

THE UNIVERSITY OF MANITOBA

ASPECTS OF THE BIOLOGY OF THE GREAT GRAY OWL,
STRIX NEBULOSA FORSTER

by

K. MICHAEL COLLINS

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ASPECTS OF THE BIOLOGY OF THE GREAT GRAY OWL,

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KENNETH MICHAEL COLLINS

A thesis submitted to the Faculty of Graduate Studies of
the University of Manitoba in partial fulfillment of the requirements
of the degree of

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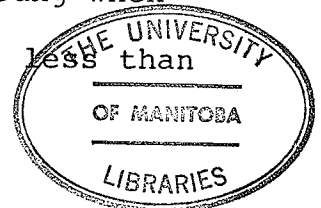
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ABSTRACT

Field studies of the Great Gray Owl (Strix nebulosa) were conducted in May and June 1975 and January to June 1976 in southeastern Manitoba and northwestern Minnesota. In addition, nesting records and records of occurrence of the Great Gray Owl in North America were obtained from museums, nest record programs and through correspondence with ornithologists. Several aspects of the biology of the Great Gray Owl, particularly breeding distribution, nesting habitat, breeding biology and vocalizations, winter hunting behaviour and population movements, are examined here.

Of 107 breeding records in North America up to 1976, 75% were situated in Pacific Rain, Closed Boreal and Montane Woodland forests, 18% in the Northern Hardwood-Conifer forest and 7% in unspecified habitat types. Most nests located in my study area in southeastern Manitoba and northwestern Minnesota were associated closely with large stands of tamarack (Larix laricina) and black spruce (Picea mariana).

The female incubates the eggs and cares for the young at the nest. The male owl hunts and obtains the food for his female, their young and himself. Young owls gain approximately 20 g/day. The mean weight of young when they leave the nest is 507 g ($n = 7$). This is less than



the mean adult weight of 953 g for males and 1298 g for females (Earhart and Johnson 1970). Growth of young was studied at two nests in 1976 and the growth patterns are discussed. Ten vocalizations used by adults and young birds during the nesting season are documented. A "Distraction Display" is also described for the first time in North America.

A little known hunting strategy of the Great Gray Owl is described in detail. Small mammal prey are captured by plunging headfirst into the snow. Measurements of snow hardness indicate that this behaviour may be affected by variations in this critical snow parameter.

Population movements of Great Gray Owls in North America between 1890 and 1976 are analyzed. This analysis is based on approximately 2,200 specimen and sight records gathered from the literature and museums, and by correspondence with observers throughout the continent. In this period, there were at least 23 winters of invasion into various regions of the continent. An hypothesis is proposed to explain the significance of population movements in this species.

The possible influence of food supply on the breeding biology of the Great Gray Owl is examined. Food supply may affect nest site selection, timing of breeding, clutch size and nestling survival within a given year, and may further influence the breeding effort of owls between

years. A general discussion of the role of food in breeding of other owl species is presented.

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Princeton Museum of Zoology, Regina Museum of Natural History, Rogers Environmental Education Center, Royal Ontario Museum, St. Bonaventure University Museum, San Bernardino County Museum, San Diego County Natural History Museum, Springfield Science Museum, Strecker Museum, Thomas Burke Memorial Washington State Museum, United States Bureau of Biological Surveys Accessions, United States National Museum of Natural History, University of Alberta Museum of Zoology, University of Arizona Museum, University of British Columbia Zoology Museum, University of California at Los Angeles Dickey Collection, University of California Museum of Vertebrate Zoology, University of Colorado Museum, University of Florida State Museum of Zoology, University of Idaho Museum, University of Iowa Museum of Natural History, University of Kansas Museum of Natural History, University of Manitoba Zoology Museum, University of Michigan Biological Station, University of Michigan Museum of Zoology, University of Montana Zoology Museum, University of North Dakota Museum, University of Puget Sound Museum of Natural History, Western Foundation of Vertebrate Zoology and the Yellowstone National Park Museum.

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INTRODUCTION

The Eurasian race of the Great Gray Owl, Strix nebulosa lapponica (Thunberg), is rather well-known with respect to its breeding biology and food habits in Sweden (Höglund and Lansgren 1968; Wahlstedt 1969, 1974, 1976), Finland (Mikkola 1969, 1971, 1976; Mikkola and Sulkava 1969a, 1970), and the U.S.S.R. (Dement'ev et al. 1966, Mikkola 1972). However, little information is available for the North American race, S. n. nebulosa (Forster). Some early authors provided limited information on its distribution, morphology and natural history (Baird et al. 1860; Bent 1938; Gmelin 1788; Henderson 1915, 1923; Ridgway and Forbes 1889; Roberts 1932; Swainson and Richardson 1831). Oeming (1955) further described its distribution, morphology and breeding biology, and added information on voice and food habits. Craighead and Craighead (1969) also reported on aspects of breeding biology and food habits. But these reports contained relatively little detailed information on the biology of the Great Gray Owl in North America.

In 1968 Dr. R. W. Nero first began his study of the Great Gray Owl in southeastern Manitoba and northwestern Minnesota. At that time there was no evidence of a breeding population extant in this area. Through the search efforts of Nero, H. W. R. Copland and R. R. Taylor (and others),

two active nests and evidence of two other nestings were located in the study area by 1973. In 1974, Dr. S. G. Sealy joined Nero and his co-workers to study three more active nests. By 1975, Nero's group had demonstrated that a breeding population was available for study in southeastern Manitoba and northwestern Minnesota.

As well as searching for nests, collecting pellets, studying nesting birds, and banding wintering owls, Nero actively solicited information on owl records from throughout North America (particularly in Manitoba). Although some of the results of these studies were published (Nero 1969; 1970a, b, c; 1971; Nero et al. 1974), much of these data on breeding biology, nesting behaviour and winter ecology were retained in Nero's unpublished field notes.

In 1975, I became involved in Nero's study of the Great Gray Owl in southeastern Manitoba and northwestern Minnesota. The objective of my study was to complement the efforts of Nero and co-workers by examining aspects of the biology of owls breeding and wintering in the study area. I also endeavoured to study aspects of breeding distribution and population movements by extending Nero's efforts of collecting specimen and sight records from North America.

In this thesis I summarize some of the results of Nero, Copland, Sealy and Taylor, and report my findings on

nesting habitat, breeding biology and vocalizations, and winter hunting behaviour of Great Gray Owls in the study area. I summarize much of the literature available for the Great Gray Owl in North America. I also report on breeding distribution and examine the population movements of this species in North America. Further, I discuss the apparent relationship between food supply and certain aspects of the biology of the Great Gray Owl.

BREEDING DISTRIBUTION IN NORTH AMERICA

Some authors have suggested that the Great Gray Owl is distributed widely as a breeding bird throughout the boreal and montane coniferous forests of North America (American Ornithologists' Union 1957, Bent 1938, Godfrey 1966). However, nesting records are few and a detailed report of its breeding distribution in North America does not exist. I have therefore compiled in this section most of the available information up to 1976 that pertains to the nesting of this species in North America, in order to identify the known limits of its breeding distribution. This information also permits the identification of the periodic movement of individuals in winter beyond the known breeding range in North America.

Methods

I attempted to obtain all available published breeding records up to 1976. I sent requests for information on Great Gray Owl egg sets and specimens to 293 museums in North America. Further data on breeding records were obtained from the Prairie Nest Record Scheme (Manitoba Museum of Man and Nature) and the nest records schemes at the Royal Ontario Museum and the Laboratory of Ornithology, Cornell University. Also, R. W.

Nero provided his unpublished data on nesting of this species. Finally, unpublished breeding records were solicited from ornithologists through requests for information in seven major, North American, ornithological journals.

In this study I have classified Great Gray Owl breeding information into three categories:

1) acceptable breeding records, 2) circumstantial evidence of breeding and 3) unconfirmed records of breeding.

Acceptable records are those data that indicate a breeding definitely occurred. The acceptable evidence for a breeding record is the location of a nest with eggs or young (i.e. a nesting record) or the location of individuals known to be young of the year.

Flightless birds are easily identified as young of the year. But fledged young (i.e. young capable of flying) are identified as young of the year on the basis of the juvenal plumage, since it seems that the juvenal plumage is lost in the first fall or winter (Oeming 1955). But the identification of this plumage characteristic may be difficult under field conditions. The location of a young of the year specimen from McMunn, Manitoba (Appendix I) on 10 August 1974 indicates that the correct identification of a young of the year bird in

the hand is still possible in August. Therefore, I have considered the location of a young of the year bird prior to September as evidence of breeding.

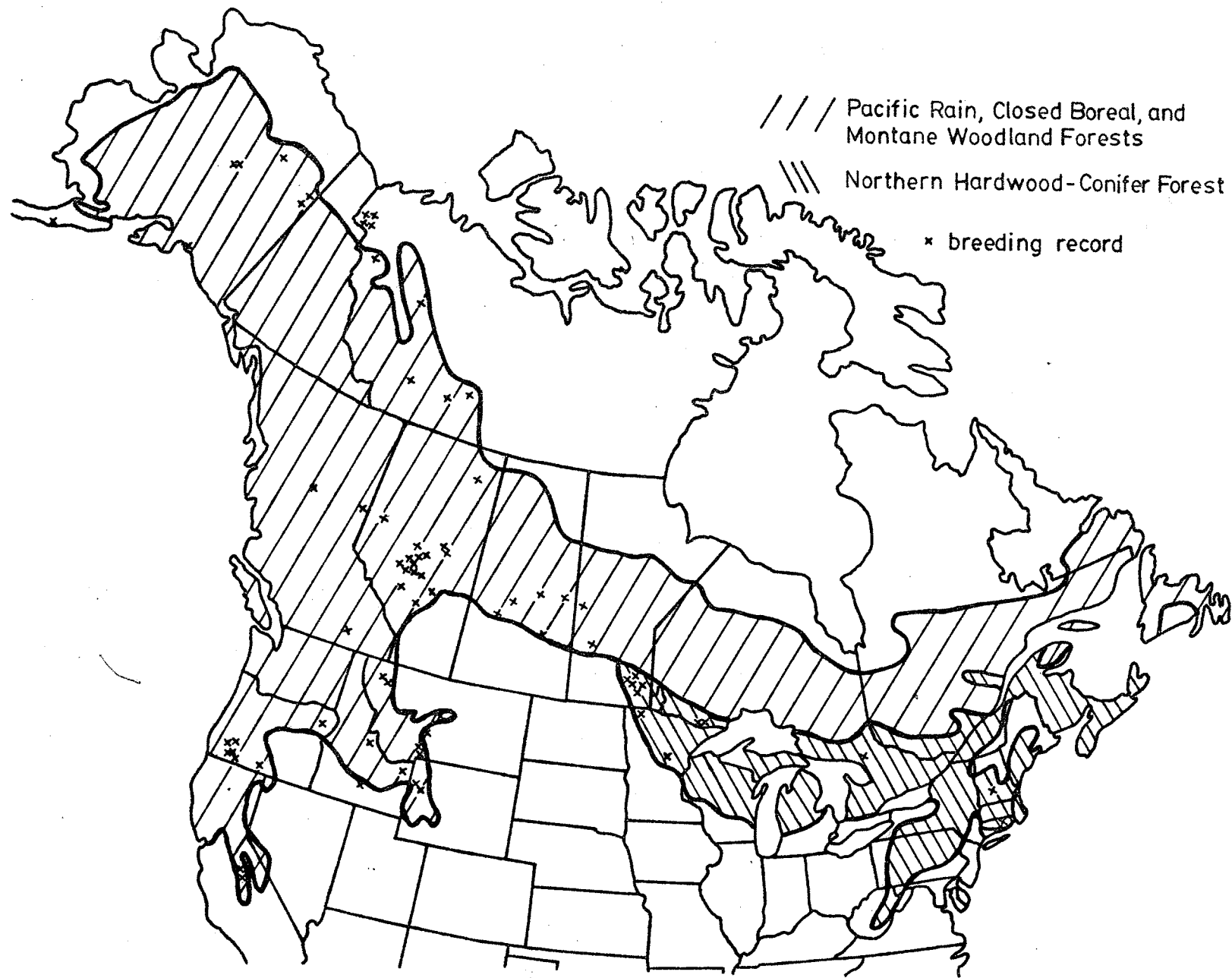
Circumstantial evidence of breeding includes three types of observations. For example, it is known that only the female incubates the eggs and develops a brood patch (see later). Therefore, I have accepted observations of birds with a brood patch as evidence of breeding. Also, it is described later how male owls carry prey to the female during the defined breeding season. This behaviour apparently does not occur at other times of the year. Consequently, the observation of an owl carrying prey during the breeding season is acceptable as circumstantial evidence. Finally, nests used for breeding by Great Gray Owls often retain many feathers of this species in the lining (R. W. Nero, pers. comm.). Therefore, the location of a nest with this evidence of previous use by Great Gray Owls was accepted as evidence of breeding.

Some of the potential records of breeding are in the form of unconfirmed records. Some authors have reported nests, but have not provided substantive data (i.e. number of eggs or young, dates of observations, or names of observers). Therefore, I have summarized these unconfirmed records of breeding with the circumstantial evidence of breeding.

Results and Discussion

Breeding records for North America are summarized in Appendix I and mapped in Figure 1. The unconfirmed records and circumstantial evidence of breeding are summarized in Appendix II. Figure 1 portrays the location of breeding records in relation to the distribution of some of the major "life areas" of North America (after Aldrich 1963). The Pacific Rain, Closed Boreal and Montane Woodland forests contained 75.2% of the known breeding records. The Northern Hardwood-Conifer forest contained 18.1%, and 6.7% occurred in unspecified vegetation types.

Figure 1 reveals that only three breeding records exist for areas east of the Great Lakes. These records are for Norwich, Connecticut (1885), Sullivan County, New Hampshire (1889) and Nipissing, Ontario (1911). It may be that these New England nests resulted from winter movements into the area (see later). There are no other known nesting records for the large areas of apparently suitable habitat (see later) north and east of the Great Lakes in North America. Much of eastern Canada and the northeastern United States are now urbanized. It is likely that these conditions are not conducive to nesting of the Great Gray Owl, since few nests were ever located near urban centres. However, there are yet large areas in Quebec and northern Ontario where apparently suitable



habitat exists in near pristine conditions, but where no known nesting records are available.

It is further revealed in Figure 1 that there are few locations in North America that may be identified as preferred breeding areas for the Great Gray Owl. In fact, only two areas have greater than 10% of the known breeding records: central Alberta and the study area in southeastern Manitoba and northwestern Minnesota (these areas contain 35.2 and 12.4% of the nests recorded in North America, respectively). It should be noted that large areas of central Alberta were intensively surveyed over several decades by many people (eg. A. D. Henderson, A. F. Oeming, E. T. Jones and R. E. Gehlert) in search of the Great Gray Owl. Similarly, much of the study area has been surveyed intensively for the Great Gray Owl since 1968, primarily by R. W. Nero and co-workers. Throughout the remainder of the continent, the total effort expended in search of nests apparently has been limited. Much of the potential habitat is still remote and inaccessible and few observers search intensively for this species, even when in suitable habitat. Consequently, the available nesting data only delineate the minimum nesting density and distribution of this species.

Therefore, it is likely that the current breeding range of the Great Gray Owl in North America is approximated by the distribution of the Pacific Rain, Closed Boreal and

Montane Woodland forests, including parts of southeastern Manitoba, northwestern Ontario and northwestern Minnesota, but excluding much of the urbanized areas of the continent. The evidence from central Alberta and the study area suggests that more intensive search effort in suitable habitat could provide data that will more precisely delineate the breeding distribution of the Great Gray Owl in North America.

THE STUDY AREA

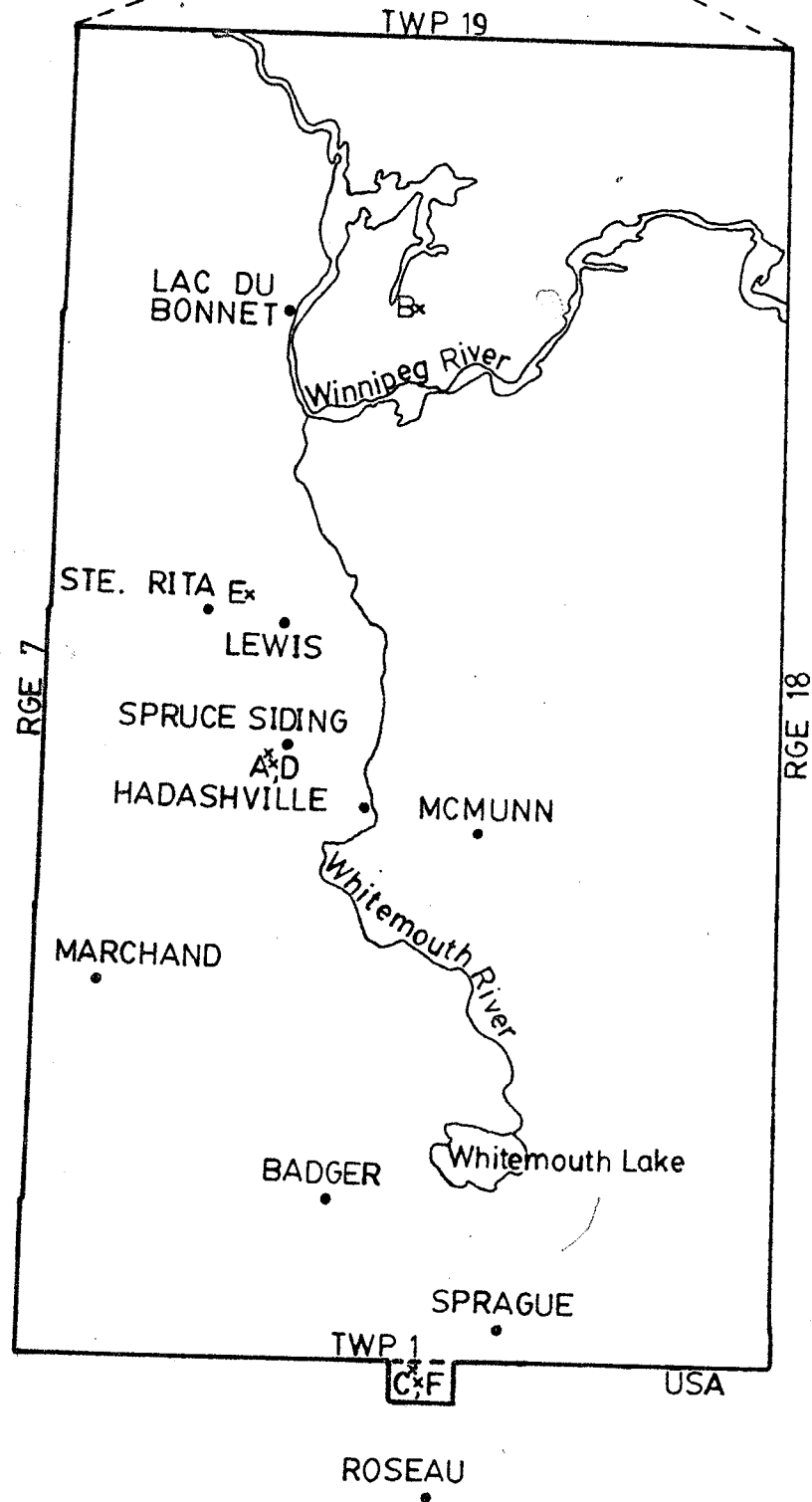
Description of the Study Area

The study area includes much of southeastern Manitoba and part of Roseau County in northwestern Minnesota (Figure 2). In Manitoba, my observations were confined to that region between Townships 1 and 19 and Ranges 7 and 18 East (the Manitoba-Ontario boundary).

According to Gill (1956), the underlying rock of southeastern Manitoba is of Pre-Cambrian origin in the east and Ordovician origin in the west. The unconformable contact of these materials lies beneath heavy drift deposits, and approximates a line running between Sprague and Hadashville. With two notable exceptions, glacial Lake Agassiz covered all of southeastern Manitoba. Lacustrine deposits of Lake Agassiz are scarce in the Pre-Cambrian Shield. Also, there is a region near Marchand which existed as an island in Lake Agassiz. As Lake Agassiz receded, a series of sand and gravel beaches surrounded this island. The rest of the study area is covered by the ground moraine of the Pleistocene glaciers and various amounts of the lacustrine deposits of Lake Agassiz. The complicated geological history of the region and the resultant variety of soil conditions accounts for the diversity of habitat within the study area.

scale in km
0 10 20 30

MANITOBA



Southeastern Manitoba is an ecologically diverse area. The region is bounded on the east by the Pre-Cambrian Shield and on the west by the plains bordering the Red River Valley. Thus, this region contains an ecotone between the closed-canopy boreal coniferous forest of the Pre-Cambrian Shield and the aspen parkland of the eastern fringe of the Red River valley. According to Rowe (1972), there are features of two Forest Regions within the study area. The Boreal Forest Region is represented by the Lower English River Forest Section, the Manitoba Lowlands Forest Section and the Northern Coniferous Forest Section. The Great Lakes-St. Lawrence Forest Region is represented by the Quetico Forest Section and the Rainy River Forest Section.

Pelly (1873), an early explorer of the region, reported large areas of muskeg or bog, and varying amounts of harvestable timber including jack pine (Pinus banksiana), red pine (P. resinosa) and white pine (P. strobus). However, forestry practices and forest fires have reduced the amount of red pine and white pine now in the region. Consequently, the tree species composition in the study area today is about 37% black spruce, 21% aspen poplar (Populus tremuloides), 19% jack pine, 7% tamarack, 3% white spruce (Picea glauca) and lesser amounts of white birch (Betula papyrifera), balsam fir (Abies balsamea), eastern white cedar (Thuja occidentalis), red pine and white pine (Gill 1969).

Great Gray Owl Nesting in the Study Area

The available information on nesting in the study area up to 1976 (Figure 2) is summarized in Table 1. Aspects of breeding biology obtained from observations at Nests A-F are discussed later. Nesting data from 1970 to 1975 were collected by Nero and co-workers. Some of these data are summarized below with their permission.

The first Great Gray Owl nest discovered in the study area was collected in Roseau County by H. Halvorson on 4 April 1935 (H. Halvorson, pers. comm.; Nero 1970b; Roberts 1936; Turner 1935).

The second active nest (found in 1970 by Nero and Taylor) was also located in Roseau County (Muir 1972; Nero 1970a, b, c; 1971; Wechsler 1973). Further evidence of nesting in the study area was obtained in late July 1970 when Nero (in litt. 1976) located a nest near Lewis, Manitoba, that contained Great Gray Owl feathers in the lining (indicating possible recent use).

On 30 May 1971 Nero observed a Great Gray Owl carry a mouse into the forest near Lewis (in litt. 1976). Since this activity is characteristic of a male owl attending a nest, such observations provide circumstantial evidence of breeding (although the active nest may not always be located).

On 31 May 1973 an active nest was found by Nero and Taylor near Spruce Siding, Manitoba (Nest A1). Further

Table 1. Evidence of nesting of the Great Gray Owl in the study area.

| DATE | LOCATION | NEST DATA |
|--------------------|---------------|---|
| 1935, 4 April | Roseau County | 3 eggs; nest collected |
| 1970, 2 May | Roseau County | 5 eggs; 3 owls fledged |
| 1970, late July | Lewis | nest previously used |
| 1971, 30 May | Lewis | owl carrying prey |
| 1973, 31 May | Spruce Siding | Nest A1; 1 young in nest; apparently fledged ¹ |
| 1973 | Ste. Rita | nest previously used |
| 1974, 4 May | Spruce Siding | Nest A2; 3 eggs; 2 young apparently fledged |
| 1974, 28 April | Lac du Bonnet | Nest B; 3 eggs; 2 young fledged |
| 1974, 11 May | Roseau County | Nest C1; 2 eggs; 1 young apparently fledged |
| 1974, 20 May | Ste. Rita | owl carrying prey |
| 1974, 10 August | McMunn | 1 fledged young; no nest |
| 1976, 5 April | Roseau County | Nest C2; 4 eggs; abandoned |
| 1976, 5 April | Spruce Siding | Nest D; 5 eggs; 5 young apparently fledged |
| 1976, 11 April | Ste. Rita | Nest E; 4 eggs; 2 young apparently fledged |
| 1976, 29 May | Roseau County | Nest F; 3 eggs; 3 young apparently fledged |
| 1976, 26 June | Roseau County | 3 fledged young |
| 1976, 25 September | Badger | 3 owls together ² |

¹Last observation was prior to fledging.

²R. W. Nero believed that this observation represented a "family" group.

evidence of breeding in 1973 was discovered on 9 June 1974 when Nero (in litt. 1976) investigated a nest near Ste. Rita, Manitoba containing old feathers from a possible occupation in 1973.

In 1974 Nest A (now A2) was used again by Great Gray Owls. Also, a nest near Lac du Bonnet, Manitoba (Nest B) was used in 1974. In this same year a man-made nest structure in Roseau County (Nest C1) was occupied by Great Gray Owls. According to Nero et al. (1974: 161), the use of Nest C1 by Great Gray Owls in 1974 probably represented "...the first successful occupancy of an artificial nest by this species in North America". Nero et al. (1974) described this nest in detail. On 20 May 1974, Nero (in litt. 1976) observed a Great Gray Owl carrying a mouse into the forest near Ste. Rita, Manitoba. Again, an active nest was not located. And on 10 August 1974, W. Nakka found a young Great Gray Owl near McMunn, Manitoba. This bird subsequently died in captivity (W. Nakka, pers. comm.). In 1976 I worked on various occasions (see later) at nests in Roseau County (Nests C2 and F), near Spruce Siding (Nest D) and near Ste. Rita (Nest E). I also observed a family group of owls (consisting of both parents and three fledged young) on 26 September 1976 in Roseau County. On 25 September 1976, C. Loiselle observed three Great Gray Owls "in a

close group-probably a family group" near Badger, Manitoba
(R. W. Nero in litt. 1976).

Nesting Habitat in the Study Area

Great Gray Owl nesting habitat has been studied in Canada (Oeming 1955), Sweden (Höglund and Lansgren 1968) and Finland (Lahti and Mikkola 1974). The frequency of nesting in the study area permitted an analysis of nest habitat in southeastern Manitoba and northwestern Minnesota.

Methods

Nesting habitat in the study area was assessed using forest inventory sheets obtained from the Manitoba Department of Natural Resources and the Minnesota Department of Natural Resources.

Nests within 200 m of each other were considered to be in the same habitat. This was because the margin of error incurred in locating nests on the aerial photographs and, subsequently, on the forest inventory sheets precluded locating the precise nest site. Since Nest C was used in 1974 (C1) and 1976 (C2) and was within 200m of the 1970 Roseau County nest, the assessment for Nest C should be weighted by a factor of three to account for the affinity of Great Gray Owls to this particular nesting area. Also, Nest D was built near Nest A which had been occupied by Great Gray Owls in 1973 (A1) and 1974 (A2). Consequently, the proximity of Nests A1, A2 and D suggests that the habitat assessment of Nest D should be weighted by a factor of three. Therefore, this nest habitat assessment for five nests is assumed to be valid for nine nest sites in

the study area.

