North America. A summary of continental data on number of birds per route from 1966 to 1989 (B. Peterjohn pers. comm.) suggests a decline in population, but the decline is not statistically significant. There is a significant ($p < 0.01$) decline in the Western region, where the population declined at a rate of 2.1% per year from 1966 to 1989. Continentally, the number of birds declined from 1966 to 1989 on significantly ($p < 0.01$) more routes than routes on which it increased. The same is true for both Canada ($p < 0.01$) and the U.S. ($p < 0.1$), and in the Western ($p < 0.01$) and Central ($p < 0.05$) regions of the continent.

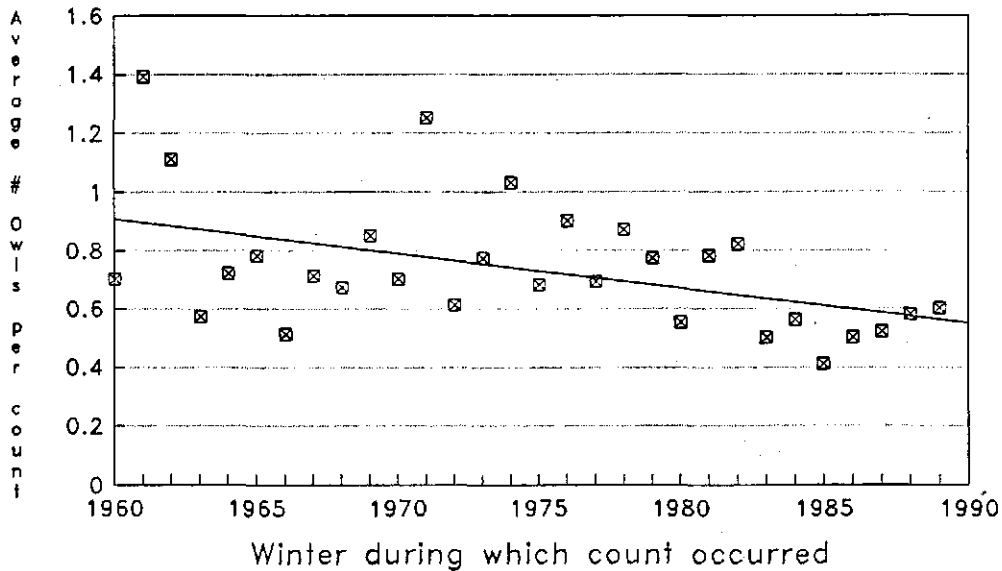
Christmas Bird Count (CBC) data from 1962/1963 through 1971/1972 indicate that during the winter the Short-eared Owl is also more numerous in the west than it is in the east (Root 1988), and that it is declining throughout North America. The number of Short-eared Owls recorded per count in North America was found to have declined significantly ($p < 0.05$) between 1960 and 1989, at an average rate of 1.4% per year (or a 42% decline overall) (Figure 3a). If only those counts that were run in at least 20 of the 30 years between 1960 and 1989 are taken into account, the decline is still significant ($p < 0.05$), at an average rate of 1.3% per year (or a 39% decline overall) (Figure 3b). This result indicates that the demonstrated decline is not simply the result of there now

Figure 3a. Population trend of the Short-eared Owl in North America according to CBC data 1960-1989*



* all counts

Figure 3b. Population trend of the Short-eared Owl in North America according to CBC data 1960-1989*



* counts run for at least 20 years

being more CBCs, many of which are not in the Short-eared Owl's wintering range. Although it would be preferable to perform a trend analysis on Short-eared Owls using owl numbers standardized by hours of field work, the available data on hours of field work proved unreliable and could not be used with confidence. However, when such an analysis was performed, the results indicated a steeper decline than that described above. Although the data provided above is not standardized by hours of field work, it seems likely that hours of effort on CBCs have increased over time rather than decreased. If so, the trend of birds per hour would show a steeper decline than that described above.

The Short-eared Owl has been on the American Birds' Blue List from 1976 to 1986, when the latest list was published. The List was first published in 1972, and was not published in 1983, 1984, or 1985. The species was added to the List because of a decline throughout much of its North American range. In the last year of publication of the List (1986), three of the seven reporting North American regions (Central and Southern Prairie Provinces, and Middle Pacific Coast region) reported the bird as greatly down in numbers, and the other four (Hudson-Delaware, Ontario, Middle-Western Prairie, and Southern Great Plains) reported it as down in numbers. The following information was extracted from Blue List summaries:

"1976. Added to list on the basis of recommendations from the Hudson-Delaware, Western Great Lakes, Mountain West regions. The population decline may be more widespread than indicated here" (Arbib 1975).

"1977. This is a species with reports from many observers in no less than 18 of our regions. 71% of these observers in 14 regions believe this owl is declining" (Arbib 1976).

"1978. Maintained on the list on the basis of a 71% majority favouring retention. Dissenting regions; Quebec, mid-Atlantic coast and Ontario. Confined to offshore islands in Mass." (Arbib 1977).

"1979. A truly declining species, with only two of 20 regions feeling otherwise. Support for retention increased from 71 to 89% this year, an alarming pattern. The species must be monitored carefully to determine whether or not this is a short-term phenomenon" (Arbib 1978).

"1980. Only 3 species garnered more regional support for inclusion than this species. Habitat loss is the reason most often blamed for the obvious decline. Continues to decrease as a wintering bird in California and virtually gone as a breeding species. Much like the Marsh Hawk, but more seriously threatened" (Arbib 1979).

"1981. In the area bounded by Ontario, the Niagara-Champlain region, Ohio and Indiana there appears to be a problem. Also in trouble in CA and IA. Oregon and West Kansas experienced high populations. What is happening farther north in the eastern range of this species?" (Tate 1981).

"1982. Populations down again at the edge of its regular breeding range in southern Ontario and the Niagara-Champlain region. The reports of population reduction extend into the Midwestern Prairies and the Northern and Southern Great Plains regions" (Tate and Tate 1982).

"1986. Widely reported as down in Ontario, Midwestern Prairies, Southern Great Plains, and as greatly down in the Central and Southern Prairie Provinces, and Middle Pacific Coastal regions." (Tate 1986).

The North American population of the Northern Harrier, which occupies similar breeding and wintering habitat as the Short-eared Owl, has also experienced a decline in numbers this century, although not as severe as that of the Short-eared Owl. The Harrier has been on the American Birds' Blue List since its inception in 1972 because of a perception of a declining population, particularly east of the Mississippi and in the northcentral U.S. Breeding Bird Survey data from the period 1965 through 1979 indicate significant decreases in the population in the Eastern and Central regions of the continent, including eastern Canada, but a rising tendency in the Western region which offset the declines so that the continental trend was not significant. An analysis of Christmas Bird Count data from 45 states (Brown 1973 in Cadman 1991) showed a decline in Harrier numbers between 1954 and 1965, followed by an increase between 1967 and 1979. However, unlike the Short-eared Owl, the Northern Harrier still occurs in fairly good numbers and therefore does not fit existing COSEWIC categories of "Vulnerable", "Threatened", or "Endangered" (Cadman 1991).

Northeastern United States

The Short-eared Owl may have been uncommon in the northeastern U.S. prior to extensive land clearing (Holt 1986). It undoubtedly benefitted from the clearing of forests which created more extensive open habitat, some of which was suitable for Short-eared Owls. However, at the same time, the destruction of marshes and natural grasslands for agricultural purposes likely depleted prime habitat. Now that much land has been allowed to return to a forested state, at the same time that agricultural practices have intensified on remaining farmland, and wetland destruction has continued, the Short-eared Owl population in the northeastern United States has declined. Holt (1986) states that, if recent surveys and estimates are accurate, then Short-eared Owls are in great danger of being extirpated in the northeastern United States.

Nature Conservancy ranks (Table 1) and state Atlas data (Table 2) indicate that the Short-eared Owl is an extremely rare breeder in the northeastern and northcentral United States. Melvin et al. (1989) describe the breeding population of the Short-eared Owl in the northeastern United States as "small and declining", and they consider the species to be "the rarest and most threatened species of owl nesting in the northeast". Historically, the Short-eared Owl was distributed more widely as a breeding bird in the northeast and was an uncommon nester in Maine, Connecticut, New Jersey, Pennsylvania and Maryland (Melvin et al. 1989). Although it may be still be a rare summer resident in New Jersey and Maryland, it is currently confirmed as breeding (according to Atlas data) in only four northeastern states: Massachusetts, where it is ranked as S1 (critically imperiled) by the Nature Conservancy and has been officially designated as Endangered; Vermont, where it is ranked as S1B (critically imperiled breeder) by the Nature Conservancy and is designated as a species of Special Concern; New York, where it is ranked as S2 (imperiled) by the Nature Conservancy and is designated as a species of Special Concern; and Pennsylvania, where it is ranked as S1 (critically imperiled) by the Nature Conservancy and is officially designated as Endangered. However, Atlas projects have not been undertaken in Massachusetts, New Jersey, or Virginia, and the species may still be breeding in all three states; it is officially designated as Endangered in Massachusetts and New Jersey, and the Nature Conservancy considers it to be a critically imperiled breeder in all three states. During atlas projects in New York, Pennsylvania, and Vermont, confirmed breeding evidence was recorded in a total (all states combined) of only nine squares surveyed, and the species was recorded in less than 1% of squares surveyed in any one state (Table 2).

In the late 1800s and early 1900s, the Short-eared Owl was considered to be a widely distributed resident species in New York (Eaton 1914 in Eaton 1988). By 1974, however, the species had become a scarce and local breeder in the state, and its numbers had greatly decreased in recent years (Bull 1974). Clark (1975) stated that "ecological changes due to agriculture, urban development, and succession" had made former breeding grounds in the state no longer suitable. Contamination from the use of toxic chemicals may also be a problem in agricultural areas (Eaton 1988). During New York's Breeding Bird Atlas project (1980-1985), the Short-eared Owl was recorded in only 36 (< 1%) of all blocks surveyed, and breeding was "confirmed" in only five blocks (Andrle and Carroll 1988). Breeding pairs are concentrated along the southwest shore of Long Island, in upstate New York along the northeast Lake Ontario Basin, and west of the Finger Lakes region (Tate 1992). Although the species is currently considered to be a rare breeder in New York (Eaton 1988), that state appears to contain the largest population of breeding Short-eared Owls in the Northeast region of the U.S. (Tate 1992).

Table 1. Available State/Nature Conservancy Ranks and Official Status Designations for the Northeastern and Northcentral United States and Eastern Canada.*

<u>State</u>	<u>Designation</u>	<u>Rank</u>
Connecticut	Threatened	SHB, S1N
Delaware	?	SHB, S2N
Iowa	?	S1
Illinois	Endangered	S1
Indiana	Endangered	S2
Kentucky	Endangered	S1
Massachusetts	Endangered	S1
Maryland	Special Concern	SH
Maine	Not Listed	SH
Michigan	Endangered	S1
Minnesota	Special Concern	S3
New Brunswick	Not Listed	-
New Hampshire	Not Listed	SN
New Jersey	Endangered	S1
New York	Special Concern	S2
Nova Scotia	Not Listed	-
Ohio	Not Listed	S1S2
Ontario	Not listed	S3S4
Pennsylvania	Endangered	S1
Pr. Edward Is.	Not Listed	-
Quebec	Not listed	S4
Rhode Island	?	S1N
Virginia	Not Listed	S1
Vermont	Special Concern	S1B, S2N
Wisconsin	Not Listed	S1B, SZN
West Virginia	Not Listed	SN

* Ranks as of 1993; Designations as of 1990.

** B refers to breeding status; N refers to non-breeding status.

S1 = Critically imperiled in state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 = Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

S3 = Rare or uncommon in state (on the order of 21 to 100 occurrences).

S4 = Widespread, abundant, and apparently secure in state, with many occurrences, but it is of long-term concern.

S5 = Demonstrably widespread, abundant, and secure in state and essentially ineradicable under present conditions.

SA = Accidental or casual in state, including species recorded once or twice or only at very great intervals, hundreds or even thousands of miles outside their usual range.

SH = Of historical occurrence.

SN = Regularly occurring, usually migratory and typically nonbreeding species for which no significant or effective habitat conservation measures can be taken in the state.

SU = Unrankable: possibly in peril in state, but need more info.

SZ = Not of practical conservation concern in state because there are no definable occurrences, although the taxon is native and appears regularly in the state; typically applies to migrants.

Table 2. Breeding Bird Atlas data summaries for the Northeastern and Northcentral United States

State	Years of Survey	# of blocks surveyed	# and % of blocks with breeding records				
			poss.	prob.	conf.	total	(%)
Conn.	1982-86	597	0	0	0	0	0.0
Del.*	1983-87	222	0	0	0	0	0.0
Ill.	1986-90	1011	2	0	2	4	0.4
Ky.	1985-91	727	0	0	2	2	0.3
Me.**	1978-83	706	0	1	0	1	0.1
Md.	1983-87	1256	0	0	0	0	0.0
Mich.***	1983-88	1896	10	4	1	15	0.8
N.H.	1981-86	178	0	0	0	0	0.0
N.Y.	1980-85	5323	22	9	5	36	0.7
Ohio	1982-87	969	1	1	0	2	0.2
Ohio+	1982-87	764	1	0	0	1	0.1
Penn.	1983-89	4928	2	1	3	6	0.1
R.I.	1982-88	165	0	0	0	0	0.0
Vt.	1976-81	179	0	0	1	1	0.6
W. Va.	1984-89	502	0	0	0	0	0.0

- * = historical breeding records, but none during atlas
- ** = recorded during breeding season but not confirmed as breeding
- *** = based on townships
- + = priority blocks

Ohio is at the southern edge of the breeding range of the Short-eared Owl in North America, and unlike the Northern Harrier which has always been a regular summer resident in the state, the Short-eared Owl was traditionally an accidental to casual and very sporadic breeder (Peterjohn and Rice 1991). There is no evidence that a permanent breeding population has ever been established in Ohio, and summering records from two consecutive years are exceptionally rare (Peterjohn and Rice 1991). During Ohio's Breeding Bird Atlas project (1982-1987), the species was recorded in only three blocks surveyed, and breeding was not "confirmed" (Peterjohn and Rice 1991). Since the Atlas project, there has been only one record of a summering Short-eared Owl in the state, and it appears that the species remains a sporadic summer resident in Ohio (Peterjohn and Rice 1991). However, summering birds could very easily be overlooked in certain habitats, and its actual status in the state will not be known until a survey is undertaken to search specifically for Short-eared Owls (Peterjohn and Rice 1991). The species' preferred breeding habitats are virtually nonexistent in Ohio today (Peterjohn and Rice 1991), and it is possible that the

population has declined from historic numbers. Populations have substantially declined throughout western and central Ohio during this century as a result of conversion of grassland to cultivated fields. Conversely, it has increased in unglaciated counties where reclaimed strip mines provided extensive new habitats (Peterjohn 1989).

The Short-eared Owl is considered to have declined dramatically in recent years across Minnesota, where it occurs as a migrant and as a summer and winter resident; nevertheless, it can still be locally common in peak migration times (Janssen 1987). Although formerly it was perhaps the most abundant owl species in Illinois, it is currently designated as endangered in that state, and the decline is mainly because of today's clean farming practices and the destruction of prairie habitat (Bohlen 1989). The species was probably never a common breeder in Michigan, and most of the few historic nesting records are from the southeast (Evers 1991). Evers (1991) stated that "changing agricultural land-use patterns with conversion of pastures and hayfields to row crop monocultures, eventually altered its range" in Michigan. There have been few breeding records since the 1950s, and the species was recorded in only 15 of 1896 (< 1%) townships surveyed during Michigan's Breeding Bird Atlas project (1983-1988) (Brewer *et al.* 1991). The Short-eared Owl is now designated as Endangered in Michigan, and its decline is likely attributable to the loss of large native grasslands, upland oak savannas, and marshes (Evers 1991).

The Short-eared Owl has probably always been a rare breeder in Vermont, and the Atlas project (1976-1981) produced the first breeding records (four in total, including two "confirmed") in many years (Laughlin 1985). In 1927, the species was recorded in summer in 13 of 14 counties in Massachusetts, and was confirmed as breeding in five of them (Melvin *et al.* 1989). Numbers began declining greatly in that state after the 1930s (Holt 1986; Tate 1992), and the species is currently confirmed as breeding in only two counties in Massachusetts (Melvin *et al.* 1989). A study conducted in 1987 located only 18 breeding pairs in the state plus at least six unpaired territorial birds (Melvin *et al.* 1989). Nonetheless, the small population in Massachusetts (estimated at 20 to 25 resident breeding pairs in 1985) may represent the largest concentration of nesting Short-eared Owls on the east coast of North America (Tate 1992). The few remaining nesting areas in Massachusetts are threatened by commercial, residential and recreational development, and the future of the species in that state depends directly on preservation of large continuous land tracts (Holt 1986).

Available Nature Conservancy ranks for the rest of the United States (Table 3) indicate that the species is most numerous in the northern Great Plains and northern mountain states. This is also indicated by BBS results from 1966 through 1989, but BBS data are inadequate to show significant population trends in most of these

states. However, in South Dakota, the species increased on significantly ($p < 0.05$) more routes than routes on which it decreased, and in Montana it decreased on significantly ($p < 0.1$) more routes than routes on which it increased. When BBS data are summarized by ecological region, the region with the highest density of birds extends from southern Idaho through southern and central Oregon and north into central Washington. Between 1966 and 1989, an average of 0.6 birds were reported on routes in this region, and the Short-eared Owl population underwent a significant ($p < 0.05$) decline of 2.8% per year. Breeding populations of the Northern Harrier have also declined substantially in the northern United States over the past 50 years because of reforestation, more intensive agricultural practices, and wetland destruction. The Harrier is listed as Endangered in Illinois, Iowa, Indiana, Missouri, Ohio, Rhode Island, and New Jersey, and Threatened in New York, New Hampshire, and Massachusetts (Cadman 1991).

Table 3. Nature Conservancy Ranks in other U.S. States for which ranks are available.

<u>State</u>	<u>Rank*</u>	<u>State</u>	<u>Rank*</u>
Alabama	SZN	Montana	S5
Alaska	S5B, S3N	Nebraska	S2
Arkansas	S3	Nevada	S4
Arizona	SN	New Mexico	S4N
California	S2	North Carolina	SUB, S3N
Georgia	S4	Oregon	S4?
Idaho	S5	South Dakota	S4B, S4N
Oregon	S4?	Utah	S2
Iowa	S1	Washington	S4
Kansas	S2?B, SZN	Wisconsin	S1B, SZN
Louisiana	S1	Wyoming	S3B, SZN
Mississippi	SN		
Missouri	S1		

* See Table 1 for an explanation of Rank codes.

Canada

Determining the size and trend of the Short-eared Owl population in Canada or parts thereof is difficult. A portion of the population, the size of which is unknown, breeds in remote northern areas where there are few people and very little coverage is obtained. Breeding and wintering populations are erratic and local throughout the range, making it difficult to assess trends even where there are active surveys and numerous birdwatchers. Despite these

difficulties, there are indications of a general decline and that numbers are markedly down in some parts of the country.

The bulk of the breeding and wintering population in road-accessible parts of Canada is currently found on the prairies, and the same was undoubtedly true before settlement. Given the degree of grassland destruction on the prairies since settlement, it is likely that the population has declined greatly, but there are no data to corroborate this long-term decline. Data from the mid-1960s to the present indicate that a decline has occurred in that period.

Fyfe (1976) provided a summary of population trends and relative abundance for the political regions of Canada. He lists the Short-eared Owl as: fluctuating with rare-low relative abundance in the Maritimes, fluctuating with low-high relative abundance in Ontario and southern Quebec, the Prairie Provinces, and British Columbia, and fluctuating with low relative abundance in the Northwest Territories and Yukon. BBS data generally agree with Fyfe's relative abundance figures, showing the species' highest relative abundance to be in the Prairies (Table 4). Breeding Bird Survey data from 1966 to 1989 indicate that the population in Canada underwent a significant decline at a rate of 1.8% per year (or a 43% decline overall) (Table 4), largely due to the decline of the prairie population.

Table 4. Breeding Bird Survey data (1966 to 1989) on the Short-eared Owl for Canada and the Provinces in which the species has been reported (B. Peterjohn pers. comm.).

<u>Province</u>	<u>Population Trend (% per year)</u>	<u>Number of Routes+</u>	<u>Average Birds Per Route</u>
Alberta	-1.3	25	0.49
British Columbia	0.4	5	0.01
Manitoba	-2.7	9	0.11
Ontario	-1.1	5	0.01
Quebec	-0.1	4	0.00
Saskatchewan	-2.7*	25	0.51
Canada	-1.8***	74	0.12

+ = Number of routes on which the species has been reported.

* = P < 0.10

*** = P < 0.01

Unlike the Short-eared Owl, BBS data from 1967 through 1987 show no significant population trend for the Northern Harrier in Canada, but they do indicate that, although the species is common in the prairie provinces, the population there has experienced a decline in numbers, but it is not statistically significant (Cadman 1991).

Christmas Bird Count (CBC) data also indicate that the Short-eared Owl has declined throughout Canada. The number of Short-eared Owls reported on Canadian CBCs was found to have declined significantly ($p < 0.05$) between 1960 and 1989, at an average rate of 2.6% per year, or 78% overall (Figure 4a). Data from only those counts that were run in at least 20 of the 30 years between 1960 and 1989 show a significant decline ($p < 0.05$), at an average rate of 1.9% per year (or a 57% decline overall) (Figure 4b).

Newfoundland and Labrador

There is insufficient information to determine a trend in the population on the Island of Newfoundland, though B. Mactavish (pers. comm.) suspects that numbers are the same now as in historic times. Similarly, Mactavish notes that there has been no change in the amount of suitable habitat. Around the turn of the century, the species was described as a "summer resident but not common in Newfoundland" (Macoun and Macoun 1909), and Mactavish describes it as uncommon today.

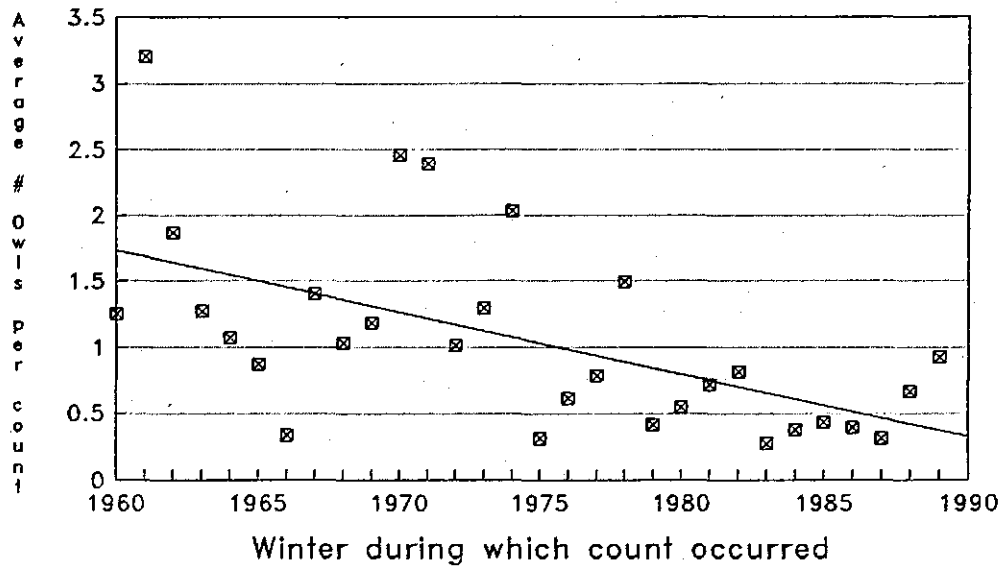
Austin (1932) describes the Short-eared Owl as an uncommon summer resident of Labrador. Todd (1963) states that there are few records from the interior of the Labrador Peninsula, and that none involve breeding, although there are potential breeding records running up the Labrador coast as far north as Nachuak.

The Maritime Provinces

Macoun and Macoun (1909) describe the species as "not common" in Nova Scotia, but more common during migrations. Tufts (1986) describes it as uncommon as a breeding bird, and there are no firm grounds for believing that the species was generally much more or less common in the past than at present (Erskine 1992).

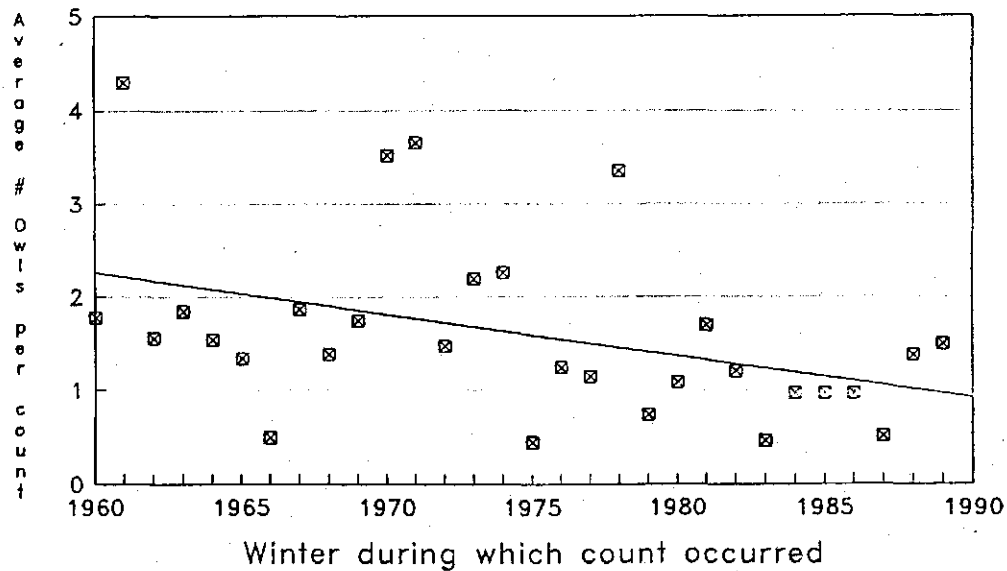
The species was reported in 28 (1.8%) of 1529 10x10 km squares surveyed during the Maritimes Breeding Bird Atlas, and breeding was "confirmed" in only eight squares, all of which were coastal (Erskine 1992). Regular concentrations of breeding pairs occur at the Tantramar Marshes, nearby Shepody Marsh, and on the Acadian Peninsula in New Brunswick, and there is a small breeding concentration at Grand Pre in Nova Scotia (Tate 1992). Erskine (1992) suggests that in most years there are fewer than 100 pairs in the Maritimes, with New Brunswick having more than half the total, Nova Scotia one-third and Prince Edward Island very few. In

Figure 4a. Population trend of the Short-eared Owl in Canada according to CBC data 1960-1989*



* all counts

Figure 4b. Population trend of the Short-eared Owl in Canada according to CBC data 1960-1989*



* counts run for at least 20 years

years with peak vole abundance (such as 1980) the population may more than double the usual population (Erskine 1992). It is presumed that this species will continue to fluctuate in distribution and numbers in the Maritime provinces in the future (Erskine 1992).