Although Great Gray Owls nest occasionally within 100m of each other (Höglund and Lansgren 1968), the actual size of the area in which prey are taken is unknown. Craighead and Craighead (1969) suggested that foraging occurs within 1 km of the nest. Observations by S. G. Sealy (pers. comm.) and Nero (1970b) indicated that much of the hunting occurs within 800m or less of the nest. Since selection of a nest site may depend on its proximity to suitable hunting areas (see later), I analyzed the nest habitat within a 800m radius of each nest.

Habitats of the five nests were designated according to the dominant feature (either tree species, vegetation complex or physiographic feature) as portrayed on the forest inventory sheets.

Results and Discussion

Tamarack and black spruce were the most dominant tree species in the habitat of seven of the nine nests in the study area (Table 2). Only Nests B and E had aspen poplar as the dominant tree species, and Nest B had black spruce as the secondary component. Nest B had open fields in the vicinity of the nest site. This was the only nest at which open fields were a large component of the habitat (23.1% of the total cover of the area). This nest was used only once in this study, and the habitat type seen at Nest B has not been observed to be frequently used by

Table 2. Habitat composition (%) at nine Great Gray Owl nests
in the study area.

| HABITAT COMPONENT | F | Cl ¹ | B | Al ² | E |
|--|------|-----------------|------|-----------------|------|
| black spruce (<u>Picea mariana</u> (Mill.)BSP) | 45.5 | 23.1 | --- | 47.8 | 28.5 |
| tamarack (<u>Larix laricina</u> (DuRoi) K.Koch) | 20.9 | 55.8 | --- | 15.9 | --- |
| white birch (<u>Betula papyrifera</u> Marsh.) | 20.3 | 10.7 | --- | --- | --- |
| balsam/white spruce (<u>Abies balsamea</u> (L.) Mill./ <u>P. glauca</u> (Moench) Voss) | 4.6 | --- | --- | --- | --- |
| eastern white cedar (<u>Thuja occidentalis</u> L.) | 4.4 | 0.6 | --- | 2.0 | --- |
| red pine (<u>Pinus strobus</u> L.) | 3.0 | --- | --- | --- | --- |
| manitoba maple (<u>Acer negundo</u> L.) | 0.9 | 1.7 | --- | --- | --- |
| willow/alder/birch | 0.2 | 0.4 | 1.2 | 2.8 | --- |
| ash | 0.2 | --- | --- | --- | --- |
| open fields | --- | 3.7 | 23.1 | --- | --- |
| road right-of-ways | --- | 3.4 | 3.9 | 1.1 | 1.8 |
| aspen poplar (<u>Populus tremuloides</u> Michx.) | --- | 0.6 | 45.2 | 9.6 | 63.7 |
| treed rock | --- | --- | 13.9 | --- | --- |
| jack pine (<u>P. banksiana</u> Lamb.) | --- | --- | 7.8 | --- | --- |
| rock | --- | --- | 2.3 | --- | --- |
| water | --- | --- | 1.9 | --- | --- |
| marsh/muskeg | --- | --- | 0.7 | 1.1 | --- |
| sedge meadow | --- | --- | --- | 4.3 | --- |
| treed muskeg | --- | --- | --- | 15.4 | 6.0 |
| TOTAL | 100 | 100 | 100 | 100 | 100 |

¹Includes analyses for Nests Cl, C2 and 1970 nest.

²Includes analyses for Nests Al, A2 and D.

Great Gray Owls in the study area. On the basis of these limited data, it appears that aspen poplar forests are of lesser significance to Great Gray Owl production in southeastern Manitoba. These data further suggest that large stands of tamarack and black spruce are of greater significance to Great Gray Owl breeding in this part of their range in North America.

In Alberta, Oeming (1955: 45) found that nests were located in poplar stands "...mixed with either black spruce or jack pine". So it seems that there may be considerable variation in the type of habitat used by the Great Gray Owl. It is likely that other factors exert a more profound influence on habitat selection in this species since, as Höglund and Lansgren (1968: 321) stated: "...this owl may breed in very different habitats and in nests of quite varying size, condition, and position due to their age and original constructor".

BREEDING BIOLOGY

The breeding biology of the Great Gray Owl in Eurasia has been studied in some detail by Höglund and Lansgren (1968), Mikkola (1969, 1971, 1972, 1976), Mikkola and Sulkava (1969a, 1970) and Wahlstedt (1969, 1974, 1976). But in North America the breeding biology of this species is not well known, although many workers (Bent 1938; Craighead and Craighead 1969; Henderson 1915, 1923; Nero 1969, 1970a, b, c, 1971; Nero et al. 1974; Oeming 1955) have studied certain aspects, mainly during the nestling stage.

Much of the information available for the Great Gray Owl in North America has been based on intermittent observations of breeding biology. There is little information available concerning behaviour of adult birds during the egg stage, and no daily growth data are available for young owls. Further, there are no detailed reports of the vocalizations of the Great Gray Owl in North America.

By 1975, work by Nero (1969, 1970a, b) and Nero et al. (1974) had indicated that a breeding population of Great Gray Owls existed in southeastern Manitoba and northwestern Minnesota. Consequently, I studied the breeding biology of Great Gray Owls in this region in 1975 and 1976.

Methods

In May and June 1975, I located Great Gray Owls by eliciting the response of these birds to a tape-recording of certain vocalizations of this species. I used recordings of the Territorial Call and the Contact Call of adult birds, and the Begging Call of the young (recordings courtesy of R. R. Taylor). These tape-recorded calls were played at various times of the day and night (but mainly from sunset to 01:00 hours CST) at stations approximately 800 m apart along roads through selected areas where owls had been observed previously (Nero, pers. comm.). Ten minutes were spent at each station alternately playing the recordings and listening for a response. A 20-watt portable amplifier and a four-inch speaker were used to play the tape-recordings.

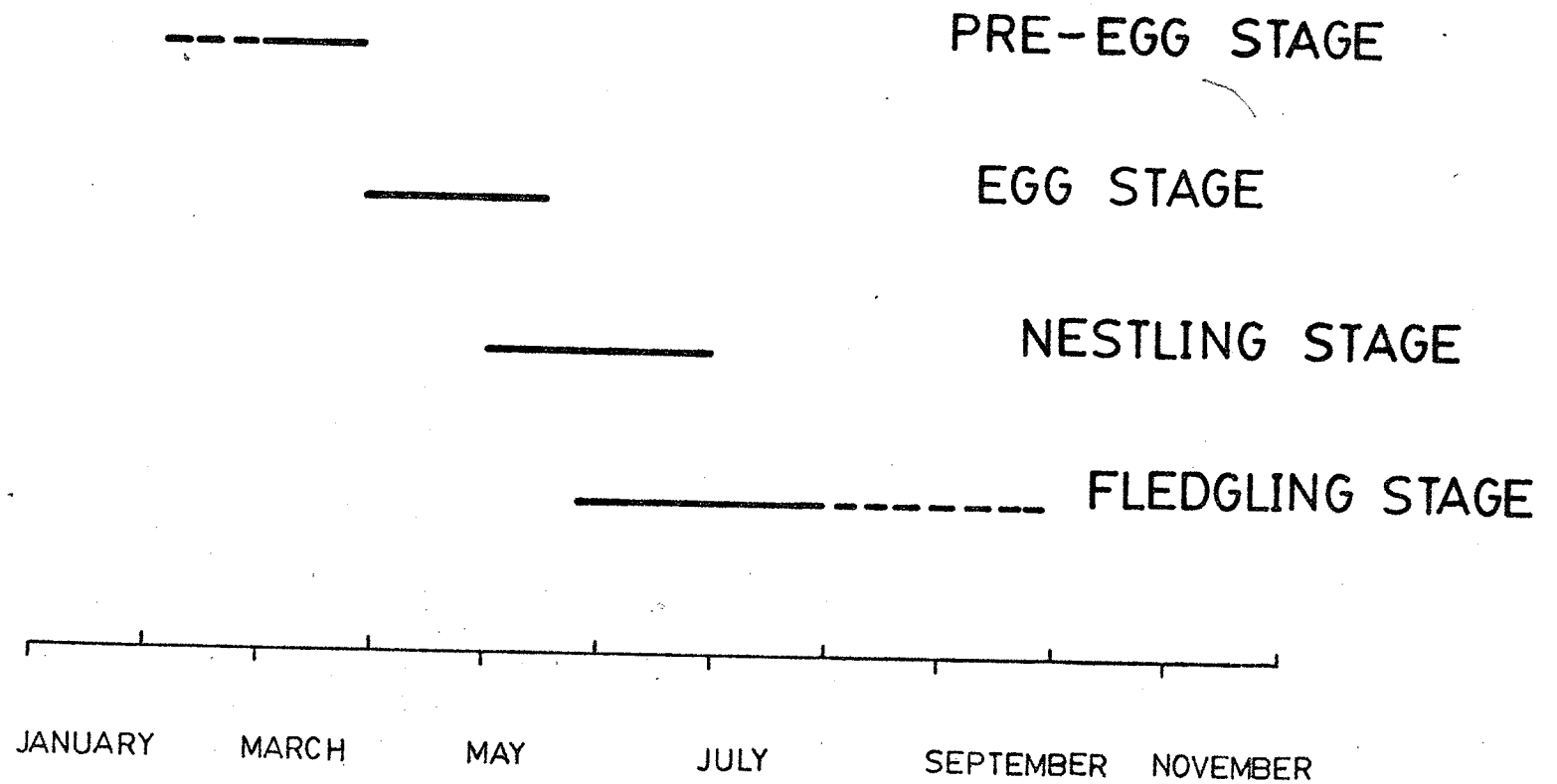
In 1976, I obtained data regularly from Nests D and E in southeastern Manitoba. I camped about 20 m from Nest D and obtained 252 hours of observation there on 7, 9, 10, 12-16, 19-22, and 26-29 April, 2-31 May, and 1-3, 6, and 8 June. Growth of young was studied by weighing (to the nearest 0.1 g) each one daily on a triple-beam balance. Tarsal lengths and the length of the tenth primary were measured (to the nearest mm) daily with vernier calipers. Similar growth data and some behavioural observations were obtained every

second day at Nest E between 2 and 20 May, and daily from 20 May to 5 June. Nest C2 was visited on 7, 10, and 17 April and Nest F on 19 and 26 June.

In 1976 I made at least one tape-recording of all vocal and mechanical utterances of adult and young birds heard during my observations at Nest D. My interpretation of the function of each utterance is based on these intensive observations at Nest D and substantiated by intermittent observations at Nest C2, E and F, and by my field observations of 1975. I have conformed, where possible, to the terminology of vocalizations described by Nero et al. (1974) and Forsman (1976). Vocalizations were recorded at 7½ ips. with a Uher 4000 Report-L Tape Recorder, a Uher M-539 microphone and, frequently, a 24-inch parabolic reflector (parabolic reflector provided by R. R. Taylor). Sonagrams were produced with a Kay Electric Company Missile Data-Reduction Spectrograph (Missilyzer 675). Vocal parameters were measured from sonagrams produced at both wide and narrow bands.

To facilitate the present discussion, I have divided that part of the year pertaining to breeding activities into four stages: Pre-Egg Stage, Egg Stage, Nestling Stage and Fledgling Stage. The Pre-Egg Stage is that part of the breeding season prior to the laying of eggs. The precise limits of this stage are not known (see later). The Egg Stage in a given year is from the

laying of the first egg in the first nest to the hatching of the last egg in the last nest. The Nestling Stage is that time of the year when young owls are in the nest. The Fledgling Stage is the period after the young have left the nest but are still dependent on the parents for food and protection. Due to the asynchrony in hatching and nest initiation, there is some overlap of the Egg Stage, Nestling Stage and Fledgling Stage in any one year. The approximate limits of these stages of the breeding season of the Great Gray Owl in the study area are portrayed in Figure 3. These limits are estimated from the data of 16 breeding records in the study area up to 1976 (Table 1).



Results and Discussion

Pre-Egg Stage

The precise start of the Pre-Egg Stage is not clearly known. At some time in winter, birds begin certain behaviour (notably, nest visits) that appear to be associated with breeding activities. Pre-Egg Stage activities of particular interest include possible territorial behaviour, nest site selection, courtship feeding and copulation. In the study area the Pre-Egg Stage commences during the winter months, possibly as early as February (Nero pers. comm.). Consequently, observations of winter territorial behaviour may relate to the Pre-Egg Stage.

Territory

Some bird species defend non-breeding territories during the winter months (Pettingill 1970, Ricklefs 1973). Godfrey (1967) and Brunton and Pittaway (1971) reported that Great Gray Owls apparently establish winter territories in that period that I call the Pre-Egg Stage. However, observations in the study area of similar intraspecific interactions during winter (Nero in litt. 1976) indicated that this sort of behaviour may not necessarily represent only a "territorial confrontation", as interpreted by Brunton and Pittaway (1971: 317). These activities and the apparent defense of territory also may be related to

courtship and choice of a suitable nest site (Nero, unpublished notes). Nero (op. cit.) stated:

"Aggressive encounters on winter feeding grounds, in some cases far from breeding sites, have been noted by several authors and may be understood partly in terms of competition for food. However, since sexual behavior must begin early, encounters in late February and March may have sexual connotation".

This interpretation is reasonable at present. However, further research is required on marked birds to understand better the implications of territorial activities during the Pre-Egg Stage.

Nest Site Selection

Since the Great Gray Owl generally uses old nests of other species (Bent 1938, Höglund and Lansgren 1968, Pulliainen and Loisa 1977), nest site selection presumably involves a search for existing nest structures. In Sweden Höglund and Lansgren (1968) found this species using old nests of the Goshawk (Accipiter gentilis), Common Buzzard (Buteo buteo), Honey Buzzard (B. apivoris) and two artificial nests. Wahlstedt (1974) reported that one pair of owls nested on a tree stump. Of the 96 nests studied in Finland by Lahti and Mikkola (1974), 84 were in "twig nests", 10 were on tree stumps, one was on the ground and one was on a "rock face". The North American race has used nests previously occupied by the Goshawk, Red-tailed Hawk (B. jamaicensis), Broad-

winged Hawk (B. platypterus), Great Horned Owl (Bubo virginianus), Common Crow (Corvus brachyrhynchos), as well as man-made nests (Bent 1938; Henderson 1915, 1923; Nero et al. 1974; Oeming 1955).

Observations at nest sites indicate that nest site selection begins as early as late winter. In Sweden Höglund and Lansgren (1968: 368) reported: "Already on March 27, 1964, a pair was staying at a nest...which was used by great grey owls in the preceding year". Also, they heard birds calling from nests on 23 April and cited evidence of nest visits on 23, 24 and 25 April. Höglund and Lansgren (1968: 367) stated concerning nest visits: "...we noted that the owls (the female?) had scratched in the nest so violently that the bottom had fallen down. Judging from remnants on the snow the activity had been fairly intensive. No enlargement whatever of the nest could be noticed".

In North America Henderson (1923) reported a mid-March visit to a nest in central Alberta. In this case the female was sitting in the nest and the male was perched nearby. This nest was not ultimately used by those birds. In my study area, preliminary visits to nests have begun as early as mid-February (Nero et al. 1974, Nero in litt. 1977). Evidence of a nest visit at Nest C on 6 March 1971 (Nero et al. 1974) demonstrated that these early nest visits may not necessarily result in the use of that nest in the following breeding season. Observations

by S. G. Sealy (pers. comm.) near Lac du Bonnet also provided evidence of this sort of nest site appraisal by birds. On 20 April 1974 Sealy observed a marked female owl near Nest B, but on 24 April found this bird sitting in another nearby nest. Nest B was finally chosen, but it is not clear what factors influenced the selection of this nest. It is certain that Great Gray Owls begin nest searching early in the year and use some cue(s) to assess the suitability of the available nest structures.

It is evident that a direct positive relationship exists between food supply and reproductive effort in many owl species (Hagen 1965, Linkola and Myllymäki 1969, Southern 1970). This relationship may be manifested in the choice of a nesting area. That is, birds may not nest in areas without sufficient food. It is likely that nest site selection by Great Gray Owls is affected similarly by the availability of sufficient food (food items reviewed later). In the winter of 1973-74 Nero consistently observed owls hunting in a particular field near Lac du Bonnet, Manitoba (Nero in litt. 1976). In 1974 Nest B (in proximity to this hunting area) was occupied by a female that was caught and colour-marked by Nero in the study area on 24 February 1974. It may be that the concentration of prey in the nearby hunting area induced this breeding attempt.

Nest site selection may also be influenced by the location of the nest occupied in the previous year (Hildén 1965). Nest site fidelity occurs in Tawny Owls, Strix aluco (Southern 1970) and Screech Owls, Otus asio (VanCamp and Henny 1975). Concerning the Great Gray Owl in Finland, Mikkola and Sulkava (1969a: 130) reported: "Some separate pairs have, however, bred or at least have been staying for many consecutive years on the same nest site...". In Sweden Wahlstedt (1976: 125) cited evidence of this nesting area fidelity:

"Four records of ringed adult female owls have been made at the same places where they were earlier ringed. Three of them had been ringed as adult owls in the same nests in 1973, and one of them as an adult owl in 1970 - only 1.5 km from the record place in 1974! During the autumn and winter 1973-74, one adult male owl hooted regularly and bred once again in 1974 on the same spot as in 1973."

It is possible that fidelity to a nest site also occurs in the study area. Nest A was used in 1973 (A1) and 1974 (A2) and Nest C was used in 1974 (C1) and 1976 (C2). But since these birds were not banded or individually colour-marked, it is impossible to determine if nest site fidelity was an important factor in the occupation of these nests. Nest area fidelity may be advantageous to Great Gray Owls, since familiarity with the available hunting areas may facilitate successful breeding.

It seems, therefore, that nest site selection by Great Gray Owls may be influenced by the availability of adequate nest structures, the food supply in the nesting area and, possibly, nest site fidelity.

Courtship Feeding

Courtship feeding, the ritualized feeding of one sex by the other (Welty 1975), is reported in Short-eared Owls (Asio flammeus) by Clark (1975) and in Boreal Owls (Aegolius funereus) by Bondrup-Nielsen (1977). Also, Taylor (1973) suggested that Snowy Owls (Nyctea scandiaca) performed courtship feeding. In Boreal Owls courtship feeding consists of the male owl leaving a prey item to be eaten by the female when she enters the nest hole (Bondrup-Nielsen 1977). Clark (1975) observed courtship feeding six times in Short-eared Owls. In one instance this behaviour was followed immediately by copulation. The possible relationship between prey densities, courtship feeding, copulation and the subsequent reproductive effort of Snowy Owls was examined by Taylor (1973). He suggested that courtship feeding may be the mechanism by which owls can adjust their reproductive effort to suit the prey base available to them for reproduction. A mechanism of this sort would be essential to any species exploiting a prey base that is subject to extreme, cyclic fluctuations.

It seems likely that Great Gray Owls perform some type of courtship feeding. In Sweden the female gives a food begging call during copulation (Berggren and Wahlstedt 1977). This suggests a close relationship between copulation and food. According to Welty (1975) ritualized courtship feeding continues and becomes real feeding of the incubating female by the male. It is known that the male Great Gray Owl feeds the female at the nest during later stages of the breeding cycle (see later). It is also possible that the Great Gray Owl exhibits courtship feeding similar to that observed in the Boreal Owl. Nero and Sealy (pers. comm.) and I have observed several uneaten prey items accumulated on nests during the Egg Stage. Further, Nero (in litt. 1976) has observed owls (presumably males) during the Pre-Egg Stage flying from hunting areas (presumably towards a nest site) with prey in their bills. This behaviour contrasts to the usual pattern that I have seen in winter birds when the prey is eaten immediately. From the circumstantial evidence we may speculate that courtship feeding occurs in the Great Gray Owl. If this is true, then our understanding of Great Gray Owl breeding biology may be enhanced by invoking Taylor's (1973) hypothesis on predator-prey interactions (see later).

Copulation

Höglund and Lansgren (1968) and Wahlstedt (1969, 1974, 1976) in Sweden and Mikkola (1976) in Finland have not reported observations of copulation in the Great Gray Owl. However, Nero, H. W. R. Copland and R. R. Taylor observed copulation near East Braintree, Manitoba at 17:43 hours of 27 March 1971. This observation is recorded in Nero's unpublished notes and is worthy of mention here:

"...(the owl)...was joined by a second bird, apparently its mate. The pair flew off together to an open field near the farm house and out of our sight. When next seen, the female was perched about 15 feet above the snow on top of a dead, leaning tamarack pole with the male perched on her back, vigorously flapping its wings as if for purchase. Shortly thereafter the male flew away and the female resumed hunting. Although we had been observing them from nearly 300 yards, we had heard a peculiar rasping screech given by one or both birds, much unlike the mellow hooting we knew as the voice of the Gray Owl."

Egg Stage

Eggs and Clutch Size

Concerning the eggs of the Great Gray Owl, Bent (1938: 215) stated:

"The color is dull white. The measurements of 52 eggs average 54.2 by 43.4 millimeters; the eggs showing four extremes measure 58.7 by 49, 48 by 42, and 53.4 by 41 millimeters."

The 21 eggs measured by Sealy for nests in the study area (Table 3) average 53.1 by 43.3 mm with extremes of 56.1 by 42.9, 50.4 by 41.9 and 52.9 by 41.5 mm.

Up to 1976, there were at least 107 nestings of the Great Gray Owl in North America (Appendix I). These records are of eggs or young birds. Accurate clutch sizes are not available for most of these nests, since the contents of most of these nests were collected by oologists when they first visited the nest, probably before the complete clutch had been laid. Also, many of these nests were discovered after the eggs had hatched but, since young birds may disappear from the nests, brood size does not accurately reflect clutch size. Although these data may provide information on minimal clutch size, the minimal clutch size does not provide a realistic estimate of the reproductive effort. Consequently, only 11 reliable clutch sizes are available for North America (Table 4). The average clutch

Table 3. Measurements (mm) of 21 Great Gray Owl
eggs from the study area.

| NEST | MEASUREMENTS |
|---------|---|
| A2 1974 | 53.7 x 43.4 (1) ¹ 52.6 x 44.0 (2) 54.5 x 43.1 (3) |
| B 1974 | 51.5 x 44.5 (-) 52.9 x 41.5 (-) 53.1 x 44.3 (3) |
| C1 1974 | 56.0 x 44.5 (1) 56.1 x 42.9 (2) |
| C2 1976 | 53.6 x 42.5 (-) 52.3 x 42.3 (-) 51.5 x 41.9 (3) 50.4 x 41.9 (4) |
| D 1976 | 53.3 x 43.4 (1) 52.1 x 44.4 (2) 53.3 x 44.1 (3) 52.3 x 43.9 (4) 51.9 x 43.5 (5) |
| E 1976 | 54.5 x 43.2 (1) 53.0 x 44.0 (2) 54.2 x 43.5 (3) 52.3 x 44.0 (4) |
| mean = | 53.1 x 43.3 (n = 21) |

¹Numbers in parentheses indicate laying order where known.

Table 4. Clutch size of 11 Great Gray Owl nests in
North America (from Appendix I).

| NEST | NUMBER OF EGGS |
|------------------------------------|----------------|
| 19 July 1862, Fort Good Hope, NWT. | 4 |
| 1 May 1913, Belvedere, Alta. | 2 |
| 8 May 1969, Lake County, Ore. | 3 |
| 12 May 1972, Mackay, Alta. | 4 |
| 1974, Nest A2 | 3 ¹ |
| 1974, Nest B | 3 |
| 1974, Nest C1 | 2 |
| 1976, Nest C2 | 4 ² |
| 1976, Nest D | 5 |
| 1976, Nest E | 4 |
| 1976, Nest F | 3 |
| mean = | 3.4 |

¹1974 mean = 2.7, n = 3

²1976 mean = 4.0, n = 4

size for these 11 nests is 3.4 eggs. This is significantly smaller than the average clutch size of 4.4 eggs reported for 91 nests in Sweden (Höglund and Lansgren 1968; $t = 2.35$; 100 df; $P < 0.05$). Both Lack (1968) and Murray (1976) suggested that there may be geographical variation in the clutch size of owls, and this phenomenon certainly appears to occur in the Great Gray Owl. These geographical effects may be readily compounded by the influence of other factors on the clutch size of owls.

Many authors (eg. Hagen 1965, Southern 1970) have demonstrated that a positive relationship exists between food supply and reproductive effort in some owl species (see later). The clutch size produced by a pair of owls is a manifestation of the reproductive effort and is, therefore, subject to the effects of variation in food supply. Lack (1968) hypothesized that this maximizes the number of young produced by a pair of birds each year, since there are supposedly no more young hatched than can be supported by the available food. In Sweden Höglund and Lansgren (1968) suggested that this relationship between food supply and clutch size applies to the Great Gray Owl. It is possible that food supply also regulates the clutch size of the Great Gray Owl in North America. The apparent difference in clutch sizes in the study area between 1974 (mean = 2.67, $n = 3$) and 1976 (mean = 4, $n = 4$) may be

a manifestation of this phenomenon, since it seems that prey populations were greater in 1976 (Figure 21).

Clutch Initiation

Consideration of the approximate date of clutch initiation for nests in the study area (Table 5) reveals that clutches in Nests A2, B and C1 in 1974 were started approximately three weeks later than the clutches of Nests C2, D and E in 1976. According to Lack (1968) this variability in the timing of clutch initiation is an adaptation that guarantees ample food will be available to the young when the eggs hatch. At the same time, the condition of the female with respect to her ability to lay eggs may also affect the timing of laying (Klomp 1970). The implication of Lack's hypothesis in the study area is that food supply in 1976 was sufficiently more abundant to promote earlier nesting. The apparently larger average clutch size of the 1976 nests (Table 4) supports the suggestion that food was indeed more abundant in 1976. However, the timing of clutch initiation in any particular year may also be affected to some extent by certain climatic factors, such as the ambient temperature. The ambient temperature might influence such factors as the availability of prey for courtship and thereby affect the laying condition of the female. For example, the occurrence

Table 5. Approximate dates of clutch initiation in the study area for 1974 and 1976.