Quebec

A comparison of reports from the turn of the century with recent reports suggests that the Short-eared Owl has undergone a long-term, non-cyclic decline since the beginning of the century in southern Quebec. Numbers appear to have stabilized over the last 20 years, but the erratic nature of the species would make population trends more difficult to discern at the current low population levels. Population levels and trends in northern Quebec are largely unknown.

Early records (Macoun and Macoun 1909) described the Short-eared Owl as a common but transient visitant at Montreal that was more common in the fall. Numbers have declined since that time. David (1980) describes the species as "rare" in the part of Quebec south of 51° 30'. Y. Aubry (Atlas des oiseaux nicheurs du Quebec, pers. comm.) reports that it is uncommon as a breeding bird and as a migrant, and is rare to very rare as a wintering bird. During Quebec's Breeding Bird Atlas (1984-1989), the species was recorded in only 120 (5%) of the 2464 squares surveyed, and breeding was confirmed in 33 (28%) of those 120 squares (J. Gauthier pers. comm. 1992). Neither M. Gosselin (National Museum of Nature) nor Aubry had noted any change in population over the last decade.

Data from the Etude des populations d'oiseaux du Quebec (EPOQ) (J. Larivee and A. Cyr pers. comm.), the largest source of data on the species throughout the year, indicate that the Short-eared Owl is rare as a breeder, a migrant and a wintering bird. There is considerable variation in the data from year to year, such that neither an increase nor decrease in population from 1970 through 1989 is apparent.

In northern Quebec, Todd (1963) described the species as fairly common both above and below the tree-line in the Finger Lakes area, south of Leafy Bay, and "sixty-odd miles west of Fort Chimo." He thought that the species probably ranged all the way across the Ungava Peninsula, although pertinent records were lacking. Todd (1963) stated that "in the low swampy country at the southern end of James Bay this owl finds congenial habitat and is correspondingly numerous. It must breed throughout this general area, although nests remain to be discovered." There is no recent information from northern Quebec for comparison to these data from the 1960s.

The Nature Conservancy gives the species a rank of "4" in Quebec, meaning that the species is "Apparently secure in the province, with many occurrences."

Unlike the Short-eared Owl, the Northern Harrier is still one of the most common raptors in agricultural areas of southern Quebec, absent only from the most heavily used farmlands (M. Gosselin pers. comm.). Gosselin has noticed no decline in the Harrier population in southern Quebec over the past 20 years (Cadman 1991).

Ontario

The large number of birdwatchers and the large number of publications on birds in Ontario makes it possible to provide a more thorough evaluation of the species' population trend during this century. The available evidence indicates a considerable reduction in the number of birds seen during fall migration since early in the century, but no discernible trend over the past decade. A review of the literature indicates that the species was more common in southern Ontario 70 to 100 years ago than it is today.

Nash (1913) called it "probably the most abundant owl" in southern Ontario, which is certainly not true today. By the 1930s, adjectives used to describe the species' abundance had changed noticeably. Baillie and Harrington (1936) stated that it was a "rare breeding species in Ontario, excepting perhaps along the shores of Hudson Bay, where it appears to be common." By 1991, it was termed a rare (to locally uncommon) summer resident, locally uncommon winter resident (in the south), and a rare to locally uncommon migrant" (James 1991).

Twenty-five nests have been reported to the Ontario Nest Records Scheme (Peck 1993), indicating that the species is indeed a rare breeding bird in at least the populated parts of Ontario. Breeding Bird Atlas data (Cadman et al. 1987) suggest fewer than 100 pairs nested in southern Ontario in any one year between 1981 and 1985. American Birds sub-regional editors in most areas of southern Ontario estimate the breeding population to be zero or very few pairs in their region. The sole exception is in Frontenac Co., where R.D. Weir (pers. comm.) estimates an annual breeding population of 45 pairs, primarily on Wolfe and Amherst Islands. All reporting ORBBP Regional Coordinators for southern Ontario described the Short-eared Owl as very rare, rare, or uncommon in all seasons with the exceptions of Elgin-West, where it was common during the winter from 1981 to 1990, and Hamilton-Wentworth-Brant, where it was fairly common during the winter from 1981 to 1990.

Most American Birds sub-regional editors and ORBBP Regional Coordinators in southern Ontario considered that the species' numbers had been stable for the last decade. A few indicated that

numbers were irregular and two suggested a slow decline in numbers in migration during the same time period: increases were noted in Niagara R.M. (summer), Middlesex Co. (winter, and possibly summer), and York R.M. (summer, fall, and winter). Between 1950 and 1980, however, the species was reported to have declined in four out of 10 ORBBP regions, while populations remained stable in four and fluctuated in two. A comparison of Ontario Nest Records Scheme (ONRS) (Peck and James 1983) and Atlas data suggests that the species' breeding range in southwestern Ontario has been reduced. There were no records of "confirmed" breeding during the Atlas in the counties and Regional Municipalities of Kent, Elgin, Haldimand-Norfolk and Metropolitan Toronto, where the species formerly bred according to the ONRS. The irruptive and irregular nature of the species might provide a partial explanation of the apparent shrinkage of breeding range: the records from Kent, Elgin, Haldimand-Norfolk and Metropolitan Toronto are based upon very few documented nests over a prolonged period of coverage (Sandilands 1980).

The available information is most clear in describing the decline in numbers of birds observed during fall migration in southern Ontario. A decline in the number of migratory birds passing through southern Ontario would be expected if much of the continental population is in decline, as indicated by BBS data, CBCs, and the Blue List. Fleming (1907) described the Short-eared Owl as "abundant in the fall near Toronto when large flocks sometimes occur", and Nash (1908, 1913) and MacClement (1915) made similar comments. Speirs (1985) mentioned a flock of 50 birds in Ashbridges Bay in 1889, and Taverner (1922, 1934) stated that a "great many" fell to the guns of sportsmen at that time. Nash (1913), referring to southern Ontario, mentioned that most Short-eared Owls arrived in fall, but the great bulk were gone by winter. Large concentrations during migration are now unusual, suggesting that the population which migrates through Ontario has decreased during this century. Of all American Birds sub-regional editors and ORBBP Regional Coordinators in Ontario who responded to questionnaires on the species, only six individuals (R.D. Weir of Kingston, K. McLaughlin and R. Dobos of Hamilton, H. Lancaster of Elgin-West, P. Read of Middlesex, and B. Thompson of Huron) called the species an uncommon fall migrant; in all other areas it was described as rare or very rare in the fall. E.R. McDonald reported that the Short-eared Owl is not known to occur in fall migration in the Port Hope area, and M. Bain and J. Barker list it as rare in fall migration in Durham R.M., although it is reported almost every year.

There is little solid information on which to determine a winter population trend, though comments from American Birds sub-regional editors indicate a long-term decline in southwestern Ontario. K. Burke (pers. comm.) reported that old records show up to 100 birds at a time along Lake St. Clair, but similar numbers have not been seen since the 1940s. J. Holdsworth (pers. comm.) mentioned a

concentration of six to eight wintering birds in Oxford County in the late 1950s, and stated that concentrations of that size have not been seen since. A new Christmas Bird Count begun in 1989/1990 in the Hagersville area found a relatively large population of Short-eared Owls. That area is known to have relatively high numbers of wintering raptors (J. Miles pers. comm.), probably because it contains an extensive area of grassy fields.

There is a perception that, like Short-eared Owls, numbers of Northern Harriers are low or have been declining in southern Ontario, but evidence suggests that over the past decade numbers have stabilized there, with the exception of the southwest where numbers have declined and are currently low (Cadman 1991).

Northern Ontario

D. Elder (pers. comm.) estimated that "dozens" of Short-eared Owls bred in the Rainy River area in 1988, making it one of the most important areas in the province for the species. However, there were few if any records from the area during 1989 and the spring of 1990. There is a relatively large amount of potential breeding habitat in the area, and new open habitat is being created through land clearing. However, ditching and draining of large damp fields is underway and is likely to affect the suitability of much habitat that is currently preferred by the owls.

The situation regarding the breeding population on the north coast is somewhat unclear because of the sparsity of information available and the species' irruptive nature. The small amount of evidence available suggests that a decline has occurred along the Hudson and James Bay coasts since early this century. Spreadborough (in Macoun and Macoun 1909) found the Short-eared Owl to be "very abundant" on both James Bay shores in 1904. Northern biologists now describe the species as uncommon on the Hudson Bay Lowlands (P. Pevett and J. E. Thompson pers. comm.), and Atlas data from 1981 to 1985 (Cadman *et al.* 1987) support that. The large numbers noted by Spreadborough may reflect a larger continental population early in the century, which would be consistent with the larger numbers seen on migration in southern Ontario at the time. They may also reflect a large local population due to high small mammal numbers that year in the area.

Other information from the middle of the century is open to interpretation. Lewis and Peters (1941) found the species to be the most abundant owl on the James Bay coast in September and early October, noting it in seven locations. Manning (1952) summarized information to that date, stating that the Short-eared Owl "appears to be the common owl of the James Bay and southern Hudson Bay coast". However, as there are no other species of owls expected to breed along this coastal area, these latter two statements do not necessarily imply that the bird was actually common. On the coastal barrens in 1947, Manning saw one Short-eared Owl at North Point on

June 6, one at Piskwanish on June 12, four at Cape Duncan from June 26 to 27, and one, which was collected, at Cape Tatnam on August 25. This small number of birds suggests that the Short-eared Owl was an uncommon breeding bird in 1947, and from previous evidence noted in Manning (1952) it may have been uncommon for the 30 years before that.

Atlas data from far northern Ontario reveal that the species was reported in 12 of 34 coastal or tundra squares which received at least 10 hours of coverage (i.e., those squares which were covered well). Abundance estimates were provided in five of these squares: four of these were of one pair and the other was of two to 10 pairs. From these data, the breeding population for the 200 squares on the James and Hudson Bay coasts can be estimated at between 90 and 210 pairs during any one year. This figure should be regarded as a crude estimate. Nevertheless, the low total estimated suggests that the species was uncommon along the coasts of James and Hudson Bay during the Atlas period (1981-1985).

Recent (1990 and 1991) seasonal bird surveys conducted at five sites (three coastal and two inland) in the coastal zone of the Hudson Bay Lowland (Wilson and McRae 1993) found relatively small numbers of Short-eared Owls, probably because of a lack of small mammals in those years. The species was recorded at three of the five sites surveyed: from May 28 to June 9, 1990, the species was recorded on six of 13 possible study days at the Shagamu site, with a maximum daily count of three; from August 20 to 30, 1990, it was recorded on one of 11 possible study days at the Shagamu site, with a maximum daily count of one; from June 12 to 20, 1990, it was recorded on two of nine possible study days at the Eckwan site, with a maximum daily count of three; and from June 5 to 15, 1991, it was recorded on two of 11 possible study days at the Longridge site, with a maximum daily count of one. No Short-eared Owls were recorded at the Brant site, where they could be expected in numbers during a high small mammal year (Wilson and McRae 1993). Wilson and McRae (1993) stated that the Short-eared Owl's centre of abundance in Ontario is the coastal strip of the Hudson Bay Lowlands, and that the species was clearly under-represented during their study.

The Prairies

The available evidence suggests that there has been a marked decline in the Short-eared Owl population on the Canadian prairies. Breeding Bird Survey (BBS) data show a clear downward population trend. The number of birds per route in the "Central Prairies" declined from 0.68 (1966 to 1977) to 0.21 (1978 to 1983) (Collins and Wendt 1989). BBS data from 1966 to 1989 summarized by physiographic region indicate a significant decline of 2.9% per year in the northern portion of the prairies, and non-significant declines in the central and southern prairies (B. Peterjohn pers. comm.).

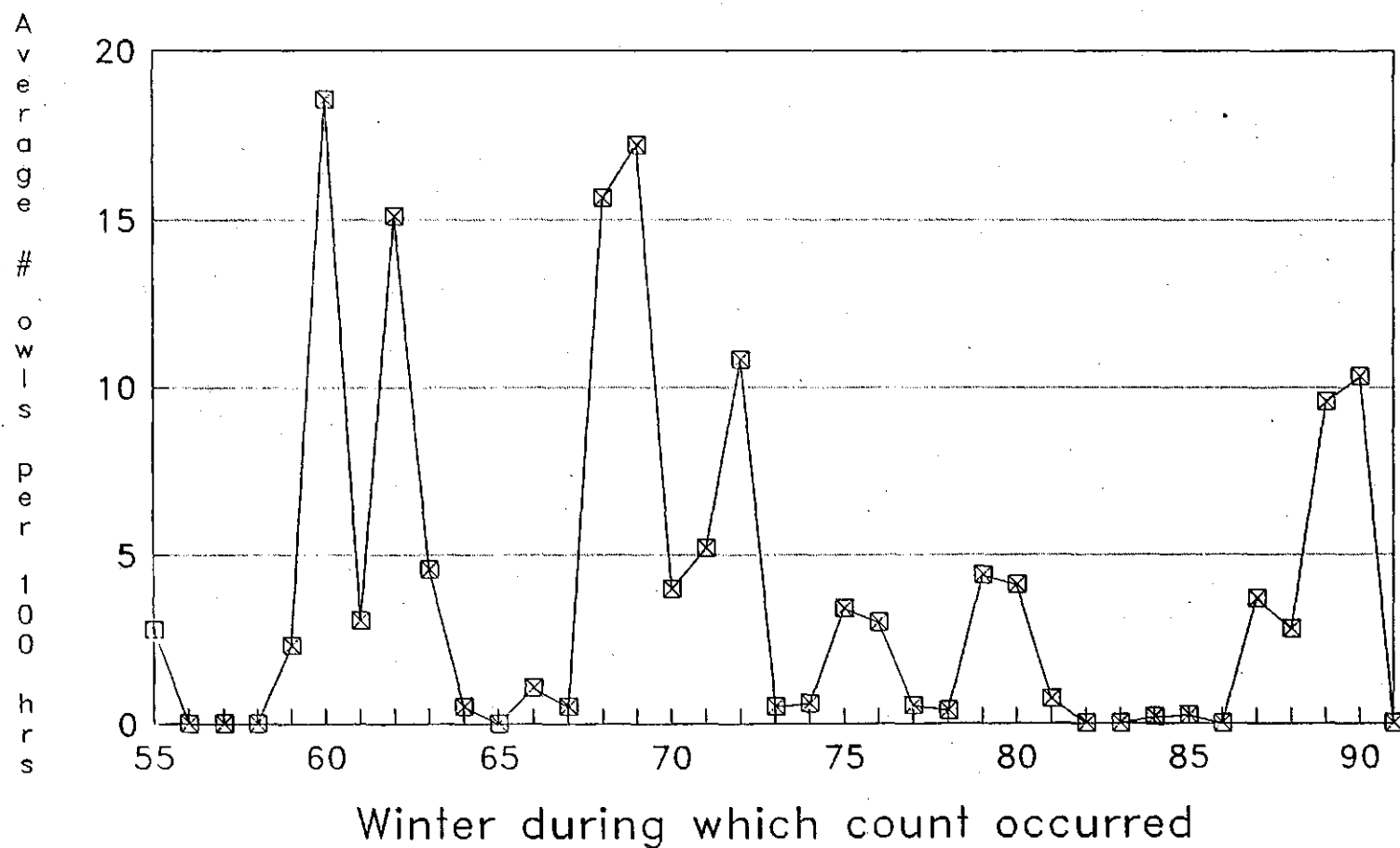
Around the turn of the century, the Short-eared Owl was described as "tolerably common" in Manitoba by E.T. Seton (in Macoun and Macoun 1909). In 1990, R. Koes (pers. comm.) described the species' population as irregular in (southern) Manitoba, with numbers varying greatly between years. He felt that since 1969 there had been a slow decline in the population. R.E. Jones (pers. comm. 1994) described the species as 'tolerably common' in such areas as Delta Marsh, Oak Hammock Marsh and probably the Netly-Libau Marshes.

The species was described as common in 1892 around Indian Head, and "quite common" in 1894 at Crane Lake, Saskatchewan (Macoun and Macoun 1909). Callin (1980) described it as a regular and fairly common summer resident in the Qu'Appelle region, while Belcher (1980) called it an uncommon summer resident at Regina, though it is occasionally more common when mice are especially plentiful. Nevertheless, in Saskatchewan, where the species has been reported on 25 BBS routes between 1966 and 1989, there has been a significant decline averaging 2.7% per year (Table 4). A. Smith (Canadian Wildlife Service, Saskatoon, pers. comm.) has noticed a marked decline in the population in Saskatchewan, such that "more birds were seen in poor years during the late 1960s and early 1970s than were seen in the good years of the late 1980s." D.G. Hjertaas (pers. comm. 1994) states that "Consulting with Saskatchewan birders shows Short-eared Owls have become rare in most areas. Consulting with Ducks Unlimited biologists delivering Prairie Care produced no reports of Short-eared Owls in the northern region, but a few sightings in the area around the Quill Lakes. The species has also been observed recently at the Last Mountain Lake National Wildlife Area. These seem to be the only areas of regular occurrence in the past several years."

Around the turn of the century in Alberta, the Short-eared Owl was described as common along the Milk River and on the West Butte, "quite common" at Medicine Hat, "not rare" between Lesser Slave Lake and the Peace River, and was seen in "fair" numbers in the Red Deer District (Macoun and Macoun 1909). Salt and Wilk (1958) called the species a common summer resident in Alberta. Pinel et al. (1991) state that although numbers fluctuate due to food supply, there seems to have been a population decline in southern Alberta. W. W. Smith (pers. comm.) states that there has been a large scale decline in recent years and that the species is not now widespread like it used to be. The species was common in Alberta in the 1960s, but it might now be described as scarce as a breeding bird (W. W. Smith pers. comm.).

Christmas Bird Counts have taken place in Regina, Saskatoon, Calgary and Edmonton almost every year from 1962 to the present. In the period from 1962 through 1972, those four counts had among the highest numbers of Short-eared Owls of any counts in all of North America (Root 1988), indicating that southern Saskatchewan and Alberta are important congregation areas in late fall: the species

Figure 5. Population trend of the Short-eared Owl in the Prairies* according to CBC data 1955-1991



* Alberta and Saskatchewan

overwinters in some years (Pinel et al. 1991). Because of the above facts, only those four counts were used in the following summary of CBC data from the prairies (see Figure 5). Short-eared Owl numbers were highly erratic during the 1960s and early 1970s, but decreased markedly from then until the mid-1980s. There was an increase in numbers (but not to former levels) from 1987 to 1990, but in 1991 numbers dropped off again. Although the species' abundance is highly erratic, CBC data indicate an overall downward trend in peak numbers, and these data, in combination with negative trends in BBS data and the observations of biologists and birdwatchers, indicate a decline in the population of both wintering and breeding Short-eared Owls on the prairies over the past 20 years.

British Columbia

There is evidence to suggest that Short-eared Owl populations in British Columbia have declined. Early in the century, the species was described as "abundant" both on the [presumably Vancouver] Island and on the mainland, as an abundant resident in the lower Fraser valley, and as rather common in the Okanagan District in winter (Macoun and Macoun 1909). Recently, Campbell et al. (1990) described the species as an uncommon resident on the extreme southwest coast, a rare resident in the Okanagan valley, and a very rare resident in the Peace Lowlands. In addition, Campbell et al. (1990) stated that the species is an uncommon spring and autumn migrant throughout the province, and is casual in winter in the north.

The rapid loss of old-growth fields in the Fraser River delta is threatening the existence of a formerly dense breeding population there (Campbell et al. 1990). The Fraser River delta is the main wintering area in British Columbia, where the species was the fifth most common raptor in winter censuses from 1975 to 1980 (Campbell et al. 1990). Recently, however, wintering numbers have been quite low, with Christmas Bird Count data from the Lower Mainland showing a steady decline in the owl's peak numbers over the past 16 years (Campbell et al. 1990). It is listed as an uncommon resident in the Okanagan Valley, though it is fairly common in winter in the Vernon area (Cannings et al. 1987).

Northern Canada

According to Snyder (1957), the Short-eared Owl is largely distributed south of the Arctic, but is found sporadically on the Arctic mainland, and may be established on Banks Island. He considered that the population in the Arctic is nowhere dense, and is highest when and where lemmings and mice are plentiful.

J. Sirois (Canadian Wildlife Service, Yellowknife, pers. comm.) described the bird as uncommon on the mainland of the Northwest Territories north of the treeline. In that area it is often outnumbered by Peregrine Falcons, Golden Eagles and Rough-legged Hawks. Sirois added that it is a regular breeder in the western arctic, where it can be locally common, but numbers vary from year to year depending upon small mammal populations. Because of the small number of Short-eared Owls he sees, he was unable to determine whether there had been a population change.

The species is listed as a fairly common breeder in the southeast portion of the Beaufort Sea area (presumably around and to the east of the Mackenzie Delta), but is a rare visitant and breeder in the remainder of the Beaufort Sea area (Johnson and Herter 1989). Martell et al. (1984) state that the species nests commonly on the tundra of the Mackenzie Delta region in years when food is abundant. They also state that Short-eared Owls have been observed in summer on the Yukon North Slope and in the vicinity of Fort McPherson.

According to the Yellowknife regional bird checklist, the Short-eared Owl is an occasional summer resident of the Yellowknife region. It is not included in the list of birds of Nahanni National Park (Scotter et al. 1985). Along the Dempster Highway, it is considered to be a sparse summer resident, though it is yet to be reported on the Northwest Territories section of the highway (Frisch 1987).

Twenty years ago the species was considered a summer resident whose numbers vary greatly at Churchill, Manitoba (Jehl and Smith 1970), but there is no recent information for comparison.

HABITAT

Habitat Requirements

In general, the Short-eared Owl depends on relatively open habitat, and usually quite extensive areas of open habitat. Eckert (1974) stated that it is primarily a bird of marshland and deep grass fields. In winter, congregations generally hunt and roost in open areas such as abandoned pastures, fields, hay meadows, grain stubble, airports, young conifer plantations, marshes, and old fields interspersed with trees and shrubs (Clark 1975; Borko 1977; Everett 1977; Lack 1986; Evers 1991). In summer, the species is found in prairie, grassy plain or tundra (Clark 1975). Habitats used by Short-eared Owls are thus most often early successional habitats, except for tundra and perhaps prairie if it can be considered a climax grassland.

Breeding habitats in Ontario include cattail and sedge marshes and adjacent fields (R.D. Weir and J. McCracken pers. comm.), dry open farmland, pastureland with grain and hayfields not far away (J. Johnson pers. comm.), abandoned grassy fields in agricultural areas (Peck and James 1983), heath bogs (Peck and James 1983; M.E. Foley pers. comm.), tundra (Peck and James 1983), meadows and airport fields of short grass (Peck and James 1983; Weir 1987b). Known breeding habitat in the Maritime provinces includes dyked wet meadows and marshes, and coastal bogs and grasslands (Erskine 1992). In Alberta, the species prefers to breed in relatively open country such as grassland, grassy or brushy meadows, marshland, pastures, stubble fields, croplands, and previously forested areas that have been cleared (Semenchuk 1992).

In British Columbia, the species occurs throughout the year in a wide variety of open-country habitats including marshes, swamps, sloughs, estuaries, lakeshores, spits, marine foreshores, beaches, and lagoons, as well as sedge-cranberry fields, sedge-hardhack associations, and grasslands (Campbell *et al.* 1990). In addition, it is frequently found in man-made habitats such as airports, golf courses, dykes, and agricultural fields (Campbell *et al.* 1990). The species breeds in open country with short vegetation, including rangelands, grasslands, near-dry marshes, farmlands, low arctic tundra, brushy fields, and forest clearings (Campbell *et al.* 1990). Most nests reported in British Columbia were in shrubby, grassy fields adjacent to agricultural areas, with grass heights ranging from 25 to 90 cm, but nests have also been reported in airport fields, marshes, open rangeland, sagebrush plains, and hayfields (Campbell *et al.* 1990).

Small mammal populations are generally higher in grassy fields, especially grassy fields that are damp, than in cultivated land (R. Boonstra pers. comm.). This probably accounts for the owls' preference for open grassy habitats. During periods of low rodent densities, only large, high-quality openings such as low-use pastures, hayfields, and natural dry or wet grasslands can maintain relatively stable owl populations (Evers 1991).

Long grass is often used for roosting. Craighead and Craighead (1956) noted that Short-eared Owls select fields with light-coloured grasses that closely resemble their plumage, presumably for better camouflage when roosting. Bosakowski (1986) noted that although ground-roosting is typical in Short-eared Owls, they will roost in conifers when snow depth exceeds 5 cm. Relatively undisturbed conifers or other heavy, low cover in or adjacent to suitable winter foraging habitat might be important in southern Canada, where snow depth often exceeds 5 cm.