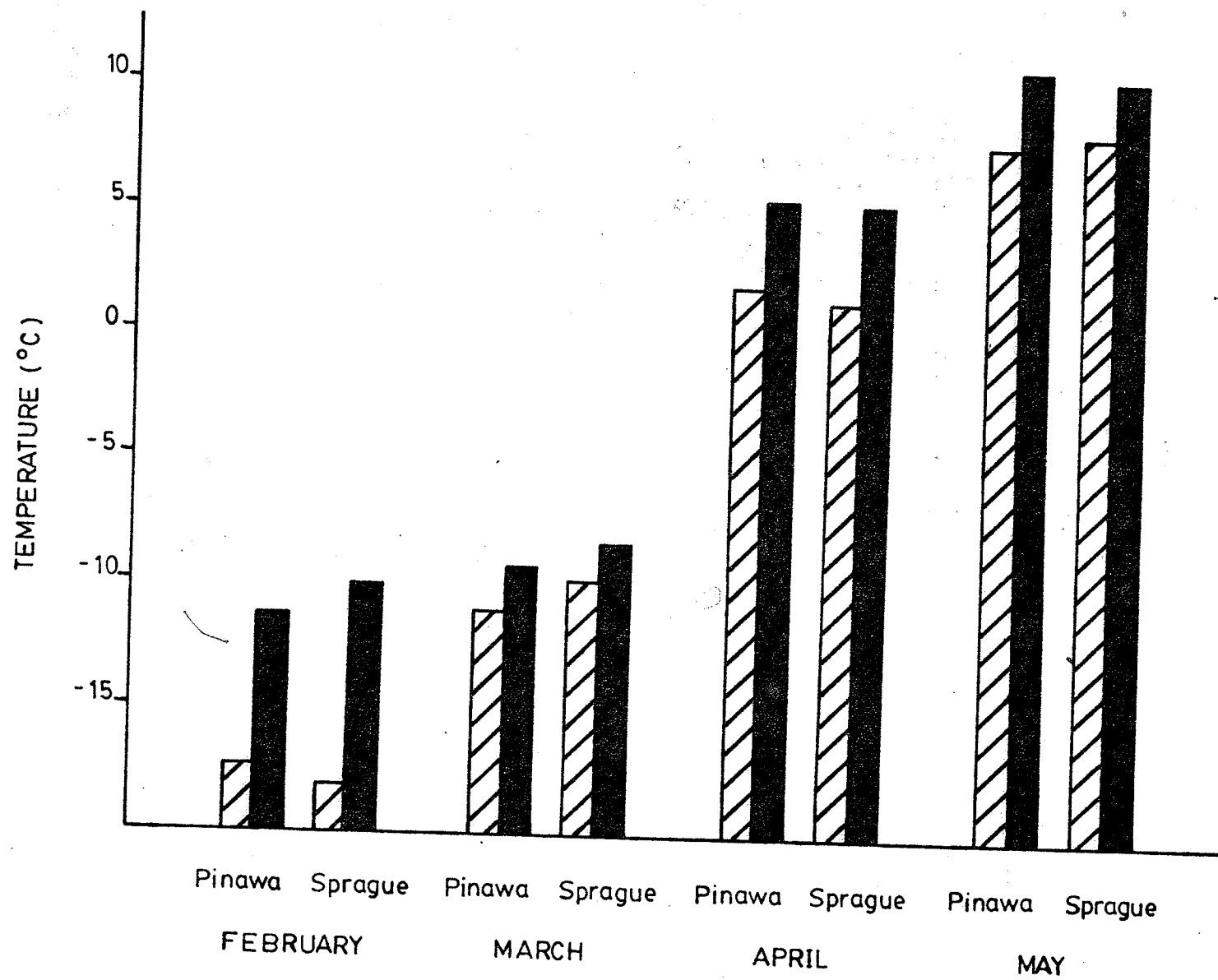
| NEST | CLUTCH INITIATION |
|---------------|--------------------------|
| Nest A2, 1974 | 22-27 April ¹ |
| Nest B, 1974 | 25-26 April ² |
| Nest C1, 1974 | 26-28 April ¹ |
| Nest C2, 1976 | 3-4 April ² |
| Nest D, 1976 | 2-3 April ² |
| Nest E, 1976 | 1-2 April ¹ |
| Nest F, 1976 | 26-28 April ¹ |

¹Back-dated using a 30-day incubation period.

²Back-dated using a 2-3 day egg-laying interval.

of warm temperatures may increase the opportunity for the male to provide food for the female (by removing snow from hunting areas) and thereby allow her to lay eggs sooner. The mean daily temperatures at Pinawa and Sprague from February to May 1976 were consistently higher than the same period in 1974 (Figure 4). It may be, then, that these warmer temperatures contributed to the slightly earlier clutch initiation of 1976.

In 1976 egg-laying in Nest F began on approximately 26-28 April (Table 5), nearly four weeks later than Nests C2, D and E. Since nests in 1974 and the other nests in 1976 were relatively well coordinated with respect to the timing of clutch initiation in these years, the later clutch initiation of Nest F in 1976 is of particular interest. It should be noted that Nest C had been abandoned by 17 April, more than one week prior to clutch initiation in Nest F. Nests C and F were less than 800 m apart in Roseau County. Great Gray Owls do occasionally renest after nest failure in Sweden (Höglund and Lansgren 1968), so it is possible that Nest F was a renesting effort by the birds of Nest C.



Egg-Laying Intervals

In the study area some variation in the egg-laying interval was recorded (Table 6). The second and third eggs of Nest B in 1974 were laid three days apart. The third and fourth eggs of Nest D in 1976 were laid two days apart, and the fourth and fifth eggs were laid, at most, four days apart. Less frequent observations at Nest C2 in 1976 indicate that the third and fourth eggs were laid, at most, three days apart.

These observations are supported by data from Finland (Mikkola 1976). If we assume that each egg requires a fixed 30-day incubation period (this study), then the one-day and two-to three-day intervals in hatching recorded by Mikkola (1976) indicate (by back-dating) that an equivalent interval occurred during egg-laying.

Table 6. Sequence of egg-laying at Nests B, D and C2.

| NEST | DATE | NUMBER OF EGGS |
|---------------|----------|----------------|
| 1974, Nest B | 24 April | 0 |
| | 28 April | 2 |
| | 1 May | 3 |
| 1976, Nest D | 7 April | 3 ¹ |
| | 9 April | 4 |
| | 10 April | 4 |
| | 14 April | 5 |
| 1976, Nest C2 | 7 April | 3 |
| | 10 April | 4 |

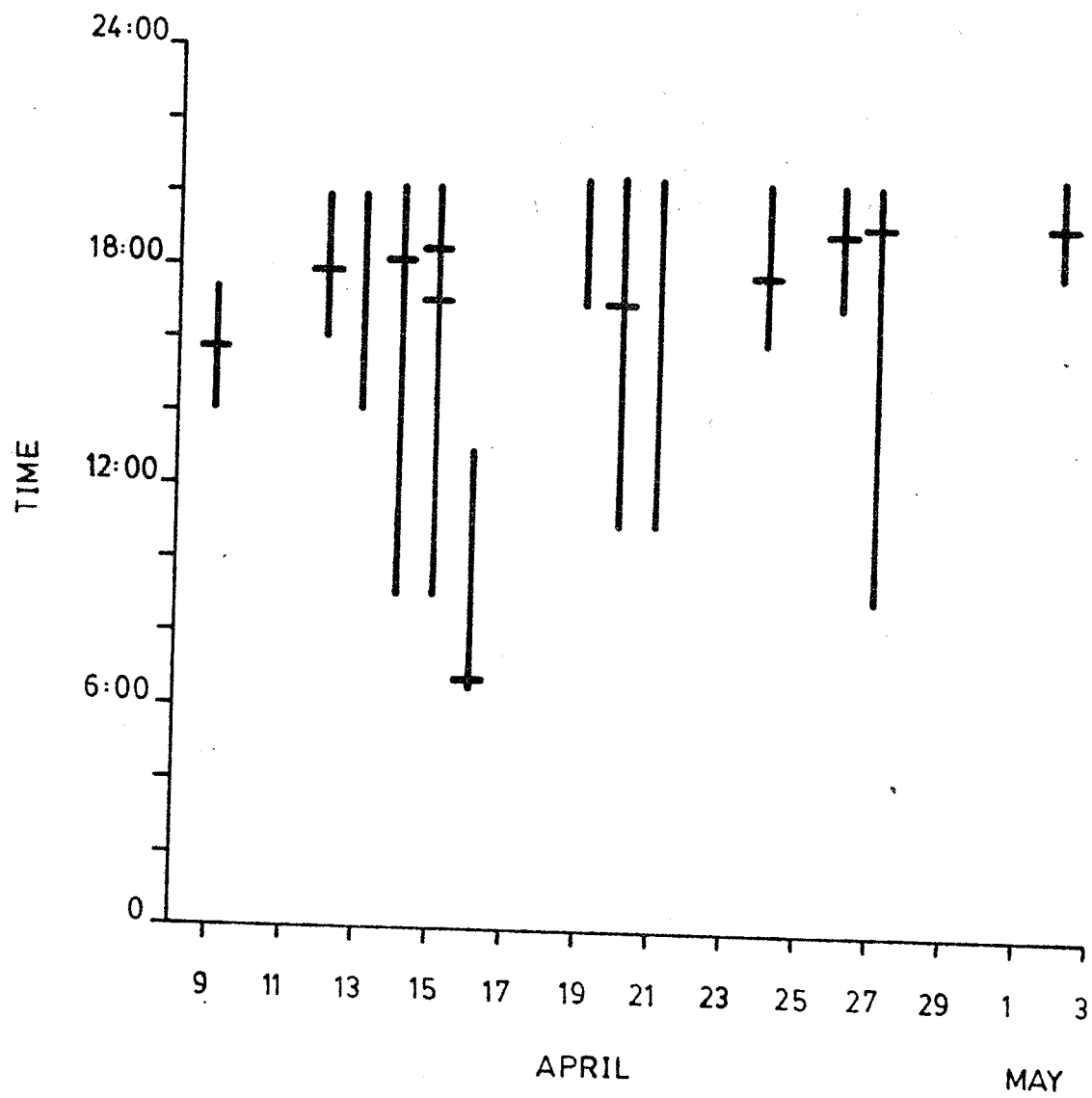
¹Third egg was judged by S. G. Sealy to be freshly laid, due to its clean, white appearance.

Incubation Period

From visits by Nero, Sealy and Copland to Nest B in 1974, it was known that the third egg was laid on 1 May (Table 3), and hatched 30 days later on 31 May. At Nest D in 1976, the fourth egg was laid on 8 or 9 April and hatched on 9 May. These observations suggest that the incubation period is 30-31 days long.

Role of the Female

The female begins incubation when the first egg is laid (Mikkola 1976). In 86 hours of observation during incubation at Nest D (see Figure 5), the female voluntarily left the nest three times for periods of five, one and four minutes, respectively. In five hours of observation at Nest E during incubation, the female left the nest once, for 15 minutes. I could not see this particular bird when she was off the nest. The female of Nest D preened, cast pellets, stretched, shook and defecated while away from the nest during incubation. She also performed these activities on the nest. At all other times during my observation of incubation at Nest D, the female was on the nest, presumably incubating.



Role of the Male

I have designated the act of the male owl bringing food to the female or young a "Feeding Trip". At Nest D in 1976 I observed 11 Feeding Trips in 86 hours of observation (0.13 trips/observation hour) during incubation (Figure 5). One of these was observed in early morning (06:48) while the other 10 were observed in late afternoon and evening (15:40-19:24). It seems, therefore, that the male exhibits crepuscular hunting activity during incubation. However, Höglund and Lansgren (1968) observed two Feeding Trips during incubation (at 23:43 and 03:04), thus indicating that hunting occurs throughout the 24 hour period during incubation. Although I could not see Feeding Trips after dark at Nest D, on 11 occasions I heard vocalizations (Begging Call and Chitter, described later) which are usually associated with Feeding Trips. It seems likely, therefore, that the female of Nest D was also fed at night.

On eight occasions at Nest D I observed the male owl roosting near the nest during the Egg Stage. On these occasions the male was perched in a tree approximately 30 m north of the nest. While at his roost, the male was intermittently involved in certain maintenance activities including preening, casting, scratching, shaking and defecating.

During the Egg Stage the male owl is occupied in the evening primarily by hunting. However, twice I heard the Territorial Call (see later) after dark near Nest D. I presumed that these calls were given by the male of this nest. Höglund and Lansgren (1968) and Wahlstedt (1969) have heard male owls give this call near the nest in an apparent territorial display. I did not hear this call after the Egg Stage.

Nestling Stage

Hatching

The time between pipping and hatching of an egg varies both among and within species (Pettingill 1970).

At Nest D in 1976 the first four eggs had a pip-hatch interval of two, one, two and one days, respectively.

Young of this species may be called semi-altricial and nidicolous, since they are covered with down yet unable to leave the nest at hatching.

Since the female begins incubation when the first egg is laid (Höglund and Lansgren 1968, Mikkola 1976), the eggs hatch asynchronously. The eggs hatch in the same order in which they are laid and, possibly, at the same intervals. Asynchronous hatching is thought to be an adaptation to a fluctuating food supply (Cody 1971; Lack 1954, 1966). It seems that the older and usually larger young can out-compete their smaller, younger siblings for the food supplied by the parents. If the food supply is inadequate, the smaller young apparently starve. According to Ricklefs (1973: 253): "Selective starvation brings the energy requirements of the brood into line with the food gathering rate of the adults and ensures that all of the young raised are adequately nourished." This phenomenon apparently maximizes the number of fledged young produced per year by a pair of birds.

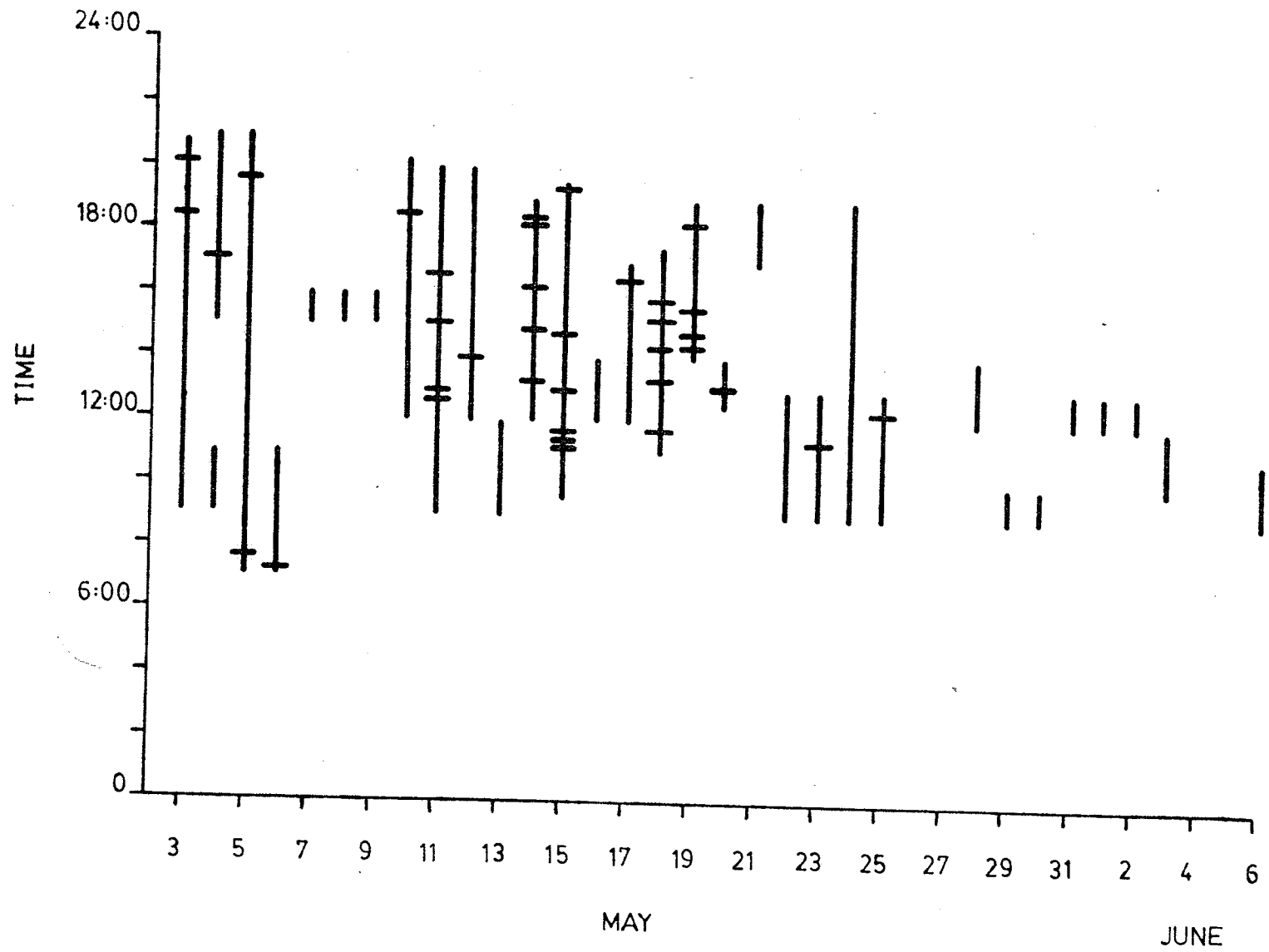
Role of the Female

My observations at Nest D in 1976 were generally consistent with reports of the Nestling Stage in Scandinavia. The female owl brooded the young and transferred prey from the male to the young. I observed the female dismember prey items for the brood, but I was unable to determine at what age the young begin to swallow whole prey. During my observations of the Nestling Stage I saw only the female feed the young owls directly. I also noted that the female became much more aggressive towards me during this stage of the breeding season, to the extent that observations at the nest and handling of the young became hazardous. These observations are consistent with those of Nero (1970b) at the 1970 Roseau County nest and Nero et al. (1974) at Nest C1 in 1974.

Role of the Male

My observations during the Nestling Stage at Nest D in 1976 indicated that the male owl hunts most of the day. Thirty-six Feeding Trips were observed in 135.2 observation hours (0.27 trips/observation hour) at this nest. These occurred throughout the day (Figure 6). Presumably, this increase in hunting activity compared to the Egg Stage is related to the increased food demands of the family. I never saw the male feed the nestlings

Figure 6. Feeding Trips observed during the Nestling Stage at Nest D. Vertical lines are observation period and horizontal lines are Feeding Trips.



directly during the Nestling Stage. The male either gave the food to the female or, in her absence, dropped the prey item in the nest. I presume that the male was not often involved in intraspecific territory defense during the Nestling Stage, since I did not hear the Territorial Call given at Nest D during this stage. From observations at the 1970 Roseau County nest, Nero (1970b: 93) stated: "The male's role appeared to be confined entirely to bringing food...to the female and to the young." Nero (1970b) also observed Feeding Trips at this nest in the Nestling Stage which occurred both at night and day.

Growth of the Young

The growth data collected at Nest D are presented in Figures 7, 8 and 9. All five young at this nest survived the Nestling Stage. The first four newly hatched young weighed 39, 39, 38 and 36 g, respectively.

Feathers apparently grew in direct relation to age (Figure 9), since the tenth primary grew with approximately regular increments. Figure 9 portrays this approximately straight-line relationship between tenth primary length and time. But it is apparent that tarsus growth and weight increments were not related directly to the age of the young (Figures 7, 8). On one occasion (24 May) Young #2 surpassed Young #1 in the length of the

Figure 7. Weights of nestlings at Nest D. The numbers are hatching order.

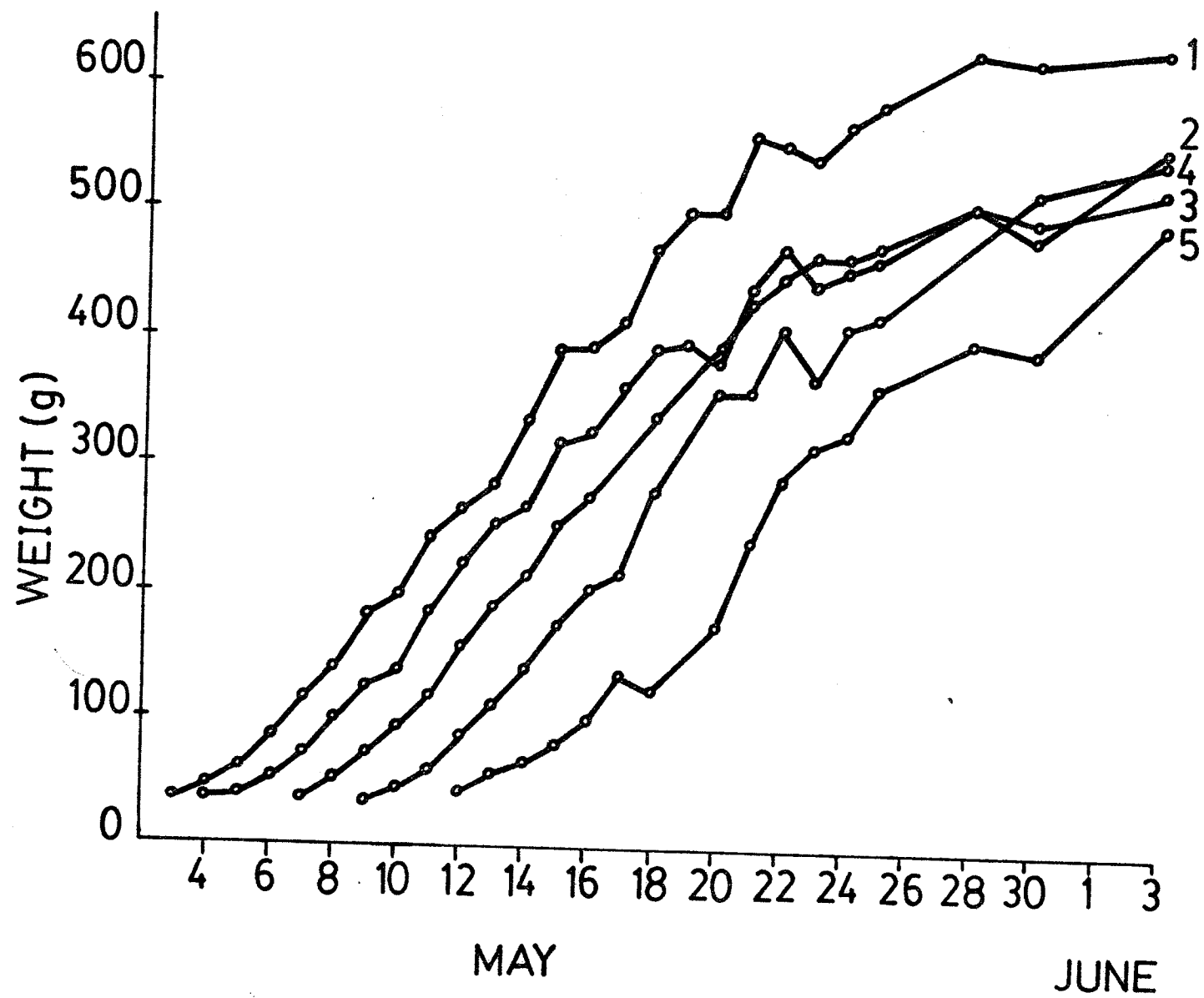


Figure 8. Tarsal lengths of nestlings at Nest D.
The numbers are hatching order.

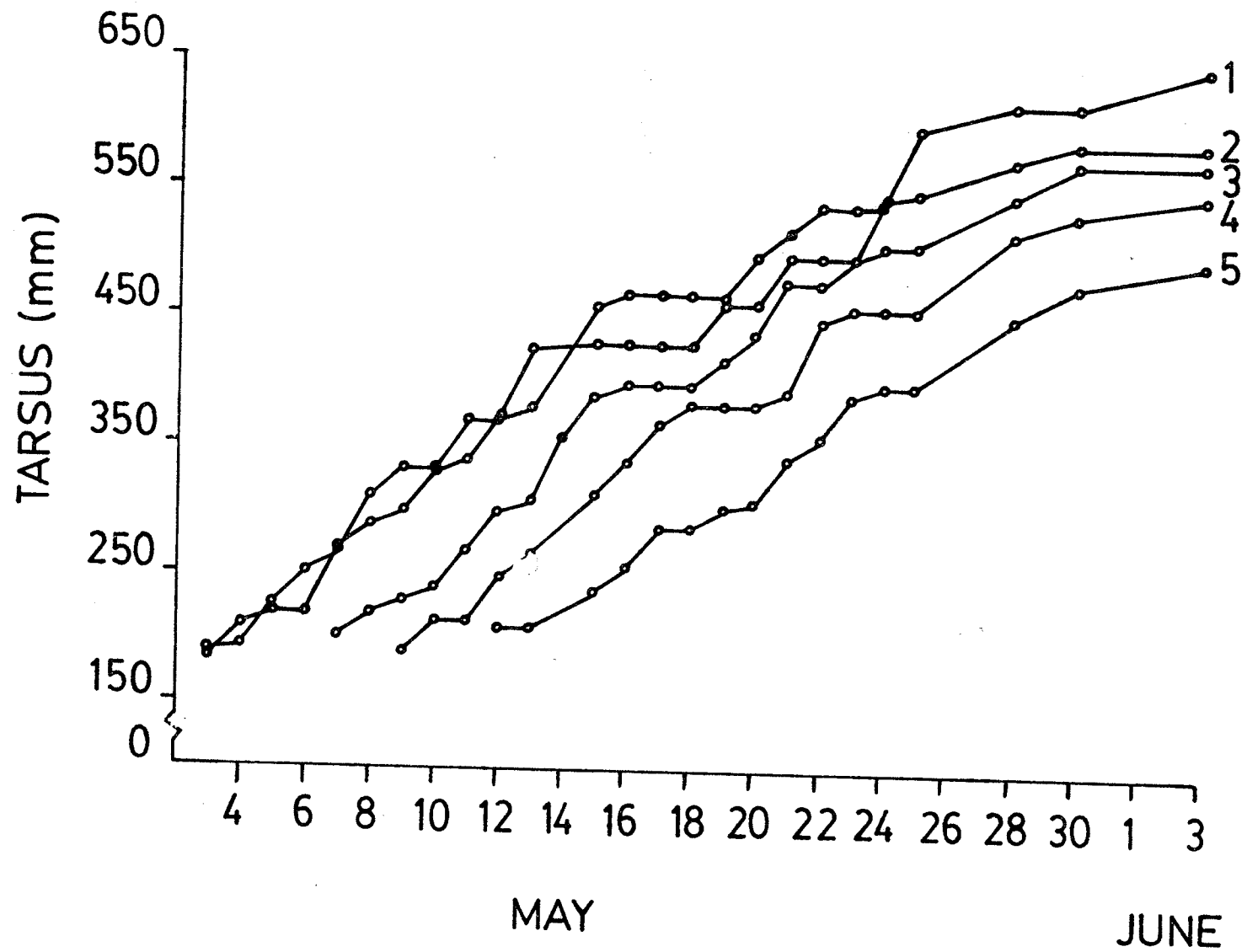
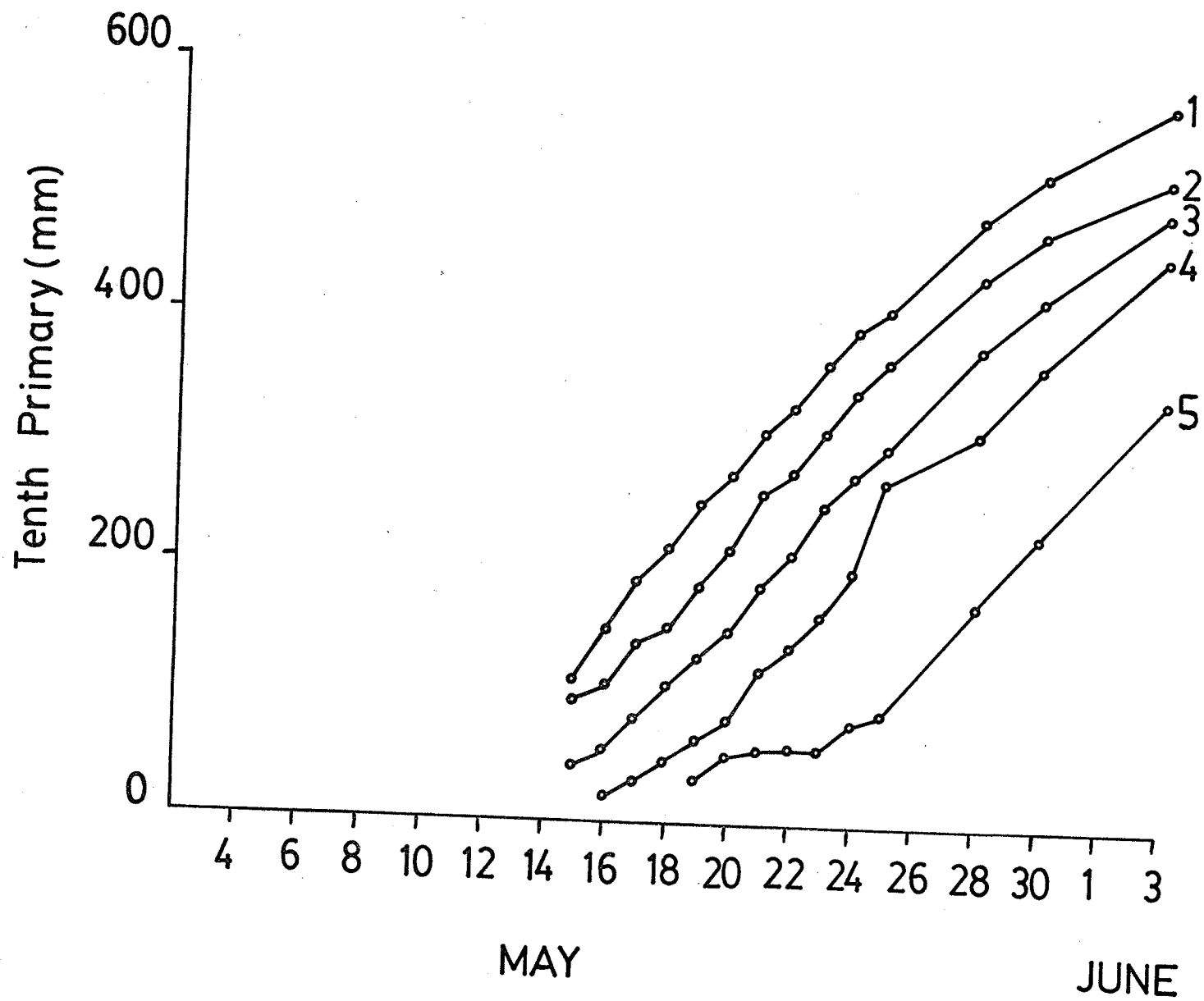


Figure 9. Tenth primary lengths of nestlings at
Nest D. The numbers are hatching order.



tarsus. The weight data demonstrate this phenomenon more dramatically. On several occasions (20, 23, 24, 25 and 30 May) Young #3 surpassed Young #2 in body weight. Also, at last measurement (3 June) Young #4 weighed more than Young #3. These data demonstrate a significant phenomenon in view of the common method of estimating the relative ages of sibling juvenile strigiformes (Taylor 1973). Usually, larger individuals are considered to be the older individuals in a brood. It is now apparent that this reasoning is not always applicable to Great Gray Owl broods.

It is possible that these differential weight gains amongst the siblings of Nest D may be related to the sex of the young. That is, female young may grow more rapidly than the males, since this species exhibits reverse sexual dimorphism in weight and wing length (Earhart and Johnson 1970, Höglund and Lansgren 1968).

The growth of young in Nest E in 1976 is illustrated in Figures 10, 11 and 12. Only two of the four young survived to the end of the Nestling Stage. Young #4 disappeared after 12 May and #3 was missing from the nest after 18 May. Young #2 was found on the ground at only 16 days of age (20 May). By 22 days, this individual was able to climb trees. However, Young #1 did not leave the nest tree until 5 June. Other than these intermittent growth data, further observations at this nest were scant.

Figure 10. Weights of nestlings at Nest E. The numbers are hatching order.

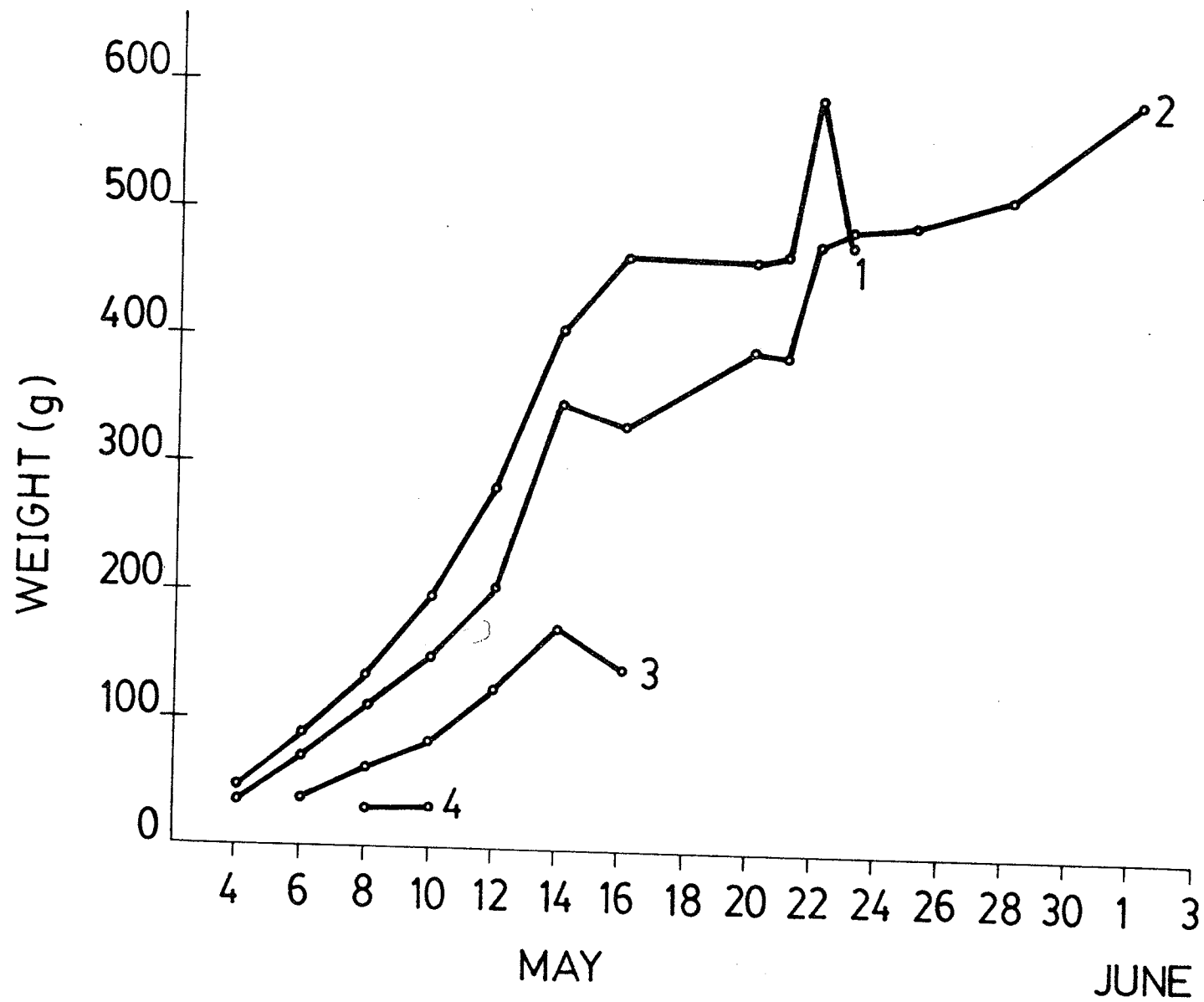


Figure 11. Tarsal lengths of nestlings at Nest E.
The numbers are hatching order.

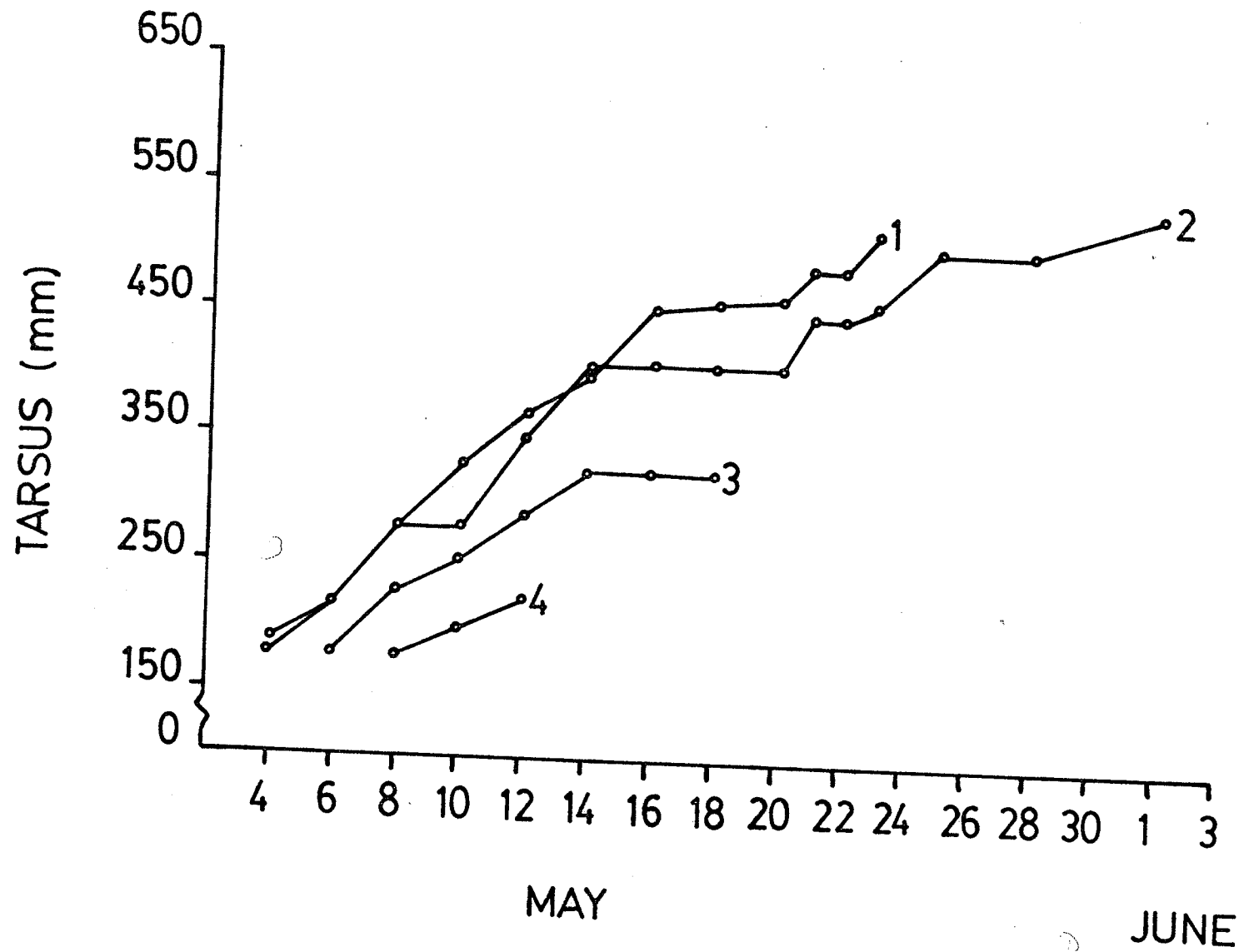
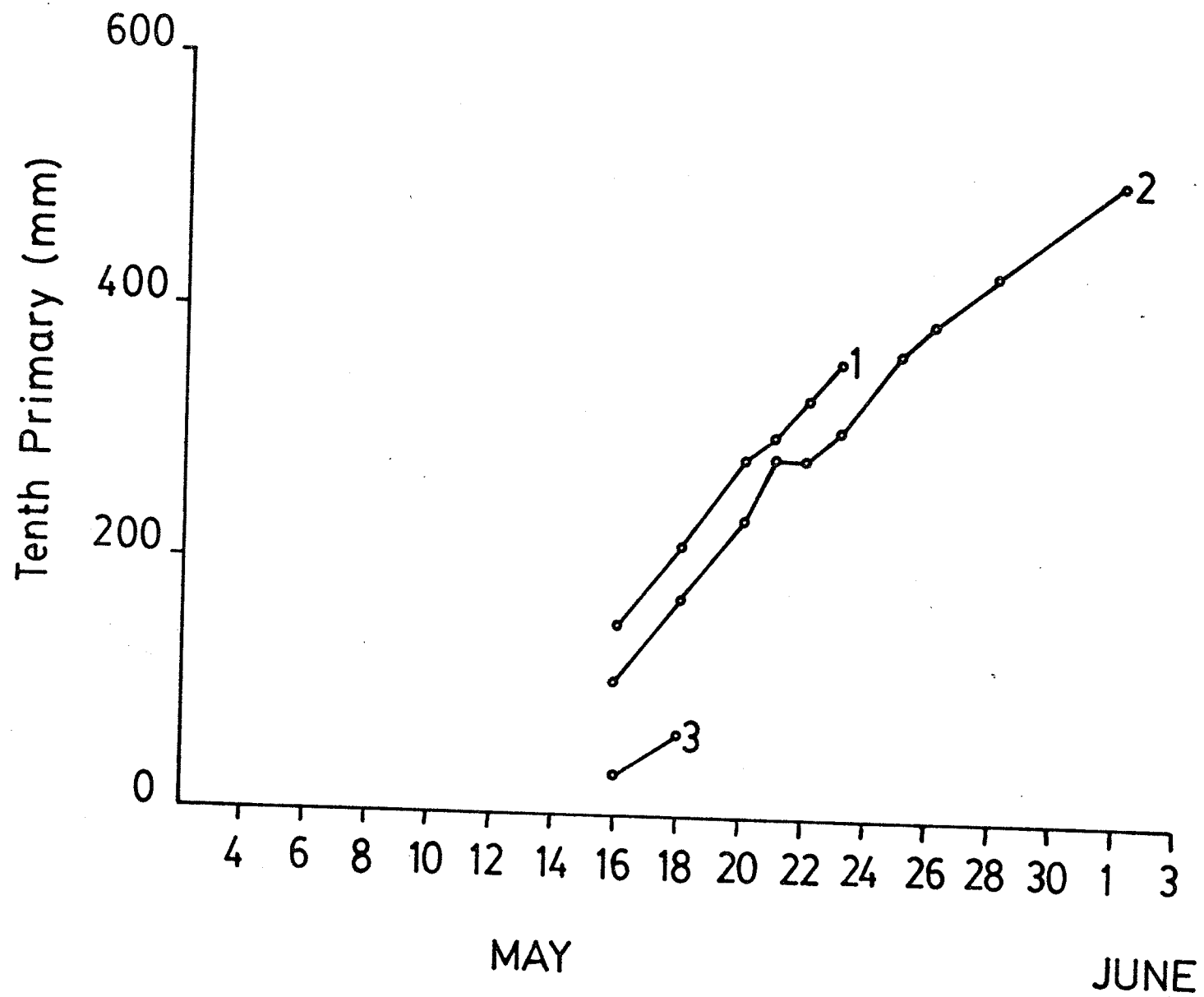


Figure 12. Tenth primary lengths of nestlings at
Nest E. The numbers are hatching order.



Fledgling Stage

According to Pettingill (1970) the term "fledgling" applies broadly to an altricial (and, presumably semi-altricial) bird from the time it leaves the nest until it becomes independent of its parents. Pettingill (1970: 371) also stated: "A young bird actually fledges (or has fledged) when it takes flight for the first time." Young Great Gray Owls leave the nest before they can fly and are dependent on the parents even after they fledge (Höglund and Lansgren 1968, Mikkola 1976, Nero 1970b). Therefore, a young Great Gray Owl may be called a fledgling once it permanently leaves the nest even though the bird may not fly for several days or more thereafter. To conform to Pettingill's (1970) terminology, I define the Fledgling Stage as that period when the young owl leaves the nest permanently and before it becomes independent of the parents. Due to the asynchrony in hatching and clutch initiation, there is some overlap of the Nestling and Fledgling Stages in any one year.

In the study area, Nero (1970b) reported on events in the Fledgling Stage. He reported that the young of this species readily climb up to 4 to 5 m in trees by using their bills, talons and wings. Nero (pers. comm.) encountered difficulty in locating young birds in the Fledgling Stage, since they apparently dispersed rapidly

from the nest. Concerning the age of first flight (fledging), Nero (1970b) observed young owls flying at about 46 days of age, whereas Oeming (1955) has seen young making short flights at about 40 days of age. In this study, I observed activities at Nests D and E until all young had left the nest. Due to the difficulty in locating birds in the Fledgling Stage, I was unable to elaborate details concerning the age of fledging or length of this stage of the breeding season.

At Nest D, Young #1 and #2 permanently left the nest on 31 May at 27 and 26 days of age, respectively. Young #3 and #4 left on 3 June (27 and 25 days old, respectively) followed by #5 on 6 June (24 days old). There were no apparent stimuli causing these young to leave the nest on any particular day. But whenever one young left, its siblings in the nest became excited. On one such occasion, I observed Young #4 hopping repeatedly from one side of the nest to the other, just after #3 had left. Approximately 30 min. later, another young at an unknown distance north of the nest was fed by the male. At the sound of this Feeding Trip, #4 became more excited and jumped across the nest, but missed the far side and fell to the ground. Once these young owls left the nest permanently, they were fed directly by the male owl. I did not see the female transfer food from the male to the fledglings.

At Nest E Young #2 was found on the ground at 16 days of age. Young #1 left the nest on 23 May (19 or 20 days old), but remained on a nearby limb of the nest tree until 5 June. This limb was approximately one m below the nest. These young left the nest earlier than the young of Nest D. However, my intermittent observations here did not reveal the cause of this phenomenon.

Vocalizations

Certain aspects of the vocal repertoire of the Great Gray Owl have been described (Berggren and Wahlstedt 1977, Blair 1962, Brunton and Pittaway 1971, Henderson 1923, Höglund and Lansgren 1968, Mikkola 1976, Muir 1972, Nero 1971, Nero et al. 1974, Oeming 1955, Wahlstedt 1969, Wechsler 1973). However, most of these authors did not use sonagrams in their analyses. Consequently, some of the vocalizations described by these authors are difficult to interpret since there is no physical basis for comparison between reports. I have prepared sonagrams for most of the vocalizations of Great Gray Owls that were heard by me in the breeding season at Nest D.

Territorial Call

This is the hooting call referred to in almost every discussion of Great Gray Owl vocalizations (Berggren and Wahlstedt 1977, Höglund and Lansgren 1968, Mikkola 1976, Nero et al. 1974, Oeming 1955, Wahlstedt 1969). It consists of several repetitions of the single note, "Hoo". These notes have a frequency range of 168-276 cps with an interval of 0.93 sec between notes (Figure 13).

In 1975 I elicited the Territorial Call from 11 Great Gray Owls by playing a tape-recording of this vocalization at selected locations in the study area. The

Figure 13. Sonagrams of some vocalizations of the
Great Gray Owl.

often aggressive response to this tape-recorded call further suggested its territorial function. On one occasion (22:45, 7 May 1975) this procedure induced two birds to begin calling to each other from approximately 0.4 km apart. This apparent territorial confrontation continued for approximately ten minutes. On another occasion (23:50, 3 May 1975) an owl responded to the tape-recording by flying twice over the speaker (the owl was about 3 m above the ground). This bird continued to give the Territorial Call intermittently for the next 90 minutes.

I have also heard the Territorial Call at Nests C, D, E and F. At Nest D it was given, apparently by the male, on two separate nights near the nest from late evening until nearly midnight. I did not hear this call given at any other times of the day nor after the eggs had hatched at this nest. I did not hear the female owl of Nest D give the Territorial Call during my 221.2 hours of observation there.

Wahlstedt (1969) suggested that this vocalization of the male owl signifies claim to a certain area. Berggren and Wahlstedt (1977) clearly defined this as the Territory Call. According to Höglund and Lansgren (1968) this call is characteristic of the male at the time of pairing and choice of a nest. My data support these findings.

Location Call

The Location Call (after Forsman 1976) of the female owl at Nest D seemed nearly identical to the Territorial Call, except that there were fewer repetitions of the basic note (between 5 and 12). The notes in this call have a frequency range of 168-313 cps with an interval of 0.87 sec between them (Figure 13).

The female owl at Nest D gave the Location Call during incubation when the male was not near the nest. It appeared that the female was attempting to establish contact with the male. The male was heard responding occasionally with the Contact Call or his Location Call.

The Location Call of the male was a shortened version of the female's Location Call (2-4 repetitions of the basic note), although there is no sonagram to support this assertion. The male owl used this call when suddenly arriving at the nest with food, apparently to announce his presence. In response, the female owl often gave her Location Call.

According to Forsman (1976: 57), the Location Call of Spotted Owls (Strix occidentalis) "...seemed to function as a general location call and as an announcement of territory." It may be that the Location Call of the female Great Gray Owl has a territorial function although my observations do not refute or support this assumption.

Berggren and Wahlstedt (1977: 245) also recorded "...A slower pattern of territory call..." that appears similar to the Location Call described above.

Contact Call

The Contact Call (after Forsman 1976) was given by both the male and female at Nest D during the Egg and Nestling Stages. It consisted of between 40 and 50 repetitions of the two-note phrase, "Doo-it". On occasion fewer repetitions were used. The notes of the male's call have a frequency range of 110-202 cps with an interval of 0.53 sec between phrases. The notes of the female's call have a frequency range of 129-212 cps with an interval of 0.53 sec between phrases (Figure 13).

The Contact Call of Spotted Owls maintains contact between the male and female (Forsman 1976). It seemed that the Contact Call of the owls at Nest D served a similar function. It was used whether or not the male was within sight of the nest. The Contact Call was heard during the day and night at Nest D and also at Nests C2, E and F.

Frequently, the male and female at Nest D used the Contact Call in an apparent duet. For up to three minutes they gave the Contact Call simultaneously from their respective locations. These duets occurred at various times of the day. According to Armstrong (1973), duetting is mutual or reciprocal song by paired birds and is supposed

to maintain contact and reinforce the pair bond (Hooker and Hooker 1969).

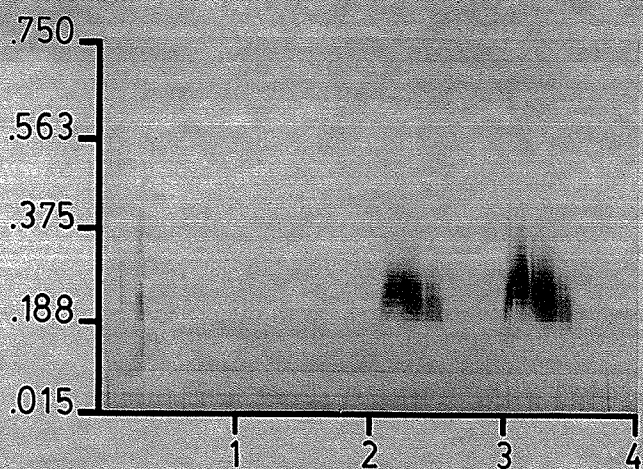
Begging Call (Female)

The female Begging Call of Great Gray Owls has been previously described as "Whoop!" or "Who-oo!" and "Shreek!" (Nero et al. 1974: 164) and has a frequency range of 109-317 cps (Figure 14). This call is given as a single phrase, and the number of repetitions and intervals between phrases seems to vary according to the time of the female's last feeding.

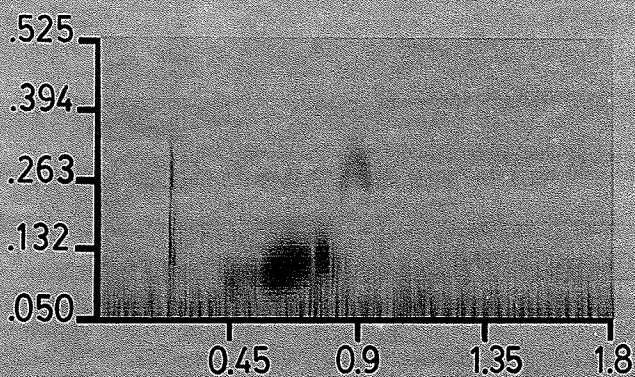
The Begging Call was always associated with a Feeding Trip or an impending Feeding Trip. During incubation at Nest D the female gave soft, low-intensity Begging Calls in late afternoon. Coincident with these calls, the male would leave his nearby roost and, presumably, begin to hunt. When he left, the female often gave a louder form of the Begging Call, in apparent anticipation of a Feeding Trip. She gave loud, high-intensity Begging Calls in rapid succession when the male approached the nest with food. If she had been fed within the past hour (approximately), she gave low-intensity Begging Calls when presented with food by the male. It seemed that the frequency and volume of the Begging Call decreased when the female was satiated.

The female Begging Call was not heard during the mid-day during incubation at Nest D. However, when the

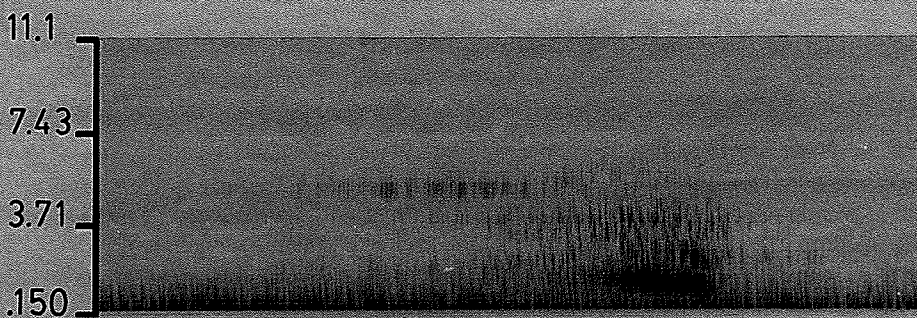
Figure 14. Sonagrams of some vocalizations of the
Great Gray Owl.