The three most important areas for wintering owls in Ontario are Amherst and Wolfe Islands near Kingston and the Hagersville area in the southwest. In these areas, agricultural practices are atypical of the rest of the province. Land-use is low intensity with plenty

of pasture, grasslands and meadows. A similar area, which still uses "turn-of-the-century, ecologically sound farming methods" on the upper peninsula of Michigan is also important for Short-eared Owls (Evers 1991).

Habitat Distribution

Open habitats suitable for Short-eared Owls are found on the prairies, in other agricultural areas, and in large marshes and grassy dyked areas across the country. Suitable habitat is not evenly distributed throughout agricultural land. Much agricultural land is unsuitable for the species, being too intensively cultivated. Although a wide variety of agricultural habitats have been reported as being used by Short-eared Owls, meadows and other grassy fields are most often used, and these are quite restricted at present.

There is suitable habitat along the coast in the Maritimes, Quebec and northern Ontario. In southern Quebec, the St. Lawrence River lowlands offer some habitat as do parts of Ontario south of the Canadian Shield and around Rainy River.

Tundra habitat is widespread across northern Canada. As is true in other habitats, the suitability of a particular area of Tundra is based largely on the small mammal population at the time. J. Sirois (Canadian Wildlife Service, Yellowknife, pers. comm.) has found more Short-eared Owls in the Northwest Territories on wet tundra than on dry upland tundra.

Trend in Quantity and Quality of Critical Habitat

There have been ecological changes due to agriculture, urban development, and succession which have rendered parts of the Short-eared Owl's range uninhabitable (Clark 1975). Habitat loss is regarded as the major reason for the decline of the species in eastern North America and central Europe (Voous 1989). Habitat in the east probably increased with the clearing of forests and has been decreasing for the past century due to succession, wetland drainage, urban expansion, and increasingly intensive farming practices which leave little land in a grassy state. Although European settlement of the Maritime Provinces led to extensive destruction of marshes, the dyking of salt marsh, by excluding tidal effects, may have helped breeding by Short-eared Owls (Erskine 1992). It is therefore difficult to assess the net effect of settlement in the Maritimes.

The trend away from pasturing in Ontario and Quebec has reduced the amount of meadow and the number of grassy fields which provide habitat. The area of pasture in Ontario has decreased steadily this century, from over 3 million acres in 1921 to just over 1 million

acres in 1986, or a 65% decline (see Figure 6) (Dominion Bureau of Statistics 1968; Statistics Canada 1987). Similarly, summer fallow land has decreased from 344,634 acres in 1931 to 198,517 in 1986, or a 42% decline (Dominion Bureau of Statistics 1968; Statistics Canada 1987). In Quebec, the area of pasture has decreased from 1,865,743 ha in 1941 to 302,000 ha in 1990: an 85% decrease (M. Robert pers. comm.). These decreases may be an important factor in the decline of the species in Canada during this century. It also seems feasible that as the amount of grassland habitat has shrunk, the patches of suitable habitat have become more fragmented, with greater distances between patches. This would make it more difficult for Short-eared Owls to find suitable habitat, and would increase the significance of the remaining patches of extensive habitat. Pastureland has decreased throughout the northeastern United States, and "may equate to a loss of foraging habitat for many Northeast raptor species" (Brooks 1989), including the Short-eared Owl.

The massive changes that have taken place in prairie habitats in the United States and Canada since settlement have undoubtedly caused considerable reduction in the Short-eared Owl population. About 80% of the Canadian prairie landscape, and 99% of the tall-grass prairie, has been transformed by agriculture and to a lesser degree urbanization and industrialization (Scott 1991). A. Smith (Canadian Wildlife Service, Saskatoon, pers. comm.) stated that farm consolidation, which has led to larger fields and less land being left fallow, has further reduced the population in Saskatchewan.

"Clean farming" practices have been cited as destroying habitat and reducing owl populations in Illinois (Bohlen 1989). In Michigan, the decline of the Short-eared Owl is likely attributable to the loss of large native grasslands, upland oak savannas, and marshes (Evers 1991).

Campbell *et al.* (1990) explained that more and more of the old field habitat throughout the lower mainland of British Columbia is being converted to agricultural, residential or recreational (e.g. golf courses) uses. Not only has this habitat loss undoubtedly contributed to the steady decline in peak winter numbers noted in the Lower Mainland, but it also threatens the existence of a formerly dense breeding population in the Fraser River delta.

There has been relatively little obvious change in the habitats of northern Canada, where an unknown portion of the population breeds. However, southern James Bay has been noted as an area of relatively high abundance of Short-eared Owls (Todd 1963). Large dams which cause flooding of habitat and alteration of drainage patterns may affect the amount of suitable habitat in that area. To date it seems likely that changes to habitat in the species' winter and breeding ranges in the United States and southern Canada are most affecting population levels.

Change in Pasture Acreage, 1921 to 1981

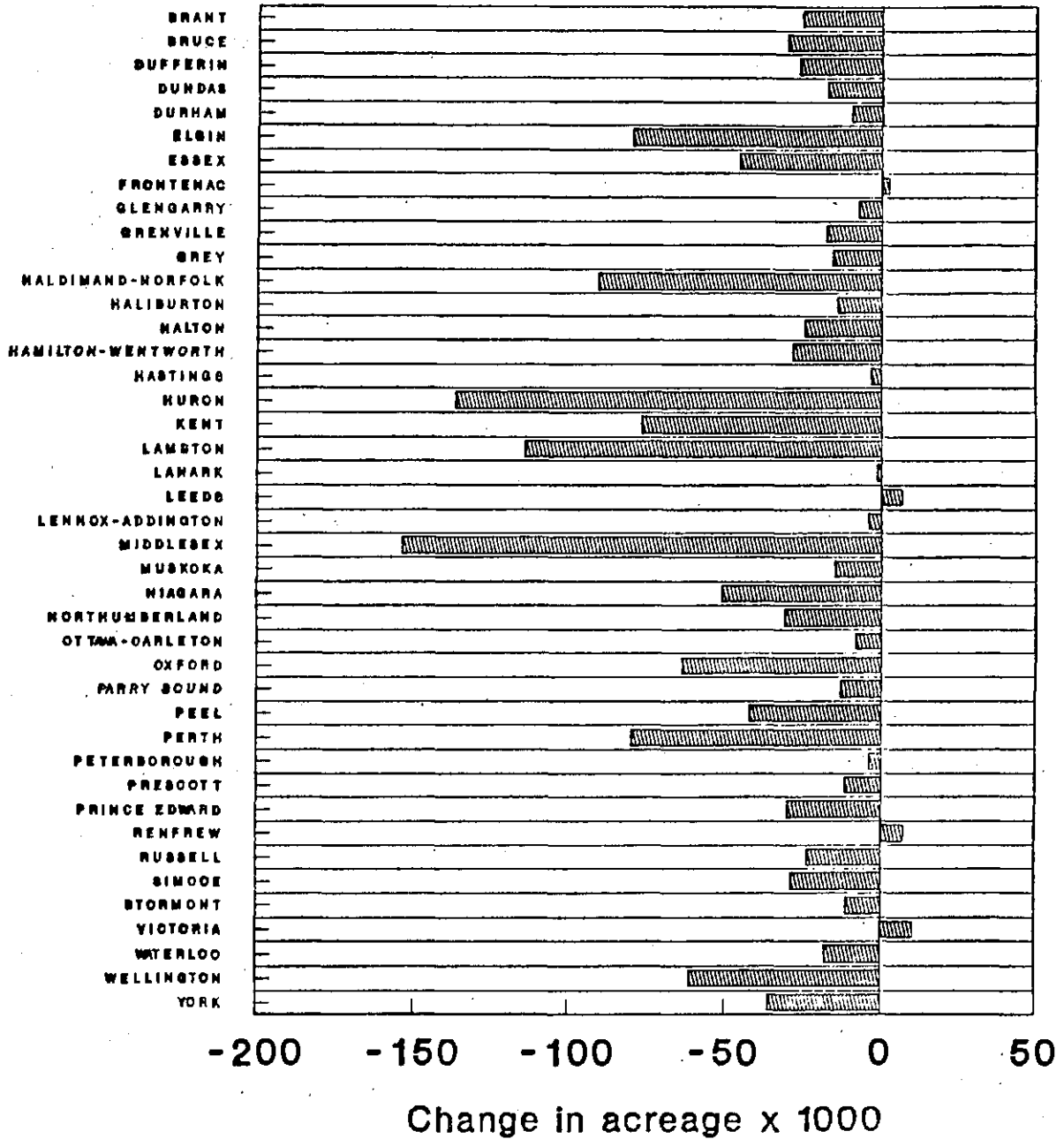


Figure 6. Change in pasture acreage in Ontario, 1921-1981.

There is general agreement among American Birds sub-regional editors that critical habitat for Short-eared Owls in southern Ontario is decreasing. Marshes are well known to have been subjected to extensive draining since settlement by Europeans, and the drainage of low-lying areas in fields is continuing. Extreme southwestern Ontario has lost about 95% of its wetlands, and this is undoubtedly a factor in the decrease of Short-eared Owls in that area.

Protection of Habitats

Agricultural land suitable for Short-eared Owls is primarily in private hands. A larger proportion of the remaining extensive marshes across Canada are under government ownership. However, the overall extent of protected habitat suitable for Short-eared Owls is unknown. The coastal areas of James and Hudson bays are largely Crown Land, though a considerable area of the coast is contained in Polar Bear Provincial Park.

The analysis of Christmas Bird Count data by Root (1988) shows relatively high concentrations of Short-eared Owls in several areas of the United States and Canada. Root notes that some of the concentration areas occur near protected or managed areas, implying that such areas are of importance to wintering owls. Similarly, Wildlife Areas and National Wildlife Reserves are mentioned as important to both breeding and wintering birds in Wisconsin (D. Tessen pers. comm.), and such areas are also considered to be important in Saskatchewan (A. Smith, Canadian Wildlife Service, Saskatoon, pers. comm). One explanation for high relative abundance would be that these protected and managed areas contain extensive habitat suitable for Short-eared Owls and that they harbour large populations of small mammals.

GENERAL BIOLOGY

Description of the Species

The Short-eared Owl belongs to the Family Strigidae (Typical Owls). Distinctive features, according to Godfrey (1986), include: "Ear tufts very short. A medium-sized buffy-white owl, the upper parts broadly but softly streaked, the abdomen narrowly and more sharply streaked with brown. Flight feathers and tail barred with brown. Eyes yellow, framed by a small poorly defined blackish area on facial disc. Active in daylight, especially at dusk, and inhabiting open places (not a woodland owl). Like the Long-eared Owl, it shows in flight a black patch near the wrist on the underside of the wing, but the more buffy general colour and complete lack of any cross-barring on the abdomen of the Short-eared Owl should distinguish it. The Rough-legged Hawk shows a similar black wrist

patch in flight, but the owl has a different big-headed silhouette and lighter, more buoyant flight. Northern Harriers, inhabiting similar open areas, have a conspicuous white rump patch, which the owl lacks" (Godfrey 1986).

Reproduction

The age of first breeding is one year (Cramp 1985) or less (Mikkola 1983; Glutz and Bauer 1980 in Tate 1992). The age and sex ratio of the population is not reported in the literature. The species has been known to live for 15 years in captivity (Eckert 1974), and banding data show one wild bird to have reached 12 years and 9 months of age (Cramp 1985).

The species is essentially single-brooded, but is occasionally double-brooded in the southern United States (Eckert 1974) or in years when food is plentiful (Harrison 1978 in Semenchuk 1992). In addition, if the nest is destroyed or predated, the female may renest (Tate 1992).

The Short-eared Owl is unique within its family (Strigidae), being the only member to build its own nest rather than use abandoned nests of crows or other birds (Tate 1992). The nest is usually a slight depression or shallow scrape in the ground (Peck and James 1983; Ehrlich *et al.* 1988; Campbell *et al.* 1990; Semenchuk 1992), and some nests in Ontario were simply cups of dried weeds and/or flattened grasses (Peck and James 1983). The nest is usually concealed under low shrubs or other vegetation such as reeds and grasses (Peck and James 1983; Semenchuk 1992), but several nests in British Columbia were in open, exposed situations (Campbell *et al.* 1990). The nest is often in the vicinity of water (Semenchuk 1992); in wet areas in Ontario, some nests have been found on hummocks and small knolls (Peck and James 1983). Most nests reported in British Columbia were positioned at the bases of grass clumps, but some were next to small shrubs or fence posts, and one was located in a willow thicket (Campbell *et al.* 1990). The nest is unlined or sparsely lined with dried grass, weed stalks, and occasionally feathers from the female's breast (Peck and James 1983; Ehrlich *et al.* 1988; Campbell *et al.* 1990; Semenchuk 1992).