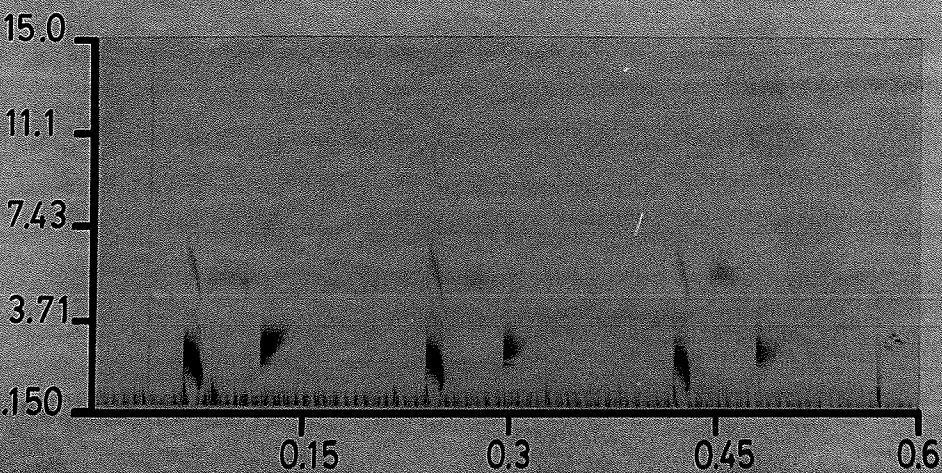
ALARM HOOT (♀)



BEGGING CALL (♀)



BEGGING CALL (YOUNG)



CHITTER (YOUNG)

FREQUENCY IN KILOHERTZ

TIME IN SECONDS

first egg started hatching, the female began the Begging Call in the morning and continued throughout the day with more intense begging. The male owl remained at his roost and responded occasionally with the Contact Call until late afternoon. By the second day after the first egg hatched the male began diurnal foraging and increased the number of Feeding Trips per day, apparently in response to the increased food demands of the female and her young (Figure 6). After all eggs had hatched the female Begging Call was heard frequently throughout the day.

Chitter

The Chitter has a frequency range of 941-7010 cps, and occurs in both the female and young birds (Figures 13 and 14, respectively). The intervals of this call are apparently related to the excitement level of the owl involved. Since this call is associated with the arrival of food, the intensity of the Chitter is presumed to be related to the food stress of the individual receiving food.

I observed both the female and the young owls of Nests D and E give the Chitter in response to a Feeding Trip. When the female or a young owl received food from the male, that bird gave the Chitter. If the owl was excited (presumably hungry), it gave the Chitter as it swallowed the prey and continued this call at a low

intensity for some time after the meal. Excited birds that had not been fed recently often gave the Chitter in anticipation of a meal, even as they begged. Consequently, there is (at times) a confusing juxtaposition of the Begging Call and the Chitter in both the female and young owls, such that the Chitter might have been mistaken for a begging call. However, the Chitter generally occurred during or after the transfer of food between the male and female, male and young, or female and young. The female at Nest D often gave a low-intensity Chitter while brooding the young. It appeared that this call was given while the female was dismembering prey items in the nest.

Berggren and Wahlstedt (1977: 248) have identified a "fast begging call" in young owls and an "excited feeding call" in the female owl. I believe these vocalizations correspond to the Chitter, as described above.

Begging Call (Young)

Young Great Gray Owls also give a Begging Call, although this call does not sound much like that of the female. The frequency range of this call is 546-4537 cps (Figure 14). The young at Nest D gave Begging Calls during both the Nestling and Fledgling Stages. Fledglings were observed giving the Begging Call at all times of the day. The male responded positively to these calls and often

ignored young begging from the nest. As with the female Begging Call, the intensity of begging of the young appeared to be related to the food stress of the individual involved. Nero et al. (1974: 164) suggested that the food-begging call of young owls consisted of "low chattering notes or Twittering" and "Shreek!" (given by older young). This description matches the vocalization that I have interpreted as the Chitter. My observations at Nests D and E indicate that young Great Gray Owls give a Begging Call that is distinct from the Chitter (Figure 14).

Whistle

One day prior to hatching of the fifth egg of Nest D, a whistle or "peep" was heard from within the egg at three-second intervals during my 11 min visit to the nest. This sound was never heard after hatching.

Alarm Hoot

Infrequently, the female at Nest D gave a call consisting of one or two loud, excited "hoots". The frequency range of this call is 188-375 cps (Figure 14). Most often, this call was given in response to human disturbance at the nest, although the presence of a Great Horned Owl near the nest once elicited the same response. I was unable to determine how the male owl responded to the female's Alarm Hoot. I did not hear the male use this

vocalization.

Bill-snap

The Bill-snap is a common, non-vocal utterance of many owl species (Bent 1938, Clark 1975, Martin 1973). I observed female and young Great Gray Owls Bill-snapping in response to human disturbance. The intensity of this response (as indicated by the number of successive Bill-snaps) varied according to the duration of the disturbance. Agitated Bill-snapping of the young at Nest D resulted in the female owl Bill-snapping and Hissing in an aggressive fashion at the intruder.

Hiss

The Hiss is also a characteristic utterance of many owl species (Clark 1975). My observations at Nest D indicate that the Hiss was a more aggressive response than the Bill-snap in Great Gray Owls. The combination of the Hissing and Bill-Snapping of the young owls at this nest often resulted in the female attacking the intruder.

Distraction Display

A Distraction Display or injury-feigning by adult birds to protect young has been described by Clark (1975) in male Short-eared Owls, by Bird and Wright (1977) and Peterson (1977) in Barred Owls (Strix varia), and reported in Great Horned Owls by Bent (1938), Davis and Husband (1976) and Fyfe (1959). Wahlstedt (1969) mentions behaviour of a female Great Gray Owl in Sweden that may have been an attempt to lure an intruder away from the young. Mikkola (1976) described an injury-feigning behaviour in both male and female Great Gray Owls at a nest in Finland. R. W. Nero has observed a Distraction Display in Great Gray Owls in the study area (Nero in litt. 1980). My observations of the Distraction Display are described below.

On 24 May 1976 I observed the female owl at Nest D exhibit a behaviour similar to the Distraction Display described by Mikkola (1976). After an attempted attack on the observer, the female owl flew to a perch (about 3 m high) about 20 m north of the nest tree. Her initial vocalization was a very loud, excited, but somewhat distorted version of the Chitter. Immediately after this call, she gave three or four loud "hoots" which resembled a distorted version of the Begging Call. While giving these "hoots", her beak was held in a gaping position. During this performance the female held her body in a lowered,

hunched position with the wings stretched and drooped along the body towards the feet. When approached by the observer, she flew about 10 m further from the nest tree. Upon reaching her new perch (also about 3 m high), the owl looked directly at her pursuer and then repeated the entire performance again. As I returned to the nest tree, the Distraction Display ceased. This behaviour was observed in the same bird again on 25 and 28 May 1976. On 8 June 1976 I observed (in company with R. W. Nero) a similar Distraction Display by the female at Nest F. On this occasion the female perched on a low stump and attracted my initial attention by flapping her wings against the base of the stump and nearby branches. The presence of a dog near this nest appeared to cause this Distraction Display. In this study the Distraction Display was observed only four times, and only during the Nestling Stage.

FOOD AND WINTER HUNTING BEHAVIOUR OF THE GREAT GRAY OWL

Analyses of the food habits of the Great Gray Owl (Craighead and Craighead 1969, Fisher 1893, Höglund and Lansgren 1968, Mikkola 1972, Mikkola and Sulkava 1970, Nero 1969, Oeming 1955) demonstrated conclusively that voles, lemmings, mice (Cricetidae) and shrews (Soricidae) are the major prey items taken throughout the year.

There are occasional reports of other prey being taken. Allen (1904), Craighead and Craighead (1969) and Fisher (1893) reported that birds are eaten infrequently by Great Gray Owls. Also, Mikkola (1972) found one beetle (Coleoptera) and two snails (Gastropoda) in pellets of this species. It is evident from a review of the available literature that the Great Gray Owl takes these sorts of prey only infrequently.

The most extensive information on food habits of the Great Gray Owl is available for Sweden (Höglund and Lansgren 1968) and Finland (Mikkola and Sulkava 1970, Pulliainen and Loisa 1977). Of the 1,977 prey items from Sweden, 94% were Cricetidae and 5% were Soricidae, with the remaining 1% comprised of 16 birds and four frogs. Mikkola and Sulkava (1970) found 94.3% Cricetidae and 3.6% Soricidae in 2,049 prey items, while the remaining 2.1% was comprised of six other mammals, 40 birds and 13 frogs. Pulliainen and Loisa (1977) found 97.5% Cricetidae

and 2.5% Soricidae in 121 prey items.

In Manitoba, Nero (1969) reported that of 46 prey items from two pellets and at least seven stomachs from winter birds, 67.4% were Cricetidae, 30.4% Soricidae and 2.2% Muridae. In another study of 88 pellets collected from the study area by Nero, Copland and Taylor (mostly during the breeding season), R. E. Wrigley found 359 prey items comprised of 99.7% Cricetidae and 0.3% Talpidae (R. W. Nero in litt. 1976). A study of 28 pellets collected in the study area (primarily during the breeding season) by Nero, Copland and Sealy revealed 127 prey items comprised of 97.6% Cricetidae, 0.8% Soricidae and remains of a Snowshoe Hare (Lepus americanus), an Ermine (Mustela erminea) and a small bird (R. W. Nero in litt. 1980).

These data from the study area reveal that Great Gray Owls depend largely on a prey base of small mammals, primarily in the families Cricetidae and Soricidae. In this study, I examined the behaviour of Great Gray Owls as they attempted to exploit this prey base in winter.

Methods

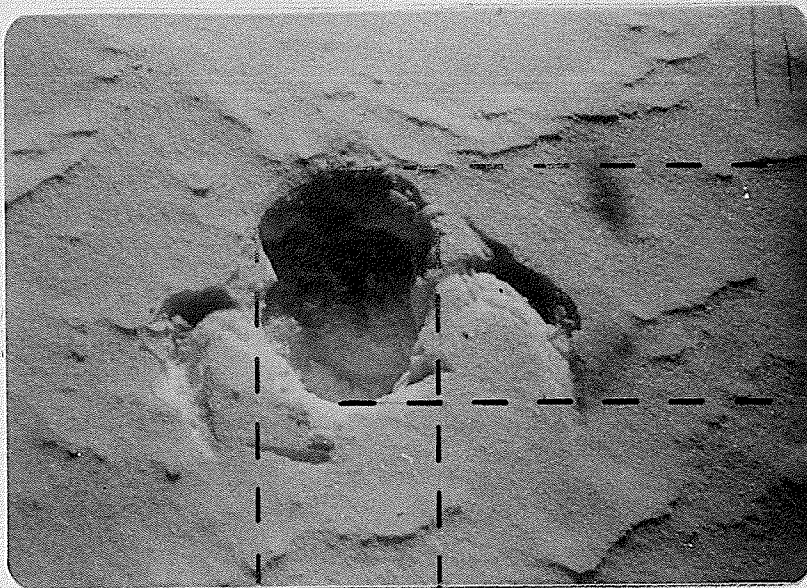
I observed Great Gray Owls hunting on 23 January, 22-23 February, and 8, 18 and 22-24 March 1976. I measured the length, width and depth of recently made plunge-holes located in the study area (Figure 15). Snow thickness and the greatest vertical hardness within the snow column were measured to assess the effects of snow cover on winter hunting behaviour of Great Gray Owls. These snow parameters were measured at 54 sites where Great Gray Owls had attempted to capture prey on or under the snow surface. Snow parameters were measured with equipment similar to that provided in the National Research Council Snow Kit (Klein et al. 1950). The snow hardness gauges were constructed by J. Butler of Lakehead University. Statistical tests follow Sokal and Rohlf (1969).

Results and Discussion

In summer, Great Gray Owls hunt from a perch 1-4 m high, repeatedly moving from one tree or stump to another in search of prey that is apparently located by coordination of visual and acoustical cues (Oeming 1955, Wahlstedt 1969). I observed similar foraging behaviour in owls in winter.

The accumulation of snow on the ground reduces the access to prey afforded to Great Gray Owls in winter.

Figure 15. Great Gray Owl plunge-holes (photographs courtesy of D. A. Sexton). The marks lateral to the main hole are impressions of portions of the wings.



length

width



The snow layers conceal small mammals, and allow them to travel along the ground with relative impunity from most avian predators (Formosov 1946). Small mammals are vulnerable to predation when they construct ventilator shafts in the snow (Formosov 1960), or when they cross the snow surface on warm days. But these animals are relatively safe from avian predators while under the snow.

Great Gray Owls exhibit an uncommon adaptation which permits them to prey on small mammals in winter. They capture prey by plunging headfirst into the snow. Although there is evidence that some prey are taken on the snow surface (McNicholl and Scott 1973), this snow plunging behaviour is probably the primary winter hunting technique used by Great Gray Owls in North America.

Of the two hunting methods of the Great Gray Owl that I have observed in winter, plunging and surface capture, only the snow plunging leaves an identifiable mark on the snow surface (the plunge-hole). Measurements of 53 of these plunge-holes are in Table 7.

Many plunge-holes measured in 1976 were found in extremely hard snow (greatest vertical hardness up to 3500 g/cm^2 , see Table 7). The variations in quality of snow cover induced by temperature and wind (Klein et al. 1950) are known to have considerable effect on the behaviour and survival rate of many mammals (Coady 1974, Formosov 1946, Pruitt 1959). It may be that variations in

Table 7. Measurements (cm) of Great Gray Owl plunge-holes, 1976.

| LOCATION | DATE | LENGTH | WIDTH | DEPTH | SNOW THICKNESS | GREATEST VERTICAL HARDNESS OF SNOW LAYERS (g/cm ²) |
|--------------------------------|-------------|--------|-------|-------|----------------|---|
| 5 km south of Spruce Siding | 24 January | 34 | 22 | 28 | 48 | 22 ¹ |
| " | " | 29 | 18 | 20 | 44 | 22 ² |
| " | " | 35 | 23 | 16 | 47 | 22 ² |
| " | " | 33 | 21 | 20 | 47 | 22 |
| " | " | 37 | 21 | 20 | 49 | 22 |
| " | 25 January | 34 | 18 | 20 | 47 | 22 ² |
| " | " | 30 | 28 | 27 | 48 | 22 ² |
| " | " | 44 | 24 | 31 | 43 | 22 |
| " | " | 28 | 17 | 33 | 50 | 22 |
| 8.5 km sw of Hadashville | 31 January | 44 | 23 | 23 | 57 | 20 ² |
| 5 km east of Marchand | 22 February | 17 | 12 | 20 | 38 | 3500 ³ |
| " | " | 18 | 10 | 17 | 32 | 3500 |
| " | " | 19 | 15 | 17 | 41 | 3500 |
| " | " | 13 | 17 | 22 | 35 | 3500 |
| " | " | 27 | 17 | 24 | 41 | 3500 |
| " | " | 21 | 17 | 22 | 38 | 3500 |
| " | " | 7 | 7 | 19 | 25 | 3500 |
| " | " | 24 | 10 | 14 | 24 | 3500 |
| " | " | 20 | 10 | 20 | 26 | 3500 |
| " | " | 21 | 18 | 20 | 40 | 3500 |
| " | " | 9 | 8 | 18 | 34 | 3500 |
| " | " | 19 | 14 | 22 | 31 | 3500 |
| " | " | 13 | 8 | 16 | 31 | 3500 |
| " | " | 24 | 18 | 19 | 38 | 3500 |
| " | " | 20 | 17 | 28 | 41 | 3500 |
| " | " | 21 | 15 | 19 | 35 | 3000 ² |
| " | " | 12 | 8 | 22 | 33 | 3000 |

| | | | | | | |
|--------------------------|-------------|----|----|----|----|--------------------------|
| 5 km east of Marchand | 22 February | 17 | 15 | 18 | 35 | 3000 |
| " | " | 10 | 8 | 18 | 40 | 3000 |
| " | " | 16 | 14 | 19 | 41 | 3000 |
| " | " | 16 | 14 | 19 | 41 | 3000 |
| " | " | 18 | 13 | 15 | 71 | 3000 |
| " | " | 14 | 16 | 26 | 37 | 3000 ² |
| " | " | 15 | 11 | 24 | 41 | 3000 |
| " | " | 18 | 11 | 15 | 48 | 3000 |
| " | " | 18 | 12 | 30 | 35 | 3000 |
| " | " | 17 | 13 | 15 | 47 | 3000 |
| " | " | 21 | 12 | 27 | 49 | 3000 |
| " | " | 21 | 13 | 20 | 37 | 3000 |
| " | " | 17 | 11 | 17 | 59 | 3500 |
| " | " | 28 | 17 | 21 | 37 | 200 |
| " | " | 25 | 14 | 17 | 35 | 3500 |
| " | " | 24 | 11 | 15 | 45 | 3500 |
| " | " | 18 | 15 | 24 | 42 | 3500 |
| " | " | 24 | 18 | 23 | 40 | 3500 |
| " | " | 26 | 20 | 24 | 41 | 3500 |
| " | " | 17 | 16 | 17 | 40 | 3500 |
| " | " | 26 | 14 | 28 | 51 | 3500 |
| " | " | 20 | 8 | 14 | 38 | 3500 |
| " | " | 32 | 19 | 25 | 48 | 3500 |
| " | " | 32 | 18 | 21 | 42 | 3500 |
| " | " | 16 | 18 | 22 | 42 | 3500 |
| " | " | 27 | 16 | 23 | 43 | 3500 |
| East Braintree | 8 March | 26 | 18 | 13 | 42 | 3500 ² |
| " | 18 March | 70 | 15 | -- | -- | 35 ² |
| " | " | 18 | 16 | 18 | 41 | (surface capture) 300 |

¹For soft snow (20-300 g/cm²), mean width = 20.5 cm, s.d. = 3.5, n = 13; mean length = 32.3 cm, s.d. = 7.1, n = 13; mean depth = 22.3 cm, s.d. = 5.9, n = 13.

²Indicates blood found in plunge-holes.

³For hard snow (3000-3500 g/cm²), mean width = 13.6 cm, s.d. = 3.6, n = 41; mean length = 19.4 cm, s.d. = 5.6, n = 41; mean depth = 20.4 cm, s.d. = 4.1, n = 41.

vertical hardness of the snow cover affects the snow plunging behaviour of Great Gray Owls. It is evident that the plunge-holes in hard snow ($3000-3500 \text{ g/cm}^2$) were smaller than those in soft snow ($20-300 \text{ g/cm}^2$), since the mean length of the plunge-hole in soft snow was greater ($t = 6.81$; 52 df; $P < 0.001$), as was the mean width ($t = 6.06$; 52 df; $P < 0.001$). Snow hardness had no apparent effect on the depth of the plunge-hole ($t = 1.31$; 52 df; NS).

In hard snow, often only the bird's feet penetrated the hard crust, and the owl's face would only leave an impression on the snow surface. In soft snow, the entire bird often penetrated at least the upper snow layers. It seems, therefore, that hard snow presents some impediment to the snow plunging behaviour of Great Gray Owls, but the actual effects of snow quality on the efficiency of this foraging technique are unknown.

Snow plunging by Great Gray Owls and the resultant plunge-holes have been observed previously in Alberta by F. Schutz (pers. comm.) and A. F. Oeming (pers. comm.) and reported by Payne (1971) and Salt and Salt (1976). Law (1960) also reported a winter hunting behaviour of the Great Gray Owl in Saskatchewan that may have been snow plunging. Plunge-holes of the Great Gray Owl are also mentioned in the chronicle, "Andrew Graham's Observations on Hudson's Bay 1767-1791" (Williams and Glover 1969). Nero and co-workers have observed this behaviour in owls

in the study area on many occasions (pers. comm.). This behaviour may also occur in the Tawny Owl (Strix aluco), Short-eared Owl, Long-eared Owl (Asio otus) and Boreal Owl (Curry-Lindahl 1978).

I observed snow plunging by Great Gray Owls eight times. From these observations, the behaviour may be described thus. While hunting from a perch, the owl appears to observe the snow surface in the nearby area. Immediately prior to a plunge, the bird directs its attention to a particular spot on the snow. The owl characteristically "stares" at a certain spot on the snow. The object of the owl's attention is not apparent to the observer, since no small mammal is visible on the snow surface. It may be that the potential prey item is at the opening of a ventilator shaft immediately below the snow surface and therefore visible to the owl. However, observations by Tryon (1943) and Payne (1971) suggested that the Great Gray Owl may have the ability to locate prey solely by the use of acoustical cues. Thus, it may be that the Great Gray Owl does not have to see the prey prior to the snow plunge. When the general position of the prey item is located, the owl leaves the perch and hovers momentarily above the selected site on the snow. During the plunge, the wings are folded approximately half-way to the body and the head and "facial discs" (feathers with a pattern of concentric rings around the eyes) are

pointing downwards. After impact with the snow surface, the feet are moved forward to grasp the prey. This movement of the feet leaves characteristic marks at the rear and bottom of the plunge-hole. Some birds almost disappear beneath the snow, leaving only their wingtips exposed. If the owl catches prey with this method, the prey is transferred from talon to bill, usually while the bird is still standing in the plunge-hole. Occasionally, the bird will stand on the snow surface beside the plunge-hole before flying to a perch. An observer can often determine the success of a plunge, since the owl usually swallows the prey while standing in or beside the plunge-hole. I have seen birds capture prey with this technique, but subsequent investigation of the plunge-hole did not reveal any traces of blood as evidence of a successful capture. Consequently, blood found in two of nine plunge-holes (22%) in one hunting area (5 km south of Spruce Siding) indicates only a minimum success rate (Table 7). It is likely that this hunting technique is more efficient than indicated by these data.

POPULATION MOVEMENTS OF THE GREAT GRAY OWL IN NORTH AMERICA

Irregular, large-scale movements of bird populations are called irruptions (Nethersole-Thompson 1975, Newton 1970, Ulfstrand 1963). There are several irruptive species of owls in North America, including the Hawk Owl (Surnia ulula), Snowy Owl, Boreal Owl, Short-eared Owl and Great Gray Owl (Bent 1938, Catling 1972, Clark 1975, Nero 1969). I have examined records of occurrence of the Great Gray Owl in North America with the view of portraying the years of irruptions and discussing aspects of the irruptive phenomenon in this species.

Methods

A detailed search of the literature provided information on records of occurrence of Great Gray Owls in North America. I considered specimen and sight records for this analysis. Unpublished data on specimen records were obtained by corresponding with curators of 293 museums in North America. Also, seven ornithological journals carried requests for unpublished information on sight records. Dr. R. W. Nero donated voluminous data from his exhaustive collection of specimen and sight records from Manitoba.

To determine the years of large-scale population movements, I tabulated most of the available specimen and sight records of the Great Gray Owl in North America. To

determine the apparent preponderance of Great Gray Owls in certain areas in particular winters (and thereby pinpoint winters of large-scale population movements or irruptions), it was necessary to portray graphically the total number of records with respect to a particular time interval which encompassed the winter months. Since the irruption phenomenon in this species may be related to the approximate end of the Fledgling Stage, I chose August as the first month of the 12-month interval. Consequently, the available Great Gray Owl records in the 12-month period from August to July, inclusive, were graphed from August 1889 to July 1976 (Figures 16, 17, 18, 19, 20). Each 12-month period is represented by the year in which 1 January for that period occurs. For example, the period from August 1889 to July 1890 is represented by the year 1890.

The numbers of observers with access to Great Gray Owl habitat have varied considerably in North America in the 86 years considered in this analysis. Currently it is not uncommon to receive reports of 20 different sightings of Great Gray Owls from all of North America in one winter. But 20 records of this species at the turn of the century would represent an uncommon occurrence of Great Gray Owls. Therefore, to determine which years had an apparent abundance of records, it is necessary to compare between years of most similar observer effort. To account for the

Figure 16. Records of the Great Gray Owl, 1890-1909.
 (Solid bars indicate number of records,
 broken horizontal line indicates the
 critical level for irruption.)

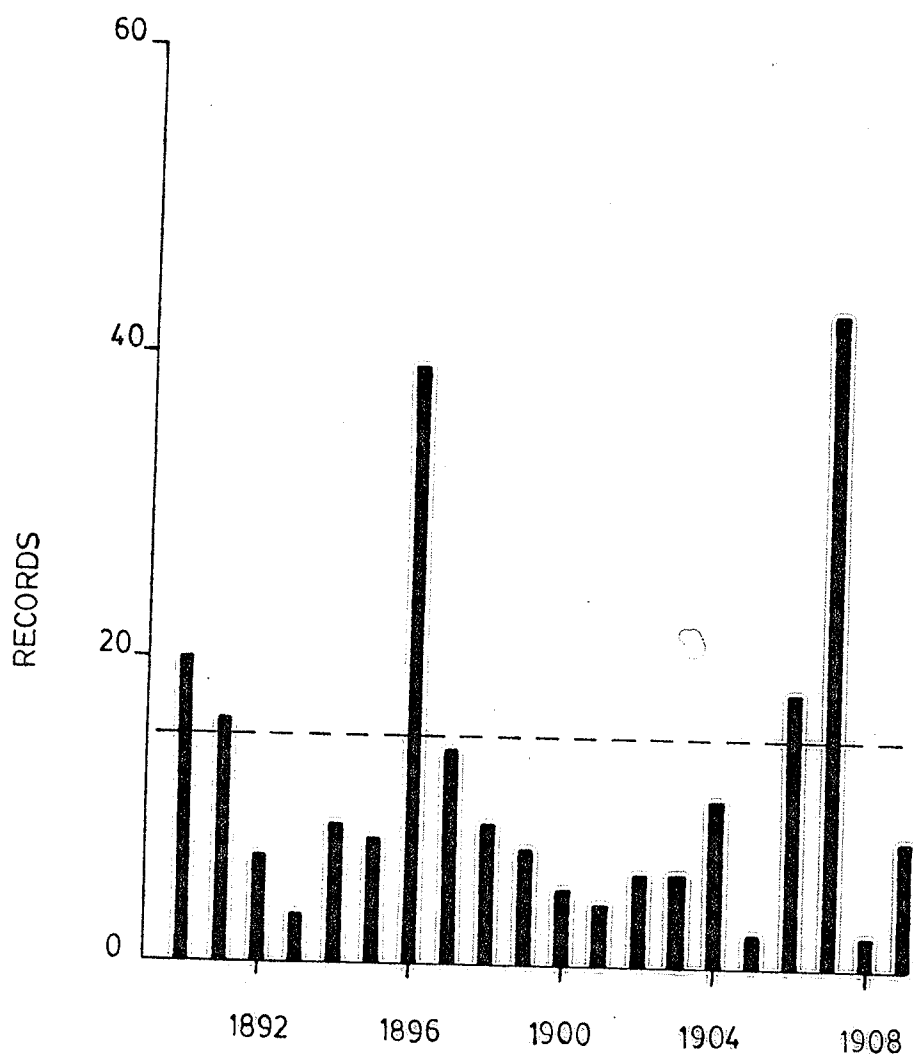


Figure 17. Records of the Great Gray Owl, 1910-1929.

(Solid bars indicate number of records,
broken horizontal line indicates the
critical level for irruption.)

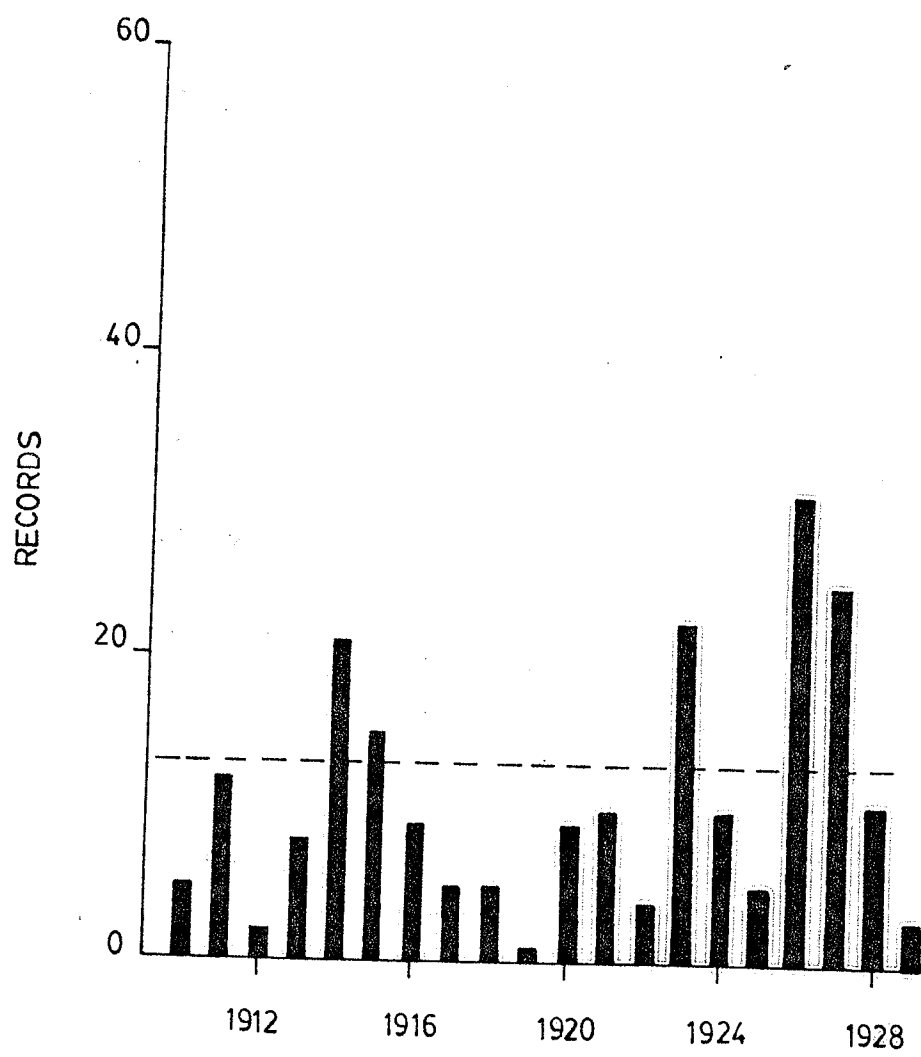


Figure 18. Records of the Great Gray Owl, 1930-1949.
(Solid bars indicate number of records,
broken horizontal line indicates the
critical level for irruption.)

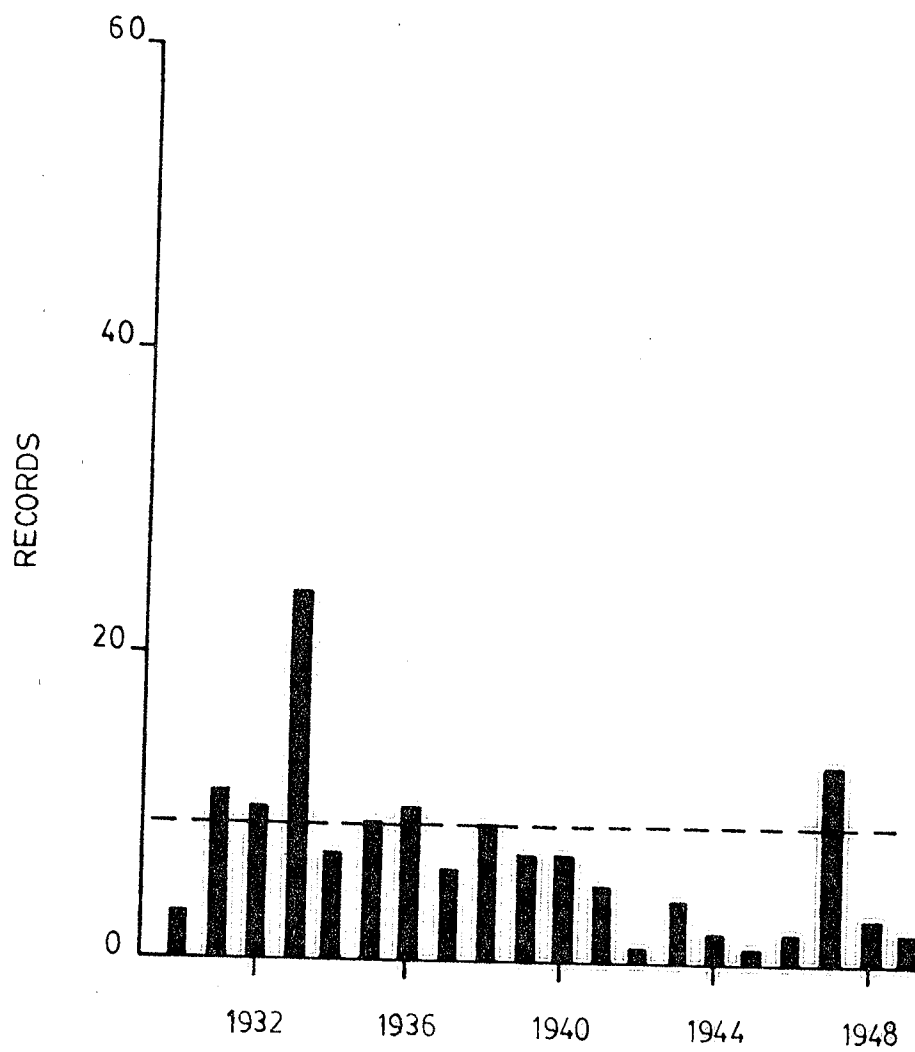


Figure 19. Records of the Great Gray Owl, 1950-1969.
(Solid bars indicate number of records,
broken horizontal line indicates the
critical level for irruption.)

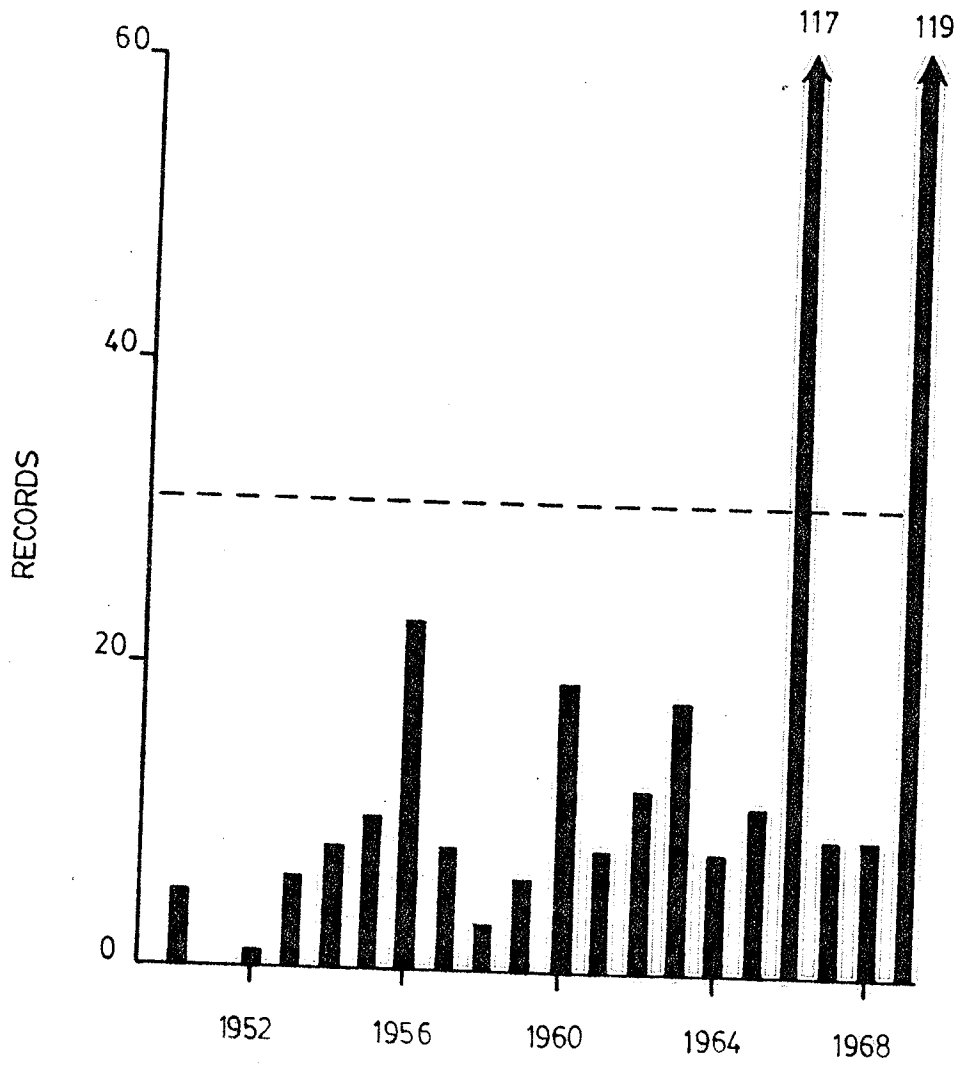
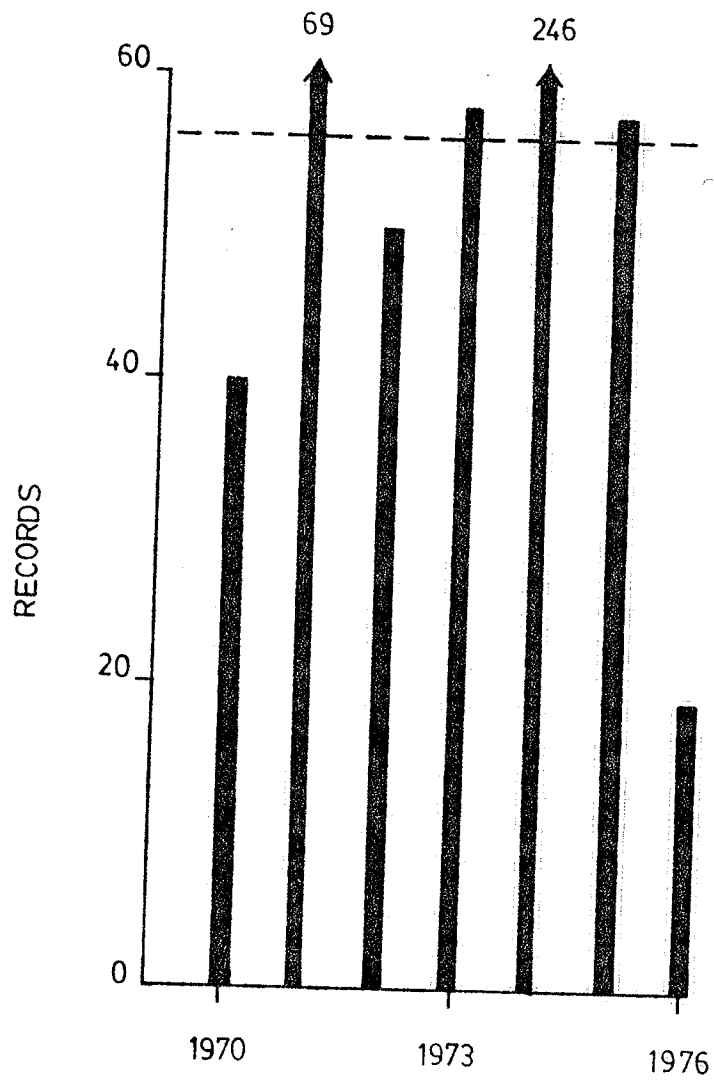


Figure 20. Records of the Great Gray Owl, 1970-1976.
(Solid bars indicate number of records,
broken horizontal line indicates the
critical level for irruption.)



extreme variation in observer effort between 1890 and 1976, I have considered the records in terms of 20-year blocks.

I have attempted to identify those years in which irruptions definitely occurred. There exists a certain number of records within each 20-year block that must serve as the criterion for this assessment. Those years within each block exceeding this critical number of records were assumed to represent years of large-scale population movement (i.e. an irruption). I have considered the critical criterion to be the mean number of records plus the standard error for each mean within each 20-year block. Therefore, the critical criterion for each period is established as follows: 1890-1909, more than 15 records; 1910-1929, more than 13 records; 1930-1949, more than nine records; 1950-1969, more than 31 records; and 1970-1976, more than 56 records. To avoid an over-estimate for the last period (only seven years), I did not include the extremely high number of records for the winter of 1974 in the calculation of the critical criterion for this period.

A number of records were not used in this analysis (Appendix III, IV). Many specimens were not labelled with the proper date or location, or otherwise lacked the appropriate data. Also, many birds may have been seen by more than one observer on several different days. Consequently, I have obtained many published and unpublished

reports that undoubtedly referred to the same bird. To eliminate duplication of records, I have tabulated the minimum number of records for each winter. Consequently, some winters may have a few more records than I have indicated here.

Results and Discussion

The large-scale movement of a population of Great Gray Owls into an area may be called an influx (Nero 1969) or an invasion (Nethersole-Thompson 1975, Newton 1970). In order to conform to the available literature on many irruptive species (Myserud 1970, Nethersole-Thompson 1975, Ulfstrand 1963), I use the term "irruption" to refer to the large-scale movement of Great Gray Owls, whereas the term "invasion" refers to a movement into a specific area.

The winters of invasion of Great Gray Owls in North America since 1890 includes at least 23 years: 1890, 1891, 1896, 1897, 1906, 1907, 1914, 1915, 1923, 1926, 1927, 1931, 1932, 1933, 1936, 1947, 1951, 1966, 1969, 1971, 1973, 1974 and 1975. Due to the intermittent published information of the 1800's, I have only been able to determine one prior invasion winter, 1843.

Most of these invasions included a relatively small portion of the continent (Table 8). But in a few winters, notably 1890, 1907, 1966, 1969 and 1974, the

Table 8. Years of large-scale invasions of the
Great Gray Owl in North America.

| YEAR | REGION INVADED |
|------|---|
| 1843 | Massachusetts |
| 1890 | Ontario, Quebec, Maine, New Hampshire, New Jersey |
| 1891 | Maine, Massachusetts |
| 1896 | Alberta |
| 1897 | Manitoba, Minnesota |
| 1906 | Manitoba, Minnesota |
| 1907 | Manitoba, Vermont, New York, Maine, Connecticut |
| 1914 | Alaska |
| 1915 | Alberta, Ontario |
| 1923 | Minnesota, Michigan |
| 1926 | Minnesota |
| 1927 | Minnesota |
| 1931 | Alberta |
| 1932 | Minnesota |
| 1933 | Minnesota |
| 1936 | Minnesota |
| 1947 | Ontario |
| 1951 | Michigan, Ontario |
| 1966 | Ontario, Quebec, Minnesota |
| 1969 | Manitoba, Minnesota, Wisconsin |
| 1971 | Manitoba, Ontario |
| 1973 | Quebec |
| 1974 | Manitoba, Quebec, Ontario, Saskatchewan, Alberta |
| 1975 | Manitoba |

invasion of this species was extremely widespread and coordinated over large areas. Probably the largest irruption in North America occurred in 1974 when large numbers of birds invaded areas across Canada from Alberta to eastern Quebec.

Most often invasions of the Great Gray Owl occur as a movement into a localized area. Such an invasion may encompass several States but does not nearly approach the area involved in the major invasions. For example, the irruption of 1971 involved only central and southeastern Manitoba. Although birds were prevalent in these areas, the invasion was not otherwise widespread. This sort of movement seems to represent the intermediate stage in the order of magnitude of Great Gray Owl irruptions.

On a lesser order of magnitude, there have been winters in which Great Gray Owls were frequently seen in certain areas, but not in sufficient numbers to meet the criterion of an invasion. For example, in the winter of 1970 in southeastern Manitoba there appeared to be a minor "influx" of Great Gray Owls (Nero 1970a). On a continental basis, the number of birds seen in this winter did not meet the criterion to qualify as an irruption. Nonetheless, Great Gray Owls were often seen throughout southeastern Manitoba in this period. This phenomenon is an aspect of Great Gray Owl irruptions not apparent in a continental comparison. That is, extremely local movements of this

species may actually represent an irruption of the lowest order of magnitude. I suggest that there exists a continuum of events that result in the variety of phenomena exhibited by Great Gray Owl populations, ranging from non-irruptive events to small irruptions, and, in the extreme cases, the large-scale irruptions and widespread invasions.

The Boreal Owl is the only owl species in which the irruption phenomenon is understood. According to Mysterud (1970: 49), the movements of this species in northern Eurasia are "multi-annual in nature with the dispersion pattern evolving as a direct adaptation to the three-four year cycle and the regional variability found in the secondary production of small mammal biomass inside the 'taiga' ecosystem." Apparently the phenomenon of Boreal Owl irruptions and the causative microtine population cycles closely resemble the irruptions of the crossbills (Loxia sp.) as related to the cone-crop cycles (Bock and Lepthien 1976). In both cases a non-residential population of birds (presumably originating from an area of food stress) invades an area of food abundance. During the subsequent "stationary phase" in Boreal Owl irruptions, Mysterud (1970: 53) hypothesizes a "survival limit" and a "reproduction limit" of food supply such that the population of owls may not necessarily breed in the invaded area. The population may continue to disperse until it reaches an area where the

reproduction limit of food supply is achieved and breeding can occur. This model accounts for emigration from the initial breeding grounds, but does not deal with extra-limital records of birds in areas where breeding never occurs. Since invasions of Great Gray Owls may often occur in areas where this species does not usually breed (such as southern Ontario and New England), Mysterud's model does not readily explain the irruption phenomenon in this species.

Svårdson (1957) suggested the "pendulum" theory to explain irruptive movements of birds. According to this theory, populations move in an east-west plane, stopping to breed in areas of abundant food supply. When an eastern geographical barrier is reached, the migration is reversed. Similarly, the westward movement is reversed when a western barrier is met. Ulfstrand (1963) criticized the pendulum theory and suggested a more circular migration route for irruptive species in Eurasia. But neither of these theories can account for the movements of the Great Gray Owl in North America, where irruptions are frequently in a southerly or southeasterly direction and geographical barriers are seldom encountered. It is clear that a different hypothesis must be developed in order to account for all the variations in magnitude of the Great Gray Owl invasions and the many extra-limital records.

By definition, a Great Gray Owl irruption is an adaptation to annual (or multi-annual) variation in food supply (Svårdson 1957). In other words, the birds are moving in response to food stress. As a food specialist preying mainly on small mammals (primarily Cricetidae), the Great Gray Owl must certainly be adapted to any recurrent variations in food supply, particularly since the microtine prey base demonstrates such well-known and dramatic cyclic fluctuations in abundance (Chitty 1960; Elton 1924, 1942; Kalela 1962; Krebs and Myers 1974; Pruitt 1968; Stenseth 1978; Tamarin 1978; Tamarin and Krebs 1969). This marked dependency of Great Gray Owls on an extremely variable prey base is of central importance to the elucidation of certain biological phenomena in this species, particularly the population movements.

The Great Gray Owl Model

The variability in breeding effort and subsequent variability in production of Great Gray Owls in any one year may be coordinated over large geographical areas. If this is true, then certain large areas of the breeding range may experience high Great Gray Owl production, moderate production or little or no production in particular years, depending on the abundance of prey. As fall and winter approach, the microtine populations may remain stable or decline in relation to their status of the previous spring.

The effects of the winter density of prey on the population movements of Great Gray Owls depend largely on the size of the winter Great Gray Owl population as determined by the prey densities of the previous spring and summer. The following cases are examples of events that may lead to population movements of three different orders of magnitude.

Case I

If spring and summer prey densities have induced major Great Gray Owl reproduction throughout much of the breeding range, then a crash of the prey base will initiate large-scale population movements. These large irruptions resulting in many extra-limital records occur infrequently and represent the largest order of magnitude in population movements.

Case II

If spring and summer prey densities have caused little or no Great Gray Owl reproduction, then an autumn rise or the winter stability of the prey base will not result in a Great Gray Owl irruption. Recent observations in Sweden indicate that Great Gray Owls are residential and exhibit breeding area fidelity for at least four years (Wahlstedt 1976). Consequently, birds probably remain on or at least near their territory in these winters when food stress does not induce movement.

Case III

This is the intermediate situation in which there is a winter of moderate food stress after a spring and summer of moderate Great Gray Owl production. In such a winter, there is local movement of birds within the breeding range to exploit the higher prey density along the "edge" areas such as road-side ditches, railway rights-of-way or clear-cut areas. These areas in early successional stages may also be exploited by Boreal Owls (Myserud 1970). This sort of movement tends to make the Great Gray Owl more visible to observers and accounts for apparent increases in abundance within the breeding range. In these winters there may also be extra-limital juvenile dispersal and resultant small invasions in areas beyond the breeding range. I suggest that this sequence or a similar sequence of events results in the more frequent smaller invasions seen in several winters since 1890 (Table 8).

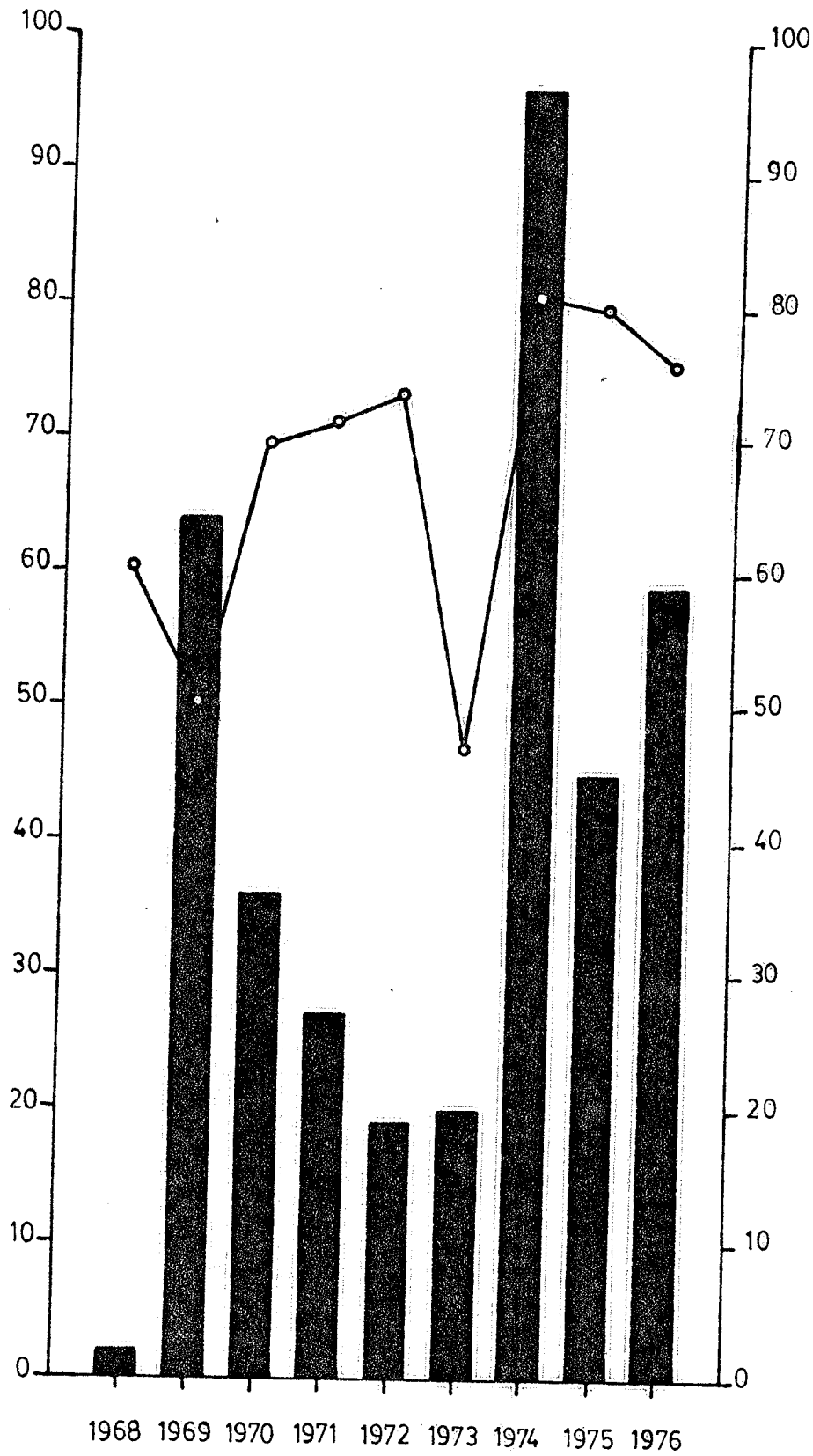
I believe that these three cases are representative occurrences along a continuum of events between non-irruptive years and winters of massive irruptions. Obviously, there are many combinations of events that may lead to irruptions of a certain magnitude and result in extra-limital occurrences of Great Gray Owls. To complicate this issue further, there are certain climatic factors that may exacerbate the circumstances already mentioned, by restricting the availability of prey, in spite of prey abundance. It appears

that snow hardness may effectively prevent Great Gray Owls from obtaining prey beneath the snow, or at least decrease their foraging efficiency. In addition, Nero (1969) and Oeming (in litt. 1976) have suggested that extraordinary accumulations of snow may force Great Gray Owls out of their normal habitat in winter, presumably due to the reduced prey availability. Formozov (1960) documented a similar phenomenon in other owl species in the U.S.S.R. This may appear to be the case in some areas of North America, but there is no demonstrable relationship between the yearly snow accumulation at Pinawa and the occurrence of Great Gray Owls in the study area (Figure 21). It is possible that these climatic factors can influence the occurrence of Great Gray Owls in a more restricted local area through their effects on the availability of prey. But it must be emphasized that these are only complicating influences on a phenomenon controlled by other factors.