The breeding season is reported to commence in direct relation to vole abundance, with a larger prey population yielding an earlier start to breeding activities (Tate 1992). Egg dates in Ontario range from April 14 to August 1 (James 1991), while in British Columbia they range from March 24 to July 9, with 51% recorded between April 20 and May 15 (Campbell *et al.* 1990). Incubation, conducted entirely by the female, generally lasts from 24 to 28 days (Johnsgard 1988). The young hatch asynchronously, and siblings are variously sized (Ehrlich *et al.* 1988). Although the young actually fledge at 24 to 27 days, they may begin to leave the nest at 14 to 18 days, walking and running in the vicinity

(Johnsgard 1988). In Ontario, nests with young have been reported from May 11 (some of these young appeared to be six to seven days old) to August 12, with most from May 11 to May 31 (ORBBP data; ONRS data). Fledged young have been reported in Ontario on May 23 and 24 (ONRS data), in mid-June (Atlas USRFs), and on July 13, July 31, and August 5 (ORBBP data). In British Columbia, dates for broods range from April 10 to September 13, with 52% of broods recorded between April 29 and June 10 (Campbell *et al.* 1990).

The Short-eared Owl is known for its ability to increase clutch size in times of prey abundance (Clark 1975), with clutch sizes of four to 14 having been noted (Eckert 1974). Murray (1976) reported a mean clutch size of 5.61 from 186 nests in North America. The largest clutch reported in the literature is 16 from Finland, laid in a year of peak vole abundance (Mikkola 1983). In Ontario, clutch sizes reported have been four to seven eggs (Peck and James 1983), while in British Columbia, they have ranged from one to 13, with 57% of clutches having six or seven eggs (Campbell *et al.* 1990). In Manitoba, a mean clutch of 8.6 eggs was reported from five clutches in 1969 (Clark 1975). The number of young surviving to independence varies greatly with prey abundance. Pairs have been known to raise 10 young successfully under conditions of high prey abundance (Beske and Champion 1971). The more normal situation is described by Clark (1975) who found four fledged young per pair during a year with abundant mice in Manitoba; clutch sizes in Clark's were eight to 10. A nest with seven young was discovered in Wellington Co., Ontario, on May 11, 1977, but it was empty on May 26 (and one dead owlet was found nearby). Although the area was checked daily until June 6, no adults or young were observed in the area after June 1, and it was concluded that the nesting attempt was a failure (Sandilands 1980).

The Short-eared Owl is strongly territorial in the breeding season, and it is known to increase its breeding density in areas of prey abundance. This has been noted in northern areas, such as Alaska (Pitelka *et al.* 1955) and Scotland (Lockie 1955), where breeding territories as small as 18 hectares have been noted. High densities like this would theoretically be possible in northern Canada in response to very high densities of small mammals. Such an event may have led to Spreadborough's comment that the species was abundant on the shores of James Bay in 1904 (Macoun and Macoun 1909).

Relatively high densities have also been noted at more southerly latitudes such as at Buena Vista Marsh in Wisconsin, where 17 pairs used the 46,000 acre marsh in 1970 (Beske and Champion 1971). Such concentrations should be theoretically possible in southern Canada. Very little quantitative information is available for territory size and breeding density in Canada.

The reproductive rate of existing populations is unknown. The general decline in populations across the continent suggests that reproduction is not replacing mortality, but there are no data for comparison.

The growth potential of the Short-eared Owl population is apparently quite high. Its ability to adjust clutch size and breeding density in response to high food availability mean that they can increase their reproductive output rapidly under favourable conditions. However, Voous (1989) points out that increased mortality in irruption years and the occurrence of non-breeding years probably counterbalances any substantial growth of the population resulting from irruptions.

There were significant increases in the number of Short-eared Owls in Britain earlier this century, which have been attributed to greater afforestation (with high densities of microtine rodents during the early stages of tree growth), and a reduction in the amount of persecution by man (Lack 1986). However, as the conifer plantations have matured, they are no longer suitable for Short-eared Owls and the species has declined recently (P. Hope Jones, Countryside Council for Wales, pers. comm. 1991). This suggests that management of the species through habitat modification and protection could be of benefit in southern Canada. However, the number of owls in southwestern Ontario does not appear to have increased with the increase in young conifer plantations in that area over the last few decades. The loss of grassy field habitat has undoubtedly outstripped the increase in young conifer plantations, leading to a net loss of habitat. That habitat loss will have been increased as the plantations matured.

The Short-eared Owl's main breeding requirement is sufficient prey in or adjacent to suitable nesting habitat. Its primary prey is microtine rodents, which are cyclic in numbers. Therefore the owl must be able to find new prey concentrations when the one they are using fails. As habitats are destroyed by land-use practices (as described below) the Short-eared Owl will have more difficulty finding sufficient prey and its numbers will fall. The fluctuating food supply may mean that Short-eared Owls are more susceptible to habitat destruction than are other species with more reliable prey; other species can return to favourable sites each year and find sufficient food there, but the Short-eared Owl cannot.

Species Movement

The Short-eared Owl is irregular in its movements, being described as nomadic by Clark (1975), who notes that they wander extensively within their winter and breeding ranges in search of abundant prey. Very little is known of the movements of Canadian birds. Campbell et al. (1990) stated that migration periods and corridors in British Columbia are not well known, mainly because of the difficulty of separating over-wintering, resident, and migratory populations. However, records from southern areas of B.C. suggest that the spring movement occurs mostly from late March through mid-April, and the autumn movement from late October through November (Campbell et al. 1990). Short-eared Owls generally arrive in

Ontario in early March, and leave by late October (James 1991), and the first migrants return to Alberta during March and early April (Semenchuk 1992).

There is overlap in the winter and breeding range as shown in Figure 1. Some birds leave their wintering areas in spring, apparently migrating to northern Canada to breed, while others stay behind to breed in southern Canada. This seems to occur most often when prey density on the wintering grounds remains high into the breeding season. It is possible that the species migrates only in search of food and consequently may remain year-round in an area that provides sufficient resources (Tate 1992).

Banding data from Europe confirms the species' nomadic nature, indicating that young birds disperse randomly and often travel far. Ten owls banded in Britain were later found in Spain (5), France (2), Belgium (1), USSR (1) and Malta (1) (Lack 1986). A similar scale of dispersal might be expected in North America, but banding data is limited. From 1964 to 1967, 426 Short-eared Owls were trapped and banded at the Vancouver International airport as part of a bird control program, and three noteworthy recoveries from that program include: one banded August 12, 1964 and recovered at Grand Coulee, Washington on April 17, 1965; one banded September 2, 1964 and recovered at Palm Dale, California in November 1964; and one banded September 16, 1964 and recovered at Albany, Oregon in March 1966 (Campbell *et al.* 1990).

The Short-eared Owl congregates and roosts communally during winter in areas with high food availability, and consequently the largest concentrations of owls are found during winter. Up to 60 birds have been reported in roosts in New York (Clark 1975), between 300 and 400 birds were reported at Pearson International Airport in Toronto in the winter of 1984-1985 (U. Watermann pers. comm.), and roosts of up to 110 birds have been noted in southwestern British Columbia (Campbell *et al.* 1990). Most congregations are, however, much smaller, being of fewer than 10 birds. Congregation areas are often used over many years in Britain (Lack 1986), and the same can be said of some areas in southern Canada. Peak wintering numbers in Michigan seem to occur about every four years (Evers 1991). The Short-eared Owl has been known to establish and defend hunting territories in wintering areas where vole densities were high, but when vole numbers were low, territories became less distinct.

A few birds are reported regularly on Brier Island, Nova Scotia's, Christmas Bird Count. Varying numbers of birds are reported almost annually to be wintering at a few locations in southern Ontario, including Pearson International Airport (U. Watermann pers. comm.), Amherst and Wolfe Islands near Kingston, southern Bruce Co., and the Hagersville area. None of these concentration points is protected. CBCs in Saskatoon, Regina, Calgary, Edmonton and Horseshoe Canyon regularly report a few

birds. The Fraser delta is the main wintering area in British Columbia (Campbell *et al.* 1990). The concentration of birds suggests that these areas have consistently favourable habitat and prey populations.

There are currently no specific areas of concentration during migration reported in the literature. This may be in part due to the extraordinary powers of flight of the Short-eared Owl, which would enable it to cover enormous distances without landing. As an indication of its capabilities, one owl was reported 680 miles from land off Puget Sound (Bent 1937), indicating that they could move from breeding to wintering areas with very few stops in between. This might explain the extremely small number of records of the Short-eared Owl in migration in the Boreal Forest Region, but the relatively small number of observers in that vast area might also be a factor. Its erratic nature may also mean that it does not tend to follow established migration corridors.

Behaviour/Adaptability

There is some evidence that the Short-eared Owl is susceptible to severe winters. Kay McKeever (pers. comm.) from southern Ontario noted a sharp drop in the number of wintering birds taken to the Owl Rehabilitation and Research Foundation after the severe winter of 1977. P.R. Martin and B.M. Di Labio (pers. comm.) noted that Short-eared Owls withdraw from the Ottawa area, at the extreme northern edge of their range, in cold or snowy winters. Clark (1975) mentioned that Short-eared Owls essentially stopped feeding after ice first crusted over snow: they started feeding a couple of days later when the mice seemed to start moving over the surface of the ice. Wintering locations of the Northern Harrier also seem to be affected by weather conditions; cold and wet weather probably reduce prey availability and may force birds to move south, and snow makes small mammals more difficult to detect, resulting in a switch to alternate prey sources. Ice storms may leave an impenetrable cover over snow, making hunting extremely difficult (Cadman 1991).

Eckert (1974) mentions that fire is a threat to Short-eared Owl nests, and that high tides sometimes flood nests in coastal areas.

Short-eared Owls appear to have about the same tolerance of direct human disturbance as other raptors. They tend to flush from the nest at the last minute when approached and keep a fairly wide berth between themselves and their disturber. Although they have been known to attack human intruders near the nest, they usually offer little defense of the nest from humans (Tate 1992). They will undertake distraction displays (such as wing-clapping, circling overhead with deep wing-beats, "barks" or "yaps", and broken-wing acts) if their nest is approached (Tate 1992).

The species' ground-nesting behaviour exposes it to danger from predators and from agricultural machinery. Campbell et al. (1990) mention that farm machinery causes high mortality when owls nest in hay fields. Melvin et al. (1989) report one pair abandoning their nest because of disturbance by a dog. Nest predation by the Striped Skunk (Mephitis) along with habitat destruction is blamed for the elimination of breeding Short-eared Owls on the island of Martha's Vineyard in Massachusetts (Melvin et al. 1989).

Short-eared Owl courtship flight and displays are easily recognized and observed, and observation and mapping of these behaviours over a nesting season is the best way to delineate an individual's breeding territory (Tate 1992). However, they may also expose the species to additional danger from hunters and predators. Courtship displays used predominately during the breeding season include wing-clapping (male and female), exaggerated or deep wing-beats, and skirmishing (Tate 1992). They may be agonistic or territorial in nature, and are also used in courtship flights (Tate 1992). The courtship flight involves song, a spiralling flight, and wing-clapping by the male, and is unique among birds (Tate 1992).

There is some controversy as to the degree of specialization in the Short-eared Owl's diet, with some data suggesting extreme specialization and others showing great plasticity. Clark and Ward (1974) suggest that the species' diet is dictated by the fact that it is restricted to open habitats for feeding, and that it feeds primarily in the late afternoon and evening. It appears to take whatever small vertebrate prey (mostly small mammals and birds, but occasionally amphibians and reptiles) is available in those circumstances. There are cases (e.g. Clark 1975; Ponshair 1976; Borko 1977; Colvin and Spaulding 1983; Tate 1991 in Tate 1992) in which close to 100% of the prey has been microtine rodents; in a few cases (e.g. Kumlein and Hollister 1951; Clark 1975) a large proportion of the diet has been made up of birds. Clark (1975) notes that most cases of Short-eared Owls preying extensively on birds have occurred during migration or on islands, suggesting that small rodents are the species' primary prey. Indeed, there appears to be consensus in the literature that small mammal populations are the key to Short-eared Owl populations despite the flexibility in food preference shown in some circumstances.

Studies of feeding habits in Ontario have shown that Microtus pennsylvanicus makes up the bulk of the Short-eared Owl's diet (Banfield 1947; Phelan and Robertson 1978). Short-eared Owl numbers have also been shown to increase in response to local increases in populations of Microtus pennsylvanicus (Banfield 1947; Phelan and Robertson 1978; Bell et al. 1979).

Vole abundance also influences most aspects of Northern Harrier reproduction and population dynamics, and Harrier numbers have been reported to fluctuate with vole numbers. However, the Harrier may be able to adapt to lower vole populations more readily than the

Short-eared Owl by including other items in its diet (Weller et al. 1955), and this lesser degree of food specialization may explain the relatively small decline in Harrier numbers compared to those of the Short-eared Owl (Cadman 1991). The declines in Harrier numbers are likely more related to declines in the same habitat type that has reduced Short-eared Owl numbers; small mammal populations are lower in cultivated areas, and the increase in cultivated land at the expense of older fields or rough pasture would reduce prey for both species.

LIMITING FACTORS

Habitat Loss

As described above, habitat loss in southern Canada and the United States is likely the primary reason for the decline of the Short-eared Owl. Intensive agricultural practices and perhaps wetland drainage are responsible for most of the habitat reduction on the prairies, which is the stronghold of the species in Canada. The same practices as well as urbanization, expansion of recreational facilities such as golf courses, succession and replanting of marginal land are all leading to declines in the amount of habitat suitable for Short-eared Owls in the rest of the developed parts of Canada. Similar activities have been blamed for the decline of the species in New York and several other states (Bull 1974; Bohlen 1989; Evers 1991). Habitat loss also appears to be the primary factor limiting Northern Harrier numbers in North America (Cadman 1991).