Ultimately it must be recognized that irruptive migrations result from an interaction between population size and food supply (Bock and Lepthien 1976, Lack 1954, Ulfstrand 1963), and that food supply is the prime moving and synchronizing force behind irruptions (Svårdson 1957). The correct interpretation of these interactions depends largely on our understanding of the adaptive significance of irruptions to a species dependent on a cyclic source of food.

Figure 21. Winter records of the Great Gray Owl in the study area in relation to snow accumulations at Pinawa (from Monthly Record 1968-1976, Environment Canada). Solid bars are numbers of owls recorded and open circles indicate snow accumulations.

OWLS RECORDED IN THE STUDY AREA



SNOWFALL AT PINAWA BY 31 MARCH (cm)

THE INFLUENCE OF FOOD SUPPLY
ON THE BREEDING BIOLOGY OF THE GREAT GRAY OWL

It has been suggested often (Cody 1966; Klomp 1970; Lack 1946, 1954, 1968; and others) that a positive relationship exists between food supply and clutch size in several bird species. Similarly, many workers have identified a relationship between food supply and reproductive effort in populations of owls (Table 9). There has been great emphasis in these works on elucidating the mechanisms by which food supply influences reproductive effort and the various aspects of breeding biology, particularly courtship, nest initiation, nesting density, clutch size, fledging success and nest site tenacity. The occurrence of these phenomena in other owls lends credence to the suggestion that these phenomena exist in Great Gray Owls.

Reproductive effort may be defined as "the proportion of resources diverted to reproduction, summed over the time interval in question" (Stearns 1976: 4). In a population of owls the reproductive effort in a given year is that number of potential breeders that attempts to reproduce. In a pair of owls the reproductive effort may be represented by certain reproductive parameters, such as the clutch size or the total number of young successfully fledged.

Table 9. Some owl species which respond to fluctuations in food supply by varying their reproductive effort.

| SPECIES | PRIMARY FOOD |
|---------------------------|--|
| <u>Bubo virginianus</u> | <u>Lepus americanus</u> , <u>Bonasa umbellus</u> (McInville and Keith 1974, Rusch <u>et al.</u> 1972) |
| <u>Asio otus</u> | <u>Microtus</u> spp. (Hagen 1965) |
| <u>Asio flammeus</u> | <u>Microtus pennsylvanicus</u> (Clark 1975, Clark and Ward 1974, Mikkola and Sulkava 1969b, Pitelka <u>et al.</u> 1955a, b) |
| <u>Nyctea scandiaca</u> | <u>Dicrostonyx groenlandicus</u> , <u>Lemmus sibiricus</u> , (Parker 1974; Pitelka <u>et al.</u> 1955a, b; Sutton and Parmelee 1956; Taylor 1973) |
| <u>Strix occidentalis</u> | <u>Glaucomys sabrinus</u> , <u>Neotoma</u> spp. (Forsman 1976) |
| <u>Strix aluco</u> | <u>Apodemus sylvaticus</u> , <u>Clethrionomys glareolus</u> (Lynkola and Myllymäki 1969, Southern 1970) |
| <u>Strix nebulosa</u> | <u>Microtus</u> spp. (Höglund and Lansgren 1968, Mikkola 1971, Mikkola and Sulkava 1969, Wahlstedt 1974) |

Studies of the Great Horned Owl near Rochester, Alberta have provided evidence of a positive relationship between the food supply and reproductive effort of this species (McInville and Keith 1974, Rusch et al. 1972). Investigations of the annual reproductive effort revealed that 20% of the five potential breeding pairs nested in 1966 and 100% of at least 16 potential pairs nested in 1971. The rise in owl numbers and breeding rates paralleled the increase in prey in 1966-1971 (McInville and Keith 1974), as it seems that the reproductive effort of the owl population was correlated with a marked increase in the numbers of essential prey items (Rusch et al. 1972). This response to food supply was less clear within each breeding pair, as the average clutch size did not reflect prey abundance except during 1970 when clutch size increased significantly, and the mean hatching date was about two weeks earlier than expected (McInville and Keith 1974). It also seems that other facets of reproduction, such as yearling breeding, may be related to prey densities (McInville and Keith 1974). It is evident that food supply has a dramatic influence on the reproductive effort of the Great Horned Owl.

Although population data on the Long-eared Owl (Asio otus) in North America are scant, data from Norway demonstrate that this species is also dramatically influenced by fluctuations in abundance of its major prey source, the

micro-rodent population (Hagen 1965). Hagen (op. cit.) suggested that this species showed more breeding attempts and produced more fledged young per breeding attempt in years of prey abundance. Hagen's (1965) indicator of reproduction (the multiplied effect of the number of breeding pairs and the number of young fledged per brood in a given year), in an average micro-rodent cycle of four years, was zero for the years prior to peak of the prey cycle, 16.8 for one year prior to peak, 68.0 in a peak year and 15.3 one year after the peak. These data portray a positive relationship between food supply and reproductive effort in the Long-eared Owl, but again without identifying precise effects on all breeding parameters.

The positive relationship between prey abundance and reproductive effort in Short-eared Owls and the related effects on clutch size (Clark and Ward 1974, Mikkola and Sulkava 1969b) and nesting attempts (Clark 1975, Pitelka et al. 1955b) has often been suggested. As stated earlier in this paper, the courtship behaviour (courtship feeding) of this species may be intimately related to this phenomenon of food supply and breeding effort. It may be that the courtship ritual acts as a mechanism whereby owls with few prey available for courtship feeding can adjust their reproductive effort in accordance with prey abundance.

The significance of the prey item in the courtship ritual in relation to breeding effort was first suggested in Snowy Owls by Taylor (1973). Taylor (1973) believed that the number of prey used in courtship could directly represent the condition of the prey base in the nesting area. Therefore, the courtship display with a prey item (important in pair formation and subsequent copulation) could potentially regulate the number of breeding pairs and clutch sizes in an area. This hypothesis helped to explain the well-documented relationship between Snowy Owl reproductive effort and food supply (Parker 1974; Pitelka et al. 1955a, b; Sutton and Parmelee 1956).

As a congeneric of the Great Gray Owl, the Spotted Owl and its reproductive responses to food supply are of particular interest. Unfortunately, this relationship has not been clearly documented. In his study of the Spotted Owl in Oregon, Forsman (1976) found that the proportion of nesting attempts and the number of young produced per nesting attempt varied annually. Although it was apparent that the reproductive effort of Spotted Owls was not constant from one year to the next, Forsman (1976) was not able to document a relationship with food supply. However, further study may identify which factors caused these fluctuations.

The Tawny Owl (Strix aluco), another congeneric of the Great Gray Owl, has been well-studied in Europe (Linkola and Myllymäki 1969; Southern 1954, 1969, 1970;

Southern and Lowe 1968; Southern et al. 1954). In his long-term study of Tawny Owls in England (1947-1959), Southern (1970) presented conclusive evidence of a direct positive effect of an abundance of food on the reproductive effort of this species. He found that the numbers of prey clearly determined the success of breeding in a particular year.

In a Finland population of Tawny Owls studied by Linkola and Myllymäki (1969) the primary prey item was subject to extreme fluctuations in abundance. In poor prey years, these workers found that few pairs of owls bred, onset of breeding was delayed, smaller clutches were laid and higher losses were sustained during nesting.

Although these studies of the Tawny Owl indicate that there is a direct relationship between food supply and reproductive effort, still little is known about the mechanisms by which food supply exerts this influence. One may speculate that the Tawny Owl exhibits a relationship between food supply, courtship behaviour and reproductive effort similar to that hypothesized by Taylor (1973) for the Snowy Owl.

In North America studies of the Great Gray Owl have not revealed conclusive evidence of a relationship between food supply and reproductive effort (Bent 1938; Craighead and Craighead 1969; Nero 1969, 1970b; Nero et al. 1974; Oeming 1955). However, studies of the Eurasian race suggest the existence of this relationship in Sweden

(Höglund and Lansgren 1968, Wahlstedt 1974) and Finland (Mikkola 1971, Mikkola and Sulkava 1969a). In Sweden Höglund and Lansgren (1968) believed that Great Gray Owls will settle periodically in localities which can offer sufficient food for breeding. Wahlstedt (1974) further suggested that an apparent abundance of breeding owls was due to a rich supply of rodents. Information from Finland also suggested that breeding of Great Gray Owls was related to prey densities. Mikkola and Sulkava (1969a) found this species breeding in great numbers in the vole years of 1966-1967. Mikkola (1971) further suggested the paucity of nests in 1971 was a direct result of an absence of rodents.

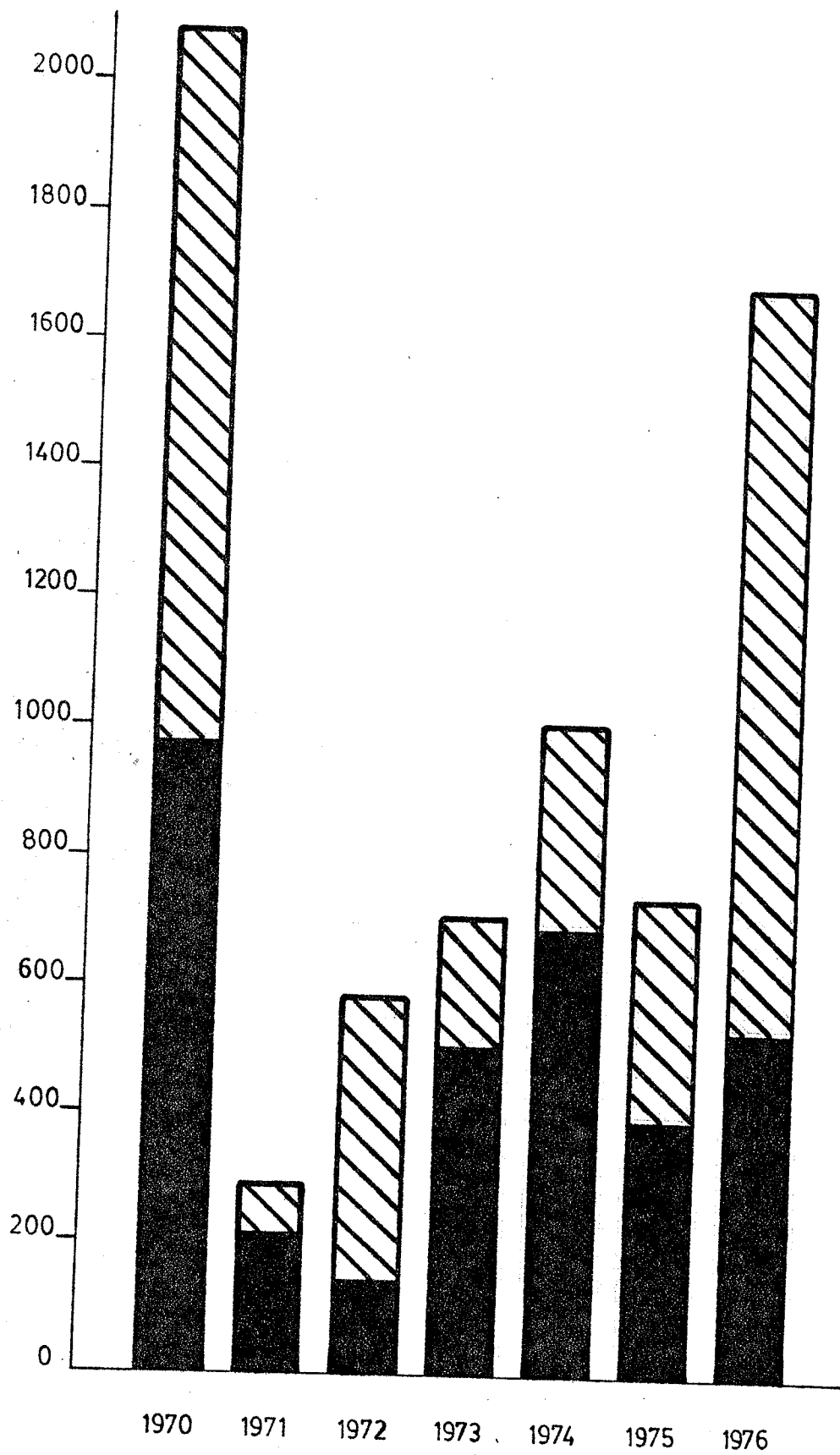
The lack of conclusive evidence of a relationship between food supply and production in the Great Gray Owl in North America does not necessarily preclude its existence. In reviewing the available information on this species and during my study of nesting birds, I have observed strong similarities in breeding biology to other owl species. During the Pre-Egg Stage there exists the potential for courtship feeding in this species. It may be that Taylor's (1973) hypothesis concerning the importance of the prey item in the courtship behaviour also applies to the Great Gray Owl. In the Egg Stage, it is apparent that variation exists in clutch size and timing of clutch initiation. In the Nestling Stage, the number of young surviving to leave

the nest also varies from one nest to another, and thus may be related to prey densities.

In the study area small mammal populations have been monitored by personnel of the Atomic Energy of Canada Limited's Whiteshell Nuclear Research Establishment at Pinawa since 1970. The numbers and species of small mammals trapped on eight 30-day/64 station removal grids from 1970-1976 are recorded in Figure 22 (W. Schwartz in litt. 1976). It is apparent from this graph that small mammal populations (particularly Cricetidae) were relatively high in 1970, 1973, 1974 and 1976. If Pruitt's (1968) hypothesis concerning the widespread synchrony in fluctuations of small mammal populations is applied to southeastern Manitoba, then we may assume that these data from Pinawa are representative of small mammal populations throughout the study area. An apparent correlation exists between prey abundance in the study area and nesting of Great Gray Owls. In years when the total number of Cricetidae trapped was over 500, Great Gray Owl nests were found in the study area. Also the larger clutches and earlier nest initiation in 1976 compared to 1974 is apparently correlated with the greater total number of small mammals occurring in 1976 (and, possibly, to the earlier warm temperatures of 1976). Therefore, it seems likely that food supply fluctuations also affected Great Gray Owl reproductive effort through influence on parameters of breeding biology.

Figure 22. Number of Cricetidae and Soricidae trapped at Pinawa 1970-76 (unpublished data from Whiteshell Nuclear Research Establishment, Atomic Energy of Canada Limited). Hatched bars are Soricidae, solid bars are Cricetidae, and the complete stacked bars are the total number of small mammals.

NUMBER OF SMALL MAMMALS



In addition to this apparent relationship between food supply and breeding biology in the Great Gray Owl, I have also suggested that food supply regulates population movements in this species. Therefore, it appears that the Great Gray Owl, due to its rather restrictive dependence on a particular prey base, has evolved specific attributes in its biology to accommodate the dramatic fluctuations of the prey base. Further studies on this species may provide more precise information concerning these predator-prey interactions.

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Appendix I. Great Gray Owl breeding records in North America.

| DATE | LOCATION | NEST CONTENTS, SOURCE |
|---------------|-----------------------|---|
| 23 May 1826 | Great Bear Lake, NWT. | 3 young; Swainson and Richardson (1831) |
| 19 July 1862 | Fort Good Hope, NWT. | 2 eggs; 2 young; MacFarlane (1891) |
| ? April 1864 | Fort Yukon, Ak. | 2 eggs; USNMNH #10277 ¹ , Bendire (1892) |
| 20 April 1880 | Fort Chipewyan, Alta. | 2 eggs; Preble (1908) |
| 8 April 1885 | Norwich, Conn. | 2 eggs; PANS #71565 |
| 16 April 1889 | Sullivan Co., N.H. | 2 eggs; FM #870 |
| 18 May 1894 | Peel River, NWT. | 2 eggs; AMNH |
| ? ? 1896 | Red Deer, Alta. | ? eggs; Macoun and Macoun (1909) |
| 15 May 1898 | Peel River, NWT. | 2 eggs; NYSM #4742 |
| 2 June 1898 | Peel River, NWT. | 2 eggs; WFVZ #35477 |
| 10 May 1901 | Peel River, NWT. | 2 eggs; UMMZ #191279 |
| 19 June 1902 | Carlton, Sask. | 2 eggs; WFVZ #35471 |
| ? April 1904 | Fort Providence, NWT. | 3 eggs; Preble (1908) |
| 6 June 1904 | Nahanni River, NWT. | 2 young; Preble (1908) |
| 12 April 1906 | Edmonton, Alta. | 4 eggs; UFSM #52344 |
| 5 July 1907 | Quill Lake, Sask. | 1 egg; FM #7095 |
| ? ? 1907 | Fort Egbert, Ak. | ? young; Gabrielson and Lincoln (1959) |
| 31 July 1911 | Nipissing, Ont. | 2 young; Taverner (1912) |
| 23 March 1913 | Belvedere, Alta. | 3 eggs; Henderson (1915) |
| 30 March 1913 | Belvedere, Alta. | 3 eggs; WFVZ |
| 6 April 1913 | Belvedere, Alta. | 5 eggs; Henderson (1915) |
| 1 May 1913 | Belvedere, Alta. | 1 egg, 1 young; FM #7096 |
| 9 April 1915 | Dunvegan, Alta. | 4 eggs; WFVZ |

| | | |
|---------------|-----------------------|--|
| 10 April 1915 | Belvedere, Alta. | 3 eggs; FM #7098, but Henderson (1923) records date as 9 April |
| 11 April 1915 | Belvedere, Alta. | 3 eggs; FM #7099, but Henderson (1923) records 2 eggs |
| 22 April 1915 | Belvedere, Alta. | 3 eggs; FM #7100 |
| 5 May 1915 | Belvedere, Alta. | 2 eggs; FM #7097, but Henderson (1923) records date as 15 May |
| 15 June 1918 | Chignik, Ak. | 3 eggs; DMNH |
| 30 April 1922 | Belvedere, Alta. | 3 eggs; USNMNH #43928 |
| 23 June 1922 | Fairbanks, Ak. | 1 young; Bent (1938) |
| 18 April 1924 | Heatherdown, Alta. | 4 eggs; WFVZ #82648 |
| 1 May 1924 | Heatherdown, Alta. | 4 eggs; UPSMNH |
| 29 April 1925 | Belvedere, Alta. | 4 eggs; WFVZ #13451 |
| 7 May 1925 | Belvedere, Alta. | 3 eggs; WFVZ #6847 |
| 14 May 1926 | Lake Dauphin, Man. | 3 young; Robinson (1954) |
| 6 April 1929 | Rochester, Alta. | 5 eggs; OSUMNH #1362 |
| 27 April 1929 | Rochester, Alta. | 4 eggs; SBCM #4329 |
| 7 May 1931 | Fawcett, Alta. | 4 eggs; WFVZ, but Kondla (1973) records date as 7 May 1930 |
| 11 May 1931 | Fawcett, Alta. | 4 young; ROM |
| 23 June 1931 | Shoshone Co., Id. | 1 young; Hand (1941) |
| 4 July 1931 | Lincoln Co., Mont. | 3 young; Weydemeyer (1932, 1975) |
| 10 May 1932 | Athabasca, Alta. | 3 eggs; UPSMNH |
| 27 May 1932 | Athabasca, Alta. | 3 eggs; Nelson Hoy Collection |
| 15 April 1933 | Boyle, Alta. | 2 eggs; SBCM #19276 |
| 21 May 1933 | Grassland, Alta. | 1 young; ROM #82256 |
| 4 April 1935 | Roseau Co., Minn. | 3 eggs; JFBMNH |
| ? ? 1937 | Pasquia Forest, Sask. | ? ?; Symons (1967) |

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|----------------|------------------------|---|
| ? ? 1947 | Moose, Wyo. | 1 young; Craighead and Craighead (1969) |
| ? May 1949 | Choiceland, Sask. | ? ?; Law (1960) |
| 27 August 1952 | Yosemite Park, Cal. | 2 young; D. Bleitz (<u>in litt.</u> 1977) |
| ? July 1953 | Crater Lake, Ore. | 3 young; R. Rohweder (<u>in litt.</u> 1976) |
| ? May 1954 | Edson, Alta. | 2 young; Oeming (1955) |
| ? May 1954 | Rocky Mtn. Hse., Alta. | 2 young; Oeming (1955) |
| ? May 1955 | Yosemite Park, Cal. | ? ?; D. Bleitz (<u>in litt.</u> 1977) |
| 4 April 1959 | Fort Klamath, Ore. | 3 eggs; WFVZ #66421, Griffiee (1959) |
| ? ? 1960 | Fort Klamath, Ore. | ? ?; Alderson (1960) |
| ? June 1962 | Wonowon, B.C. | 2 young; BCPM |
| ? ? 1963 | Forty Mile River, Ak. | ? ?; L.G. Swartz (<u>in litt.</u> 1976) |
| 5 August 1963 | Jackson Glacier, Mont. | 2 young; P.D. Skaar (<u>in litt.</u> 1976) |
| 3 June 1964 | The Pas, Man. | 2 young; Parmelee (1968) |
| 11 May 1968 | The Pas, Man. | 3 young; Mitchell (1969) |
| 7 May 1969 | Lake Co., Ore. | ? ?; Cornell nest records |
| 8 May 1969 | Lake Co., Ore. | 1 egg, 2 young; Cornell nest records |
| ? June 1969 | Grand Teton Park, Wyo. | 2 young; Johnson (1974) |
| 18 July 1969 | Yellowknife Hwy., NWT. | 2 young; D.L. Trauger (<u>in litt.</u> 1976) |
| 2 May 1970 | Roseau Co., Minn. | 5 eggs; Nero (1970) |
| 23 May 1970 | Mackay, Alta. | 2 young; E.T. Jones (<u>in litt.</u> 1976) |
| 23 May 1970 | Mackay, Alta. | 2 young; E.T. Jones (<u>in litt.</u> 1976) |
| 20 July 1970 | Quetico Park, Ont. | 1 young; B. Brooks (<u>in litt.</u> 1976) |
| 17 April 1971 | Edson, Alta. | 4 eggs; R.E. Gehlert (<u>in litt.</u> 1976) |
| ? May 1971 | Edson, Alta. | 3 young; R.E. Gehlert (<u>in litt.</u> 1976) |
| 7 May 1971 | Mackay, Alta. | 4 eggs; E.T. Jones (<u>in litt.</u> 1976) |

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|-----------------|---------------------------------|--|
| 6 June 1971 | Mackay, Alta. | 2 young; E.T. Jones (<u>in litt.</u> 1976) |
| 12 June 1971 | Eleanor Lake, Man. | 3 young; R.W. Nero (<u>in litt.</u> 1976) |
| 16 August 1971 | North Gulf Coast, Ak. | 2 young; Isleib and Kessel (1973) |
| 4 May 1972 | Miquelon Lake, Alta. | 3 eggs; Kondla (1973) |
| 12 May 1972 | Mackay, Alta. | 1 egg, 3 young; E.T. Jones (<u>in litt.</u> 1976) |
| 25 May 1972 | Edson, Alta. | 3 young; E.T. Jones (<u>in litt.</u> 1976) |
| 25 May 1972 | Edson, Alta. | 3 young; E.T. Jones (<u>in litt.</u> 1976) |
| 11 June 1972 | Fort Klamath, Ore. | ? ?; H.B. Nehls (<u>in litt.</u> 1976) |
| 3 July 1972 | Driftwood River, B.C. | 2 young; BCPM Photo #253 |
| 2,3 August 1972 | Quetico Park, Ont. | 2 young; B. Brooks (<u>in litt.</u> 1976) |
| 31 May 1973 | Spruce Siding, Man. | 1 young; this study, Nest A1 |
| ? ? 1973 | South Mocassin Mountains, Mont. | 2 young; P.D. Skaar (<u>in litt.</u> 1976) |
| ? ? 1973 | Fairbanks, Ak. | 1 young; L.J. Peyton (<u>in litt.</u> 1976) |
| 19 July 1973 | Crazy Mtns., Mont. | 2 young; American Birds 26: 880 |
| 1 May 1974 | Lac du Bonnet, Man. | 3 eggs; this study, Nest B |
| 4 May 1974 | Spruce Siding, Man. | 3 eggs; this study, Nest A2 |
| 11 May 1974 | Roseau Co., Minn. | 2 eggs; this study, Nest C1 |
| 20 May 1974 | Edson, Alta. | ? ?; R.E. Gehlert (<u>in litt.</u> 1976) |
| 1 June 1974 | Freemont Co., Id. | 1 young; C.H. Trost (<u>in litt.</u> 1976) |
| ? ? 1974 | Glenevis, Alta. | ? ?; V. Lang (<u>in litt.</u> 1976) |
| 2 June 1974 | Glenevis, Alta. | ? ?; E.T. Jones (<u>in litt.</u> 1976) |
| 10 August 1974 | McMunn, Man. | 1 young; W. Nakka (pers. comm.) |
| 29 May 1975 | Wallowa Co., Ore. | 2 eggs; R. Anderson (<u>in litt.</u> 1976) |
| 12 June 1975 | Kootenay Park, B.C. | ? ?; R.W. Campbell (<u>in litt.</u> 1976) |
| 28 June 1975 | Bozeman, Mont. | 2 young; P.D. Skaar (<u>in litt.</u> 1976) |

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|----------------|---------------------------------------|---|
| 24 July 1975 | Prince Albert National Park, Sask. | 2 young; Sept (1976) |
| 26 July 1975 | Aitkin Co., Minn. | 2 young; Blanich (1975) |
| 26 August 1975 | Salmon, Id. | 2 young; American Birds 30: 99 |
| 10 April 1976 | Roseau Co., Minn. | 4 eggs; this study, Nest C2 |
| 11 April 1976 | Ste. Rita, Man. | 4 eggs; this study, Nest E |
| 14 April 1976 | Spruce Siding, Man. | 5 eggs; this study, Nest D |
| 29 May 1976 | Roseau Co., Minn. | 3 eggs; this study, Nest F |
| 12 June 1976 | Fort Klamath, Ore. | 2 young; H.B. Nehls (<u>in litt.</u> 1976) |
| 12 June 1976 | Gallatin Co., Mont. | 2 young; R.A. Hays (<u>in litt.</u> 1976) |
| 26 June 1976 | Roseau Co., Minn. | 3 young; this study |

¹The museums providing some of these data were: American Museum of Natural History (AMNH), British Columbia Provincial Museum (BCPM), Delaware Museum of Natural History (DMNH), Field Museum of Natural History (FM), James Ford Bell Museum of Natural History (JFBMNH), New York State Museum (NYSM), Oregon State University Museum of Natural History (OSUMNH), Philadelphia Academy of Natural Sciences (PANS), San Bernardino County Museum (SBCM), United States National Museum of Natural History (USNMNH), University of Florida State Museum of Zoology (UFZM), University of Michigan Museum of Zoology (UMMZ), University of Puget Sound Museum of Natural History (UPSMNH) and Western Foundation of Vertebrate Zoology (WFVZ).