It is not clear what effects global warming would have on habitat or prey populations.

Environmental Contamination

There has been very little work published that investigates the effects of environmental contamination on Short-eared Owls. Peakall and Kemp (1980) found variable levels of organochlorines in Short-eared Owls in British Columbia, with levels of DDE ranging from 0.05 to 2.69 ppm. They state that the high values were likely caused by food items from the aquatic food chain where high bioconcentrations of organochlorines are found. Henny et al. (1984) found DDE in four of five Short-eared Owl eggs from Oregon, but concentrations were considered low. Short-eared Owls may be somewhat more susceptible to accumulating DDE and other environmental contaminants than are most small mammal specialists because of their association with wetland habitats. DDE is widely known to cause reproductive failure in raptors, but the authors found no information linking DDE to reproductive failure in Short-eared Owls.

Henny et al. (1984) found Heptachlor epoxide (HE) less frequently in owl eggs than they did in hawk eggs from Oregon. HE was found in three of five Short-eared Owl eggs. The HE was thought to have entered the owls through ingestion of prey which had fed upon seeds treated with HE. No definite effects of HE on productivity were readily apparent from the limited series of nests.

The Short-eared Owl winters in Ontario largely on the Great Lakes Plain, where toxic chemicals are commonly used. I was unable to locate any research to determine what quantities of these chemicals are being acquired by the birds and what effects such chemicals might have on them.

It should be noted that, although proof of biological effects of agricultural and other chemicals on Short-eared Owls has not been shown, there has been very little work on this topic. It is also worth noting that the extensive grassy areas favoured by the species are likely the types of areas that receive the smallest dosages of agricultural chemicals.

Human Disturbance

Clark (1975) lists the following causes of Short-eared Owl mortality attributable to human activity: shooting; collisions or entanglement with aircraft, trains, cars, barbed wire, and farm machinery; and pole trapping by game keepers. In addition, collisions with large, aerial radio antennas or high-tension guy wires may also be a problem (Tate 1992). Shooting was mentioned by Nash (1908) in that "a great many" fell to sportsmen each fall in southern Ontario. Their association with wetlands no doubt contributed to the problem by concentrating owls and waterfowl hunters in the same area. Bent (1937) makes a similar observation. Shooting undoubtedly causes less mortality today because numbers are much lower than previously. The potential problem of shooting at communal roosts of Short-eared Owls was mentioned by one correspondent, but no evidence was presented to indicate that this has been known to happen.

The Short-eared Owl's affinity for the open habitat of airports remains a problem, and considerable money is expended to keep this and other species away from the runways at Pearson International Airport in Toronto.

Fitzer (1975) and R.D. Weir (pers. comm.) also mentioned collisions with barbed wire as a cause of mortality. Fitzer (1975) mentioned that the nomadic nature of the species means that it does not become intimately familiar with an area as a resident species would and so is more susceptible to these types of accidents.

Farm machinery causes some mortality, especially of young birds which spend several weeks in and around the nest (Voous 1989). The McKeever's Owl Rehabilitation and Research Foundation in Ontario has received several birds badly mutilated in this way. Campbell et al. (1990) stated that nests in British Columbia are often destroyed by farm machinery, and because of this mortality is high when the species selects hayfields as nesting sites.

The effects of pole trapping on the Short-eared Owl population in Canada are essentially unknown, though Robinson (1986) reported 90 Short-eared Owls taken among 655 recent incidents of raptor pole-trapping in Britain. Recent clarification of the pole trapping regulations under the Game and Fish Act might help reduce the pole-trapping problem in Ontario. Robinson (1986) reported that intensive enforcement of regulations in Britain was successful in decreasing the number of pole-trapping incidents by about 75% in three or four years in the early 1970s, but that by 1983/1984 the figure was back to its pre-campaign level.

Species Competition

For the Short-eared Owl, the major problem associated with habitat loss is loss of food supply. Habitat loss is likely to have a detrimental effect on numbers by increasing competition both among Short-eared Owls, and among these owls and other predators. Competition may be one of several proximate causes of the species' decline, but the key factor is habitat loss.

The Short-eared Owl is widely believed to be the night-time counterpart of, and therefore a competitor with, the Northern Harrier (Circus cyaneus), but Clark and Ward (1974) dispute that argument. The two species often nest and roost in close proximity to one another, and are sympatric over most of their ranges. However, the harrier is a prey generalist and the owl is a specialist, relatively speaking. Clark and Ward (1974) concluded that if prey making up less than 5% of the diet and those that are "temporarily superabundant" are discounted, there is no evidence of competition for food between these species in North America according to their food habits as reported in the literature.

It is worth noting, however, that incidents of interspecific piracy between Short-eared Owls and Northern Harriers have been reported (e.g. Bildstein and Ashby 1975). As well, M. Tait (in Campbell et al. 1990) found that some areas in British Columbia which formerly held both species now hold only Harriers, and suggested that competition with the Northern Harrier may (in addition to habitat loss) be playing a role in the decline in owl numbers noted in that province.

High populations of small mammals tend to concentrate both avian and mammalian predators (i.e., Lockie 1955). Under this circumstance, the Short-eared Owl is likely to be in competition with other predators. Clark (1975) considered the Short-eared Owl to be often in competition with the Northern Harrier and the Rough-legged Hawk (Buteo lagopus) in its New York state wintering area. He stated that the competition is mostly territorial, with the Short-eared Owl the attacker. Voous (1989) mentioned that interspecific encounters between Short-eared Owls and harriers, Buteo hawks, falcons and (European) kestrels occur frequently, and that each species may rob the other.

During the breeding season, when the Short-eared Owl has a nest or is feeding young, it is tied to its nesting territory. If the prey population declines in the territory, the owl must travel further afield to hunt, and nesting productivity is likely to be lower. By reducing food supply, competition from other predators can thus affect Short-eared Owl productivity.

Predation

There are references in the literature to predation on adult or juvenile Short-eared Owls by the following species: Great Horned Owls (Bubo virginianus) (Bluhm and Ward 1979), Snowy Owls (Nyctea scandiaca) (Lein and Boxall 1979), Red-tailed Hawk (Buteo jamaicensis), Northern Harrier (Circus cyaneus) and Carrion Crow (Corvus corone) (Melvin et al. 1989), Peregrine Falcon (Falco peregrinus) (Clark 1975), Red Fox (Vulpes vulpes) (Lockie 1955), and Striped Skunk (Melvin et al. 1989). Predation is unlikely to be of significance to a large and healthy population, but could be of some importance in a small population. However, Tate (1992) stated that "the potential for an increase in the threat of predation or disturbance by domestic or feral cats and dogs may be high. Cannibalism among nestlings has also been reported (Ingram 1962).

SPECIAL SIGNIFICANCE OF THE SPECIES

The Short-eared Owl has a wide global distribution and is not threatened on a global scale, although it is officially designated as Endangered in several states in the eastern United States. It is not hunted, captive reared, or commercially exploited to any significant degree. Evers (1991) mentions the species' role as an agent of control in rodent outbreaks, and states that "by encouraging its survival, land managers could minimize spraying of environmentally unsound rodenticides, chemicals which have the potential of significantly damaging the surrounding ecosystems". As a raptorial bird it may be subject to adverse attitudes among a small sector of the public.

The species shares its grassland breeding habitat with several other Threatened or Endangered Canadian bird species, including the Loggerhead Shrike (Lanius ludovicianus), Henslow's Sparrow (Ammodramus henslowii), Ferruginous Hawk (Buteo regalis), and Burrowing Owl (Athene cunicularia). No other Asio species of owls are currently designated as Vulnerable, Threatened, or Endangered in Canada.

EVALUATION AND PROPOSED STATUS

The Short-eared Owl is widespread in Canada as a breeding bird, with local nesting in much of the area from the southern border to the low arctic, but it is absent throughout the Boreal Forest Region and other heavily forested areas. It winters in fairly small numbers in southern portions of most provinces, with a large portion of the population wintering in the United States. Breeding Bird Survey data from 1966 to 1989 indicate a significant decline, at a rate of 1.8% per year, in Canada's breeding population of Short-eared Owls. In addition, Christmas Bird Count data from 1960 to 1989 indicate that the wintering population has declined significantly in both North America and Canada.

In Canada, the species is most numerous in the prairie portions of Saskatchewan and Alberta. Based on the amount of habitat loss, numbers on the prairies have probably declined considerably since European settlement, though no presettlement numbers are available for comparison. Breeding Bird Survey data indicate that populations in Saskatchewan and the physiographic region in the northern prairies have declined significantly in the period from 1966 to 1989, and Christmas Bird Count data suggest that the wintering population in Alberta and Saskatchewan has undergone a long-term decline in numbers, as well. In addition, several knowledgeable individuals believe that the Short-eared Owl population on the prairies has declined considerably in recent years.

There is a general consensus that breeding and wintering populations in British Columbia have declined, as well, particularly in the Fraser River delta where a large proportion of the B.C. population resides. Christmas Bird Count data from that area show a steady decline in the Short-eared Owl's peak numbers between 1975 and 1990, and rapid habitat destruction is threatening the existence of a formerly dense breeding population in the area.

Numbers of breeding and wintering birds in eastern Canada likely increased with the clearing of the forests, but remain low and have decreased this century with continuing loss of grasslands and marshes. Numbers observed on migration in southern Ontario and Quebec have decreased greatly from the turn of the century. Numbers appear to be relatively stable, at low levels, in the Maritimes, and appear to have been stable and low for the past decade in southern Ontario and southern Quebec. However, given the erratic nature of the species, it would be difficult to determine slow declines or increases at low population levels.

The situation regarding the breeding population in northern Canada is largely unknown. However, there is widespread concern that the species is declining throughout the United States and southern Canada, where all northern birds winter. As mentioned, considerable declines in the number of migrants, particularly fall migrants, in Ontario and Quebec during this century suggest a large-scale decline in the continental population. The relatively small changes to northern environments strongly suggest that the species is declining because of changes in the wintering grounds in southern Canada and the United States.

Bent (1937) attributed early declines in numbers to shooting by "ignorant and thoughtless gunners", but the main reason for the decline of the Short-eared Owl is generally agreed to be habitat loss in southern Canada and the United States, where some of the population breeds and the entire population winters. The potential to stabilize this trend is small because the factors causing the decline are symptomatic of human population growth and modern agricultural practices - two processes that will continue into the foreseeable future - and succession, which will obviously continue.

Based upon the available information, it is recommended that the Short-eared Owl be designated as **Threatened** in Canada.

LITERATURE CITED

- American Ornithologists' Union. 1983. Check-list of North American birds, 6th ed. A.O.U., Washington.
- Andrle, R.F. and J.R. Carroll. 1988. The atlas of breeding birds in New York State. Cornell Univ. Press, Ithaca.
- Arbib, R. 1975. The blue list for 1976. Amer. Birds 29(6): 1067-1071.
- Arbib, R. 1976. The blue list for 1977. Amer. Birds 30(6): 1031-1039.
- Arbib, R. 1977. The blue list for 1978. Amer. Birds 31(6): 1087-1096.
- Arbib, R. 1978. The blue list for 1979. Amer. Birds 32(6): 1106-1113.
- Arbib, R. 1979. The blue list for 1980. Amer. Birds 33(6): 830-835.
- Austin, O.L. 1932. The birds of Newfoundland and Labrador. Nuttall Ornith. Club, Cambridge, Mass.
- Baillie J.L., Jr. and P. Harrington. 1936. The distribution of breeding birds in Ontario, part 1. Trans. R. Can. Inst. 21: 1-150.

- Banfield, A.W.F. 1947. A study of the winter feeding habits of the Short-eared Owl (Asio flammeus) in the Toronto region. Can. J. Res. 25D(2): 45-65.
- Belcher, M. 1980. Birds of Regina. Spec. Pub. No.12. Sask. Nat. Hist. Soc. Regina, Sask.
- Bell, G.P., F.J.S. Phelan and R.C.P. Wypkema. 1979. The owl invasion of Amherst Island, Ontario, January-April 1979. Amer. Birds 33: 245-246.
- Bent, A.C. 1937. Life histories of North American birds of prey, part 1. Bull. U.S. Natl. Mus. No. 137.
- Beske, A. and J. Champion. 1971. Prolific nesting of Short-eared Owls on Buena Vista Marsh. Passenger Pigeon 33(2): 99-103.
- Bildstein, K.L. and M. Ashby. 1975. Short-eared Owl robs Marsh Hawk of prey. Auk 92: 807-808.
- Bluhm, C.K. and E.K. Ward. 1979. Great Horned Owl (Bubo virginianus) predation on a Short-eared Owl. Condor 81(3): 307-308.
- Bohlen, H.D. 1989. The birds of Illinois. Indiana Univ. Press, Bloomington.
- Borko, M. 1977. Short-eared Owl food items in winter. Kingbird 27(2): 80-81.
- Bosakowski, T. 1986. Short-eared Owl winter roosting strategies. Amer. Birds 40(2): 237-240.
- Brewer, R., G.A. McPeck and R.J. Adams, Jr. 1991. The atlas of breeding birds of Michigan. Michigan State Univ. Press, East Lansing.
- Brooks, R.T. 1989. Status and trends of raptor habitat in the northeast. Pp. 123-132 in Proceedings of the Northeast Raptor Management Symposium and Workshop (B.G. Pendleton, Ed.). Institute for Wildlife Research, National Wildlife Federation, Scientific and Technical Series No. 13.
- Bull, J. 1974. The birds of New York State. Doubleday, New York.
- Cadman, M.D. 1991. Status of the Northern Harrier (Circus cyaneus) in Canada. Unpublished report, Committee on the Status of Endangered Wildlife in Canada, Ottawa.
- Cadman, M.D., P.F.J. Eagles and F.M. Helleiner. 1987. Atlas of the breeding birds of Ontario. Univ. Waterloo Press, Waterloo.
- Callin, E.M. 1980. Birds of the Qu'Appelle, 1857-1979. Spec. Pub. No. 13. Sask. Nat. Hist. Soc. Regina, Sask.

- Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser and M.C.E. McNall. 1990. The birds of British Columbia. Volume II: Nonpasserines. R. B.C. Mus., Victoria.
- Cannings, R.A., R.J. Cannings and S.G. Cannings. 1987. Birds of the Okanagan Valley, British Columbia. R. B.C. Mus., Victoria.
- Clark, R.J. 1975. A field study of the Short-eared Owl (Asio flammeus Pontoppidan) in North America. Wildlife Monograph No. 47.
- Clark, R.J. and J.G. Ward. 1974. Interspecific competition in two species of open country raptors, Circus cyaneus and Asio flammeus. Proc. Pa. Acad. Sci. 48: 79-87.
- Collins, B.T. and J.S. Wendt. 1989. The Breeding Bird Survey in Canada 1966-1983: analysis of trends in breeding bird populations. Can. Wildl. Serv. Tech. Rept. 75.
- Colvin, B.A. and S.R. Spaulding. 1983. Winter foraging behaviour of Short-eared Owl (Asio flammeus) in Ohio, USA. Amer. Midl. Nat. 110(1): 124-128.
- Craighead, J.J. and F.C. Craighead. 1956. Hawks, owls and wildlife. Stackpole Co., Harrisburg, Pennsylvania.
- Cramp, S. 1985. Handbook of the birds of Europe, the Middle East and North Africa. The birds of the western palaeartic. Vol. iv: Terns to Woodpeckers. Oxford Univ. Press, New York.
- David, N. 1980. Status and distribution of birds in southern Quebec. Cahiers d'ornithologie Victor-Gaboriault No. 4.
- Dominion Bureau of Statistics. 1968. 1966 Census of Canada: Agriculture, Ontario.
- Eaton, S.W. 1988. Short-eared Owl (Asio flammeus). Pp. 210-211 in The atlas of breeding birds in New York State (R.F. Andrle and J.R. Carroll, Eds.). Cornell Univ. Press, Ithaca.
- Eckert, A.W. 1974. The owls of North America. Doubleday, New York.
- Ehrlich, P.R., D.S. Dobkin and D. Wheye. 1988. The birder's handbook: a field guide to the natural history of North American birds. Simon and Schuster Inc., New York.
- Erskine, A.J. 1992. Atlas of breeding birds of the Maritime Provinces. Nimbus Publishing Limited and the Nova Scotia Museum, Halifax.
- Everett, M. 1977. A natural history of owls. Hamlyn, Toronto.

- Evers, D.C. 1991. Short-eared Owl (Asio flammeus). Pp. 246-247 in The atlas of breeding birds of Michigan (R. Brewer, G.A. McPeck and R.J. Adams, Jr., Eds.). Michigan State Univ. Press, East Lansing.
- Fitzer, R.E. 1975. Owl mortality on fences and utility lines. Raptor Research 9(3/4): 55-57.
- Fleming, J.H. 1907. Birds of Toronto, Canada, part 2. Auk 24: 71-89.
- Frisch, R. 1987. Birds of the Dempster Highway. Rev. Ed., Yukon Conservation Society.
- Fyfe, R.W. 1976. Status of Canadian raptor populations. Can. Field-Natur. 90: 370-375.
- Godfrey, W.E. 1986. The birds of Canada, rev. ed. Natl. Mus. Can., Ottawa.
- Henny, C.J., L.J. Blus and T.E. Kaiser. 1984. Heptachlor seed treatment contaminates hawks, owls, and eagles of Columbia Basin, Oregon. Raptor Research 18: 41-48.
- Holt, D.W. 1986. Status report: the Short-eared Owl in the northeast. The Eya 9(2): 3-5.
- Ingram, C. 1962. Cannibalism by nestling Short-eared Owls. Auk 79: 715.
- James, R.D. 1991. Annotated checklist of the birds of Ontario, 2nd ed. Life Sci. Misc. Publ., R. Ont. Mus., Toronto.
- James, R.D., P.L. McLaren and J.C. Barlow. 1976. Annotated checklist of the birds of Ontario. Life Sci. Misc. Publ., R. Ont. Mus., Toronto.
- Janssen, R.B. 1987. Birds of Minnesota. Univ. Minnesota Press, Minneapolis.
- Jehl, J.R. and B.A. Smith. 1970. Birds of the Churchill region, Manitoba. Spec. Pub. No. 1. Manitoba Museum of Man and Nature, Winnipeg.
- Johnsgard, P.A. 1988. North American owls: biology and natural history. Smithsonian Inst. Press, Washington.
- Johnson, S.R. and D.R. Herter. 1989. Birds of the Beaufort Sea. BT Exploration (Alaska) Inc. Anchorage.
- Kumlein, L. and N. Hollister. 1951. The birds of Wisconsin. Wisconsin Society for Ornithology, Inc., Madison.

- Lack, P. 1986. The atlas of the wintering birds in Britain and Ireland. T and A.D. Poyser.
- Laughlin, S.B. 1985. Short-eared Owl (Asio flammeus). Pp. 140-141 in The atlas of breeding birds of Vermont (S.B. Laughlin and D.P. Kibble, Eds.). Univ. Press of New England, Hanover.
- Lein, M.R. and P.C. Boxall. 1979. Interactions between Snowy and Short-eared Owls in winter. Can. Field-Natur. 93(4): 411-414.
- Lewis, H.F. and H.S. Peters. 1941. Notes on the birds of the James Bay region in the autumn of 1940. Can. Field-Natur. 55: 111-117.
- Lockie, J.D. 1955. The breeding habits and food of Short-eared Owls after a vole plague. Bird Study 2: 53-69.
- MacClement, W.T. 1915. The new Canadian bird book. Dominion, Toronto.
- Macoun, J. and J.M. Macoun. 1909. Catalogue of Canadian birds. Geol. Surv. Can., Dept. Mines.
- Manning, T.H. 1952. Birds of the west James Bay and southern Hudson Bay coasts. Natl. Mus. Can. Bull. 125.
- Martell, A.M., D.M. Dickinson and L.N. Casselman. 1984. Wildlife of the Mackenzie Delta region. Boreal Inst. for Northern Research, Occ. Pap. No. 15.
- Melvin, S.M., D.G. Smith, D.W. Holt and G.R. Tate. 1989. Small Owls. Pp. 88-96 in Proc. northeast raptor management symposium and workshop. Natl. Wildl. Fed., Washington, D.C.
- Mikkola, H. 1983. Owls of Europe. Buteo Books, Vermillion.
- Murray, G.A. 1976. Geographic variation in the clutch sizes of seven owl species. Auk 93: 602-613.
- Nash, C.W. 1908. Checklist of the birds of Ontario. Pp. 7-82 in Manual of vertebrates of Ontario. Dept. Education, Toronto.
- Nash, C.W. 1913. Birds of Ontario in relation to agriculture, 2nd ed. Ont. Dept. Agric. Bull. No. 218.
- Peakall, D.B. and A.C. Kemp. 1980. Organochlorine levels in owls in Canada and South Africa. Ostrich 51: 186-187.
- Peck, G.K. 1993. ONRS 24: Ontario Nest Records Scheme twenty-fourth report (1956-1992). Dept. Ornithol., R. Ont. Mus., Toronto.
- Peck, G.K. and R.D. James. 1983. Breeding birds of Ontario: nidiology and distribution, vol. 1. Non-passerines. Life Sci. Misc. Publ., R. Ont. Mus., Toronto.

- Peterjohn, B.G. 1989. The birds of Ohio. Indiana Univ. Press, Bloomington.
- Peterjohn, B.G. and D.L. Rice. 1991. The Ohio breeding bird atlas. Ohio Dept. Nat. Res., Columbus.
- Phelan, F.J.S. and R.J. Robertson. 1978. Predatory responses of a raptor guild to changes in prey density. *Can. J. Zool.* 56: 2565-2572.
- Pinel, H.W., W.W. Smith and C.R. Wershler. 1991. Alberta Birds, 1971-1980, vol. 1. Non-Passerines. The Provincial Museum of Alberta, Nat. Hist. Occas. Paper No. 13, Edmonton.
- Pitelka, F.A., P.Q. Tomich and G.W. Treichel. 1955. Ecological relations of jaegers and owls as lemming predators near Barrow, Alaska. *Ecol. Monog.* 25: 85-117.
- Ponshair, J.F. 1976. Short-eared Owls roosting in pine plantations. *Jack Pine Warbler* 54(1): 130-131.
- Robinson, P.J. 1986. Abuse and failure of existing wild bird legislation in Britain and Europe. *Birds of Prey Bull.* (3): 142-144.
- Root, T.L. 1988. Atlas of wintering North American birds: an analysis of Christmas Bird Count data. Univ. Chicago Press, Chicago.
- Salt, W.R. and A.L. Wilk. 1958. The birds of Alberta. Govt. of Alberta, Edmonton.
- Sandilands, A. 1980. Short-eared Owl nest in Wellington County, Ontario. *Ont. Field Biol.* 34(2): 9598.
- Scott, L. 1991. Balanced land use - agriculture and wildlife. Pp. 109-111 in *Proceedings of the Second Endangered Species and Prairie Conservation Workshop*. Prov. Mus. Alberta. Nat. Hist. Occ. Pap. No. 15. Edmonton.
- Scotter, G.W., L.N. Carbyn, W.P. Neily and J.D. Henry. 1985. Birds of Nahanni National Park. *Spec. Publ. No. 15*. Sask. Nat. Hist. Soc.
- Semenchuk, G.P. 1992. The atlas of breeding birds of Alberta. Fed. Alberta Natur., Edmonton.
- Snyder, L.L. 1951. Ontario birds. Clarke, Irwin and Co., Toronto.
- Snyder, L.L. 1957. Arctic birds of Canada. Univ. Toronto Press, Toronto.
- Speirs, J.M. 1985. Birds of Ontario, vol. 2. Natural Heritage, Toronto.

- Statistics Canada. 1987. Census Canada 1986: Agriculture, Ontario.
- Tate, G.R. 1992. Short-eared Owl (Asio flammeus). Pp. 171-189 in Migratory nongame birds of management concern in the northeast (K.L. Schneider and D.M. Pence, Eds.). U.S. Dept. Int., Fish Wildl. Serv., Newton Corner, Massachusetts.
- Tate, J., Jr. 1981. The blue list for 1981. Amer. Birds 35(1): 3-10.
- Tate, J., Jr. 1986. The blue list for 1986. Amer. Birds 40(2): 227-236.
- Tate, J., Jr. and J.D. Tate. 1982. The blue list for 1982. Amer. Birds 36(2): 126-135.
- Taverner, P.A. 1922. Birds of eastern Canada, 2nd ed. Geol. Surv. Can., Dept. Mines Mem. 104., Geol. Surv. Can. Biol. Ser. 3.
- Taverner, P.A. 1934. Birds of Canada. Can. Dept. Mines Misc. Bull. No. 72.
- Todd, W.E.C. 1963. The birds of the Labrador Peninsula and adjacent areas. Univ. Toronto Press, Toronto.
- Tufts, R.W. 1986. Birds of Nova Scotia, 3rd Edition. Nimbus Publishing and the Nova Scotia Museum, Halifax.
- Voous, K.H. 1989. Owls of the Northern Hemisphere. The MIT Press, Cambridge, Mass.
- Weir, R.D. 1987a. The nesting season, June 1-July 31, 1987. Ontario region. Amer. Birds 41(5): 1429-1432.
- Weir, R.D. 1987b. Short-eared Owl (Asio flammeus). Pp. 214-215 in Atlas of the breeding birds of Ontario (M.D. Cadman, P.F.J. Eagles and F.M. Helleiner, Eds.). Univ. Waterloo Press. Waterloo.
- Weller, M.W., I.C. Adams, Jr. and B.J. Rose. 1955. Winter roosts of marsh hawks and short-eared owls in central Missouri. Wilson Bull. 67: 189-193.
- Wilson, N.C. and D. McRae. 1993. Seasonal and geographical distribution of birds for selected sites in Ontario's Hudson Bay Lowland. Ont. Min. Nat. Res., ISBN 0-7778-1443-9.

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