Appendix II. Additional evidence of Great Gray Owl breeding in
North America.

| DATE | EVIDENCE |
|----------------|---|
| prior to 1914 | <ul style="list-style-type: none"> - J. Parker Norris (1914) reported a clutch without data in <i>The Oölogist</i>. - Chapman (1924) reported a nest found by Norris at Buffalo Lake, Alta. on April 10 in an undetermined year without any other data. However, the J. Parker Norris Sr. Collection does not contain a clutch from this location (L.F. Kiff in <u>litt.</u> 1976). |
| 18 June 1915 | <ul style="list-style-type: none"> - Grinnell (1924) reported a female Great Gray Owl with a brood patch and a male bird from Yosemite National Park, California. |
| prior to 1917 | <ul style="list-style-type: none"> - five clutches are reported without data in <i>The Oölogist</i> (1917) 34: 195. |
| 25 April 1926 | <ul style="list-style-type: none"> - Roberts (1932) reported a female Great Gray Owl taken in Roseau County, Minnesota by P.O. Fryklund. |
| prior to 1938 | <ul style="list-style-type: none"> - according to Bent (1938) F.L. Farley had evidence of nests "less than 100 miles north of Edmonton". |
| prior to 1955 | <ul style="list-style-type: none"> - Oeming (1955) reported these nests for which data are unavailable: 3 nests collected by A.D. Henderson, 1 nest collected by A.C. Twomey and 1 nest collected by T.E. Randall. |
| prior to 1966 | <ul style="list-style-type: none"> - Salt and Wilk (1966) reported nests at Athabasca, Jasper and Flatbush, Alberta, but did not present data. Similarly, these nests were reported by Kondla (1973). |
| 1966-1976 | <ul style="list-style-type: none"> - A.W. Larson observed birds nesting in Yosemite National Park, California during this 10-year period, but does not have data (<u>in litt.</u> 1976). |
| late July 1970 | <ul style="list-style-type: none"> - R.W. Nero discovered a nest near Lewis, Manitoba containing various indications of use in this year (<u>in litt.</u> 1977). |
| 30 May 1971 | <ul style="list-style-type: none"> - R.W. Nero observed an owl carrying a mouse into the forest near Lewis, Manitoba (<u>in litt.</u> 1977). |
| 20 May 1974 | <ul style="list-style-type: none"> - R.W. Nero observed an owl carrying a mouse into the forest near Ste. Rita, Manitoba (<u>in litt.</u> 1977). |

- 9 June 1974 - R.W. Nero discovered a nest near Ste. Rita, Manitoba containing various indications of use in 1973 (in litt. 1977).
- 25 September 1976 - 3 owls seen by C. Loiselle near Badger, Manitoba "in a close group - probably a family group" (R.W. Nero in litt. 1977).
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Appendix III. Specimen records of the Great Gray Owl in North America.

SPECIMEN RECORDS FOR ALASKA.

| DATE | LOCATION | SEX | SOURCE |
|------------------|---------------|-----|-------------------------------|
| 11 February 1861 | Fort Yukon | ? | Gabrielson and Lincoln (1959) |
| 11 April 1868 | Nulato River | f | USNMNH #54358 |
| 15 April 1876 | Yukon Delta | f | USNMNH #70891 |
| 18 April 1876 | Yukon Delta | f | USNMNH #70890 |
| ? November 1876 | Fort Yukon | m | USNMNH #73076 |
| 19 June 1903 | Seventy Mile | ? | Gabrielson and Lincoln (1959) |
| ? March 1906 | Bethel | f | USNMNH #270548 |
| 13 December 1908 | Endicott Mts. | f | AMNH #119377 |
| 5 January 1909 | Endicott Mts. | f | AMNH #119376 |
| 16 January 1909 | Brooks Range | ? | Gabrielson and Lincoln (1959) |
| 4 February 1909 | Brooks Range | ? | Gabrielson and Lincoln (1959) |
| 25 October 1910 | Stikine Flats | ? | Gabrielson and Lincoln (1959) |
| 10 February 1913 | Tocatna Forks | f | USNMNH #242053 |
| 10 May 1913 | Tocatna Forks | f | AMNH #754239 |
| 6 August 1913 | Tocatna Forks | f | HUMCZ #252372 |
| 6 August 1913 | Tocatna Forks | m | FM #138183 |
| 6 August 1913 | Tocatna Forks | f | FM #138182 |
| 6 August 1913 | ? | m | USNMNH #242054 |
| 13 August 1913 | Tocatna Forks | f | USNMNH #242055 |
| 5 October 1913 | Tocatna Forks | f | FM #138185 |
| 10 October 1913 | Tocatna Forks | f | FM #138177 |
| 10 October 1913 | Tocatna Forks | m | FM #138174 |
| 12 October 1913 | Tocatna Forks | m | USNMNH #242052 |

| | | | |
|------------------|---------------|---|--------------------------------|
| 16 October 1913 | Tocatna Forks | f | FM #138176 |
| 12 November 1913 | Tocatna Forks | f | FM #138180 |
| 14 January 1914 | Tocatna Forks | m | FM #139178 |
| 28 January 1914 | Tocatna Forks | m | FM #138184 |
| 2 February 1914 | Tocatna Forks | f | FM #138181 |
| 2 April 1914 | Tocatna Forks | f | FM #138186 |
| 24 October 1915 | Tocatna Forks | f | FM #138179 |
| ? ? 1915 | Toklat River | ? | USNMNH #241264 |
| 17 October 1920 | Chena River | ? | USNMNH #286486 |
| 27 October 1920 | Chena River | ? | USBBSA #16670 |
| 18 March 1921 | Iditerod | f | UCMVZ #66472 |
| 21 March 1921 | Fairbanks | ? | USNMNH #286487 |
| 23 June 1922 | Swift Slough | f | USNMNH #287100 |
| 23 June 1922 | Swift Slough | ? | USBBSA #166706 |
| 3 April 1924 | Ophir | f | O.J. Murie #2773 (Brandt 1943) |
| 1 June 1941 | Tanana River | f | USNMNH #463403 |
| 14 April 1944 | Fairbanks | m | CMNH #25005 |
| 16 July 1951 | Fairbanks | ? | NCSMNH #5260 |

SPECIMEN RECORDS FOR ALBERTA.

| DATE | LOCATION | SEX | SOURCE |
|------------------|----------|-----|--------------|
| 11 December 1895 | Red Deer | m | UMMZ #55079 |
| 18 December 1895 | Red Deer | f | HMCZ #246072 |
| 2 January 1896 | Red Deer | m | HMCZ #246070 |

| | | | |
|------------------|-----------------|---|----------------|
| 29 January 1896 | Edmonton | m | ROM #42054 |
| 6 February 1896 | Innisfail | f | HMCZ #246118 |
| 12 February 1896 | Waghorn | m | HMCZ #246117 |
| 20 February 1896 | Red Deer | f | FM #16235 |
| 3 March 1896 | Red Deer | f | ANSP #46037 |
| 6 March 1896 | Edmonton | m | ROM #42059 |
| 8 March 1896 | Lacombe | m | AMNH #360875 |
| 14 March 1896 | Red Deer | f | FM #16237 |
| 15 March 1896 | Red Deer | f | FM #16236 |
| 17 March 1896 | Red Deer | f | ANSP #46036 |
| 18 March 1896 | Waghorn | m | HMCZ #279909 |
| 19 March 1896 | Aldee | m | UMMZ #44314 |
| 19 March 1896 | Olds | m | ROM #42062 |
| 19 March 1896 | Olds | ? | ROM #42048 |
| 20 March 1896 | Red Deer | m | HMCZ #180963 |
| 1 April 1896 | Blindman River | f | FM #16238 |
| 3 April 1896 | Red Deer | m | ANSP #46038 |
| 4 April 1896 | Blindman River | f | FM #16239 |
| 5 April 1896 | Red Deer | m | FM #20936 |
| 5 April 1896 | Red Deer | m | ROM #42061 |
| 1 May 1896 | ? | m | AMNH 525563 |
| 29 May 1896 | Red Deer | f | USNMNH #155794 |
| 6 June 1896 | Whitemud Lake | ? | Preble (1908) |
| 25 August 1896 | Jasper House | m | USNMNH #155796 |
| 20 October 1896 | Henry House | ? | USBBSA #24623 |
| 20 October 1896 | Rocky Mtn. Hse. | f | USNMNH #155795 |

| | | | |
|------------------|-----------------|---|----------------|
| 7 March 1898 | Red Deer | m | CM #8595 |
| 26 November 1909 | Wild Horse Val. | f | UCLADC #7967 |
| 27 December 1909 | Spruce Grove | f | UCMVZ #101811 |
| 30 November 1910 | ? | m | AMNH #754237 |
| 15 December 1910 | Redwater | f | ROM #82259 |
| 2 December 1911 | Edmonton | f | AMNH #754246 |
| ? December 1912 | Stony Plain | f | AMNH #754242 |
| 8 January 1915 | Edmonton | f | CU #3601 |
| 15 January 1915 | Edmonton | f | FM #54097 |
| 10 April 1915 | Belvedere | f | FM #97999 |
| 10 April 1915 | Belvedere | m | FM #97998 |
| 7 December 1915 | Edmonton | f | FM #54098 |
| 17 December 1919 | Fort McMurray | ? | NMNS #14443 |
| 21 April 1920 | Fort McMurray | ? | USBBSA #158572 |
| 23 April 1920 | Fort McMurray | f | USNMNH #283314 |
| 27 April 1920 | Fort McMurray | m | HMCZ #231472 |
| 8 September 1920 | Peace River | m | HMCZ #231471 |
| 8 September 1920 | Peace River | ? | USBBSA #158529 |
| 5 April 1921 | Edmonton | m | AMNH #754240 |
| 27 November 1921 | Edmonton | f | AMNH #754241 |
| 17 October 1923 | Edmonton | f | UCMVZ #75633 |
| 30 October 1923 | Edmonton | m | HMCZ #180964 |
| 7 October 1924 | Camrose | f | UCMVZ #75634 |
| ? November 1924 | Edmonton | ? | ROM #82258 |
| ? December 1924 | Edmonton | f | HMCZ #180965 |
| 11 May 1931 | Fawcett | f | FM #159619 |

| | | | |
|------------------|-------------------|---|------------------------------------|
| 11 May 1931 | Fawcett | f | ROM |
| 11 May 1931 | Fawcett | m | ROM |
| 11 May 1931 | Fawcett | m | ROM |
| 11 May 1931 | Fawcett | f | ROM |
| 11 May 1931 | Fawcett | f | ROM |
| 14 January 1933 | Slave River | f | NMNS #25234 |
| 21 May 1933 | Grassland | f | ROM #82256 |
| 15 March 1953 | Timeu | m | DMNH #55174 |
| 28 February 1954 | Ft. Assiniboine | f | UAMZ #1033 |
| ? September 1954 | Ft. Assiniboine | f | UKMNH #34954 |
| ? September 1954 | Ft. Assiniboine ? | | UKMNH #34956 |
| ? November 1954 | Ft. Assiniboine | m | UKMNH #36411 |
| 10 December 1954 | Ft. Assiniboine | f | UKMNH #36412 |
| 17 April 1956 | Ft. Assiniboine | f | DMNH #55173 |
| 6 January 1960 | Lake Isle | ? | E.T. Jones (<u>in litt.</u> 1976) |
| ? March 1963 | Lake Louise | ? | E.T. Jones (<u>in litt.</u> 1976) |
| ? ? 1970 | Edson | m | APMA #70.56.1 |
| 17 March 1971 | Lodgepole | m | APMA #71.19.1 |
| 27 March 1971 | Carrot Creek | m | APMA #71.21.6 |
| 19 October 1972 | Chub Creek | f | APMA #72.91.1 |
| ? February 1973 | Beaverlodge | f | APMA #73.89.2 |
| ? November 1973 | Burnt Stick L. | f | UAMZ #4877 |
| 19 November 1973 | Swan Lake | f | APMA #73.81.1 |
| 3 January 1974 | Pocaluco | f | UAMZ #4878 |
| ? March 1974 | 16-36-7-W5 | m | UAMZ #4879 |
| 1 April 1975 | Raven | f | LACNHM |

16 December 1975 Grande Prairie f UAMZ #4961

SPECIMEN RECORDS FOR BRITISH COLUMBIA.

| DATE | LOCATION | SEX | SOURCE |
|-------------------|---------------|-----|--------------------------|
| ? January 1890 | Sumas | ? | Brooks (1917) |
| ? September 1891 | Stuart Lake | m | BCPM #1735 |
| ? September 1891 | Stuart Lake | f | BCPM #1736 |
| ? ? 1891 | Vernon | ? | Macoun and Macoun (1909) |
| 10 February 1899 | Vancouver | ? | ISU |
| ? November 1925 | Warm Springs | ? | UCMVZ #49763 |
| 2- July 1929 | Atlin | f | CASM #32294 |
| 16 October 1931 | Okanagan | f | UCMVZ #101813 |
| 28 September 1932 | Cariboo | m | ROM #82260 |
| 21 October 1932 | Okanagan | f | ROM #82251 |
| 30 October 1933 | Chilcotin | f | UBCZM #8666 |
| 20 November 1936 | Okanagan | m | UCMVZ #101812 |
| 10 November 1938 | Windemere | f | BCPM #11208 |
| ? ? 1940 | Barkerville | ? | Munro (1947) |
| ? August 1946 | Hullcar | ? | Grant (1959) |
| 13 October 1950 | Cariboo | f | CNMNS #47866 |
| 21 October 1950 | Williams Lake | f | UBCZM #2366 |
| 30 December 1950 | Williams Lake | f | CNMNS #47867 |
| 3 March 1951 | Big Creek | m | CNMNS #47868 |
| 17 March 1951 | Horsefly Lake | m | CNMNS #47870 |

| | | | |
|-------------------|---------------|---|----------------------------------|
| 19 March 1951 | Horsefly Lake | f | CNMNS #47869 |
| 28 November 1952 | Quesnel | m | UBCZM #4819 |
| ? April 1954 | Cariboo | f | PMNH #71761 |
| 28 February 1955 | Grinrod | f | UBCZM #8016 |
| ? October 1956 | Watch Lake | f | BCPM #10166 |
| 17 July 1961 | Hullcar | ? | J. Grant (<u>in litt.</u> 1976) |
| 23 January 1962 | ? | ? | BCPM #10797 |
| 16 August 1965 | Kootenay Park | ? | UAMZ #7130 |
| 19 September 1965 | Vestuold | f | UBCZM #13514 |

SPECIMEN RECORDS FOR CALIFORNIA.

| DATE | LOCATION | SEX | SOURCE |
|-------------------|---------------|-----|--------------|
| 26 September 1913 | Siskiyou Co. | ? | UCMVZ #24484 |
| 18 June 1915 | Yosemite Park | f | UCMVZ #25535 |
| 18 June 1915 | Yosemite Park | m | UCMVZ #25534 |
| ? ? 1929 | Modera Co. | f | CSDNHM |
| 17 September 1937 | Plumas Co. | ? | UCMVZ #73353 |
| 3 July 1963 | Yosemite Park | f | LACNHM |

SPECIMEN RECORDS FOR CONNECTICUT.

| DATE | LOCATION | SEX | SOURCE |
|-----------------|-------------|-----|-----------------------|
| 6 January 1843 | Stratford | ? | Bagg and Eliot (1937) |
| 18 January 1893 | North Haven | m | Verrill (1893) |

| | | | |
|-----------------|-----------|---|-----------------------|
| 22 January 1893 | New Haven | ? | Bagg and Eliot (1937) |
| ? March 1907 | New Haven | ? | Bagg and Eliot (1937) |

SPECIMEN RECORDS FOR IDAHO.

| DATE | LOCATION | SEX | SOURCE |
|-----------------|---------------|-----|---------------|
| 23 May 1806 | Clearwater R. | ? | Jollie (1953) |
| 4 December 1914 | Coeur d'Alene | ? | Rust (1915) |
| 4 August 1919 | Warren | ? | AMNH #149228 |
| 1924 or 1925 | Benewah Co. | ? | Hand (1941) |
| 27 August 1935 | Clark Co. | f | AMNH #305597 |
| 8 December 1936 | Idaho Co. | ? | UIM |
| 8 December 1938 | Idaho Co. | ? | UCMVZ #74905 |

SPECIMEN RECORDS FOR ILLINOIS.

| DATE | LOCATION | SEX | SOURCE |
|----------|----------|-----|---------------------------|
| ? ? 1930 | Rockford | ? | Smith and Parmelee (1955) |

SPECIMEN RECORDS FOR INDIANA.

| DATE | LOCATION | SEX | SOURCE |
|-------------|------------|-----|----------------|
| ? ? 1897 | Benton Co. | ? | Perkins (1933) |
| before 1913 | Posey Co. | ? | Perkins (1935) |

SPECIMEN RECORDS FOR IOWA.

| DATE | LOCATION | SEX | SOURCE |
|---------------|-----------|---------------|--------|
| ? ? 1860 | Hillsboro | ? Bent (1938) | |
| 25 April 1921 | Sigourney | ? Bent (1938) | |

SPECIMEN RECORDS FOR MAINE.

| DATE | LOCATION | SEX | SOURCE |
|------------------|-----------------|----------------------------|--------|
| 24 April 1884 | Piscataquis Co. | ? Palmer (1949) | |
| ? December 1885 | northern Maine | ? HUMCZ #100865 | |
| 2 March 1890 | York Co. | ? Palmer (1949) | |
| 3 March 1890 | Dover | ? PMNH #1636 | |
| 8 March 1890 | Dover | ? USBBSA #11125 | |
| 12 November 1890 | Cherryfield | f BMSHP | |
| winter 1891 | Bangor | ? "27 taken" (Palmer 1949) | |
| 12 November 1891 | Beddington | m HUMCZ #43178 | |
| 6 December 1898 | Penobscot | ? PMNH #1638 | |
| 8 November 1906 | Portland | ? Palmer (1949) | |
| winter 1907 | Maine | ? "13 taken" (Palmer 1949) | |
| 11 December 1909 | Buckpond | f HUMCZ #318431 | |
| 25 November 1935 | Distel | ? REEC | |
| ? November ? | Maine | ? AMNH #437344 | |

SPECIMEN RECORDS FOR MANITOBA.

| DATE | LOCATION | SEX | SOURCE |
|-------------------|--------------------|-----|-----------------|
| 29 September 1884 | Carberry | ? | Thompson (1891) |
| ? March 1889 | ? | m | AMNH #35721 |
| ? March 1889 | ? | f | AMNH #35722 |
| 29 September 1889 | Carberry | ? | USBBSA #10086 |
| 2 February 1891 | Winnipeg | m | LSUMZ ##44333 |
| 14 December 1893 | Winnipeg | f | LSUMZ #44332 |
| ? January 1896 | Winnipeg | ? | AMNH #360878 |
| 3 February 1896 | Birds Hill | m | HUMCZ #246116 |
| 21 December 1896 | Winnipeg | m | ROM #42066 |
| 25 December 1896 | Winnipeg | m | ROM #42067 |
| 20 January 1897 | Winnipeg | m | ROM #42053 |
| 20 January 1899 | Portage la Prairie | m | ROM |
| ? ? 1900 | Winnipeg | ? | AMNH #144834 |
| ? ? 1900 | Winnipeg | ? | NMNS #19019 |
| ? ? 1900 | Winnipeg | ? | NMNS #14456 |
| ? ? 1900 | Winnipeg | ? | NMNS #19018 |
| ? November 1901 | Winnipeg | f | KMNH |
| 13 March 1904 | Winnipeg | m | SM #805 |
| ? November 1905 | Winnipeg | m | FM #100470 |
| 15 November 1906 | Winnipeg | m | HUMCZ #252376 |
| 23 November 1906 | Winnipeg | f | HUMCZ #252373 |
| 10 December 1906 | Myrtle | f | UCMVZ #32324 |

| | | | |
|------------------|--------------------|---|-------------------------|
| 12 December 1906 | Winnipeg | f | HUMCZ #252377 |
| 15 December 1906 | Winnipeg | m | HUMCZ #252374 |
| 15 December 1906 | Winnipeg | f | HUMCZ #252375 |
| 12 January 1907 | Portage la Prairie | f | AMNH #360877 |
| 26 February 1907 | Winnipeg | f | HUMCZ #316390 |
| 11 December 1907 | La Broquerie | f | HUMCZ #252378 |
| 15 December 1909 | Carman | m | AMNH #360876 |
| winter 1910-1911 | Winnipeg | ? | CMNH |
| 31 December 1913 | Brokenhead R. | f | HUMCZ #252379 |
| ? February 1917 | Swan Lake | f | MMN #1.2-521 |
| 28 March 1918 | Kalevala | f | UCLADC #18087 |
| 10 December 1922 | Wagh | f | MMN #1.2-687 |
| 16 December 1922 | Shoal Lake | m | ROM |
| 6 January 1923 | Beausejour | m | MMN #1.2-688 |
| 6 January 1923 | Winnipeg | f | MMN #1.2-689 |
| 22 December 1923 | Moosehorn | m | MMN |
| 27 December 1923 | Beausejour | m | UCMVZ #82188 |
| 1 March 1924 | Hadashville | f | UCMVZ #101810 |
| 4 December 1924 | ? | f | USNMNH #415912 |
| 7 November 1935 | Lake St. Martin | m | ROM |
| 1 December 1935 | Vivian | m | BCPM #13000 |
| 18 November 1939 | The Pas | f | ROM #68419 |
| 10 December 1942 | Herb Lake | ? | INM |
| ? November 1945 | Sandilands | ? | "2 found" (Mossop 1965) |
| 10 December 1949 | Herb Lake | ? | INM |
| ? July 1950 | The Pas | f | MMN #1.2-2337 |

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|-------------------|----------------|----|---------------------|
| 25 September 1950 | Reader Lake | f | INM |
| 25 September 1950 | The Pas | f | UBCZM #4816 |
| 26 January 1956 | Cedar Lake | f | INM |
| 4 February 1956 | Cedar Lake | m | INM |
| 4 February 1956 | Cedar Lake | m | NMNS #45272 |
| 20 December 1959 | Winnipeg | ? | Mossop (1959) |
| 26 March 1961 | The Pas | m | INM |
| 14 December 1965 | Grand Rapids | f | RNHM #9773 |
| ? ? 1966 | Teulon | ? | Nero (1969) |
| 22 February 1966 | The Pas | f | INM |
| 14 April 1968 | Mafeking | ? | MMN #1.2-2543 |
| 6 June 1968 | The Pas | 2m | MMN #1.2-2602, 2602 |
| ? June 1968 | Berens River | ? | Nero (1969) |
| 4 October 1968 | Richer | ? | Nero (1969) |
| 12 October 1968 | East Braintree | ? | Nero (1969) |
| 8 November 1968 | Lac du Bonnet | ? | Nero (1969) |
| 9 November 1968 | Carrick | ? | Nero (1969) |
| 12 November 1968 | Arborg | ? | Nero (1969) |
| 23 November 1968 | Richer | ? | Nero (1969) |
| 23 November 1968 | East Braintree | ? | Nero (1969) |
| 8 December 1968 | Pointe du Bois | m | MMN #1.2-2699 |
| 29 December 1968 | Hadashville | ? | Nero (1969) |
| 29 December 1968 | Pointe du Bois | ? | Nero (1969) |
| 29 December 1968 | Pointe du Bois | ? | Nero (1969) |
| 29 December 1968 | Sailing Lake | ? | Nero (1969) |
| 17 February 1969 | Tyndall | ? | Nero (1969) |

| | | | |
|---------------------|----------------|--------|-----------------------------------|
| 12 February 1969 | East Selkirk | ? | MMN #1.2-2711 |
| 16 February 1969 | Prawda | f | MMN #1.2-2710 |
| 20-27 February 1969 | Steinbach | ? | Nero (1969) |
| 2 March 1969 | Seven Sisters | ? | Nero (1969) |
| 18 March 1969 | Rennie | ? | Nero (1969) |
| 23-30 March 1969 | Birds Hill | ? | Nero (1969) |
| 30 March 1969 | Eriksdale | ? | Nero (1969) |
| 19 April 1969 | Pinawa | ? | Nero (1969) |
| 19-20 April 1969 | Riverton | ? | Nero (1969) |
| 23-30 April 1969 | Pinawa | ? | Nero (1969) |
| 25 April 1969 | The Pas | m | CMNH #25002 |
| 4 April 1970 | Sprague | ? | Nero (1970a) |
| 11 April 1970 | South Junct. | lf, lm | MMN #1.2-3295, 3296 |
| 4 June 1970 | Pinawa | m | MMN #1.2-2906 |
| 20 December 1970 | Stead | ? | R.W. Nero (<u>in litt.</u> 1976) |
| 23 May 1971 | East Braintree | ? | R.W. Nero (<u>in litt.</u> 1976) |
| 11 November 1971 | Marchand | ? | R.W. Nero (<u>in litt.</u> 1976) |
| 22 November 1973 | Pinawa | ? | R.W. Nero (<u>in litt.</u> 1976) |
| ? December 1973 | Seven Sisters | ? | R.W. Nero (<u>in litt.</u> 1976) |
| 12 December 1973 | Pinawa | ? | R.W. Nero (<u>in litt.</u> 1976) |
| 15 December 1973 | Woodlands | f | MMN #1.2-3297 |
| ? December 1973 | Hecla Island | ? | R.W. Nero (<u>in litt.</u> 1976) |
| 1 February 1974 | Riverton | ? | R.W. Nero (<u>in litt.</u> 1976) |
| 4 February 1974 | Pine Falls | ? | R.W. Nero (<u>in litt.</u> 1976) |
| 7 February 1974 | Pine Falls | f | UMZM |
| 27 February 1974 | Pine Falls | ? | R.W. Nero (<u>in litt.</u> 1976) |

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|------------------|-----------------|---|-----------------------------------|
| ? February 1974 | Riverton | ? | R.W. Nero (<u>in litt.</u> 1976) |
| 7 March 1974 | Pine Falls | f | UMZM |
| 9 March 1974 | Lac du Bonnet | m | UMZM |
| 20 March 1974 | Red Deer Point | m | UMZM |
| 25 March 1974 | Winnipeg | f | MMN #1.2-3298 |
| 5 May 1974 | Lake St. George | f | UMZM |
| 10 August 1974 | McMunn | ? | UMZM |
| ? January 1975 | The Pas | f | MMN #1.2-3396 |
| 5 February 1975 | Winnipeg Beach | ? | R.W. Nero (<u>in litt.</u> 1976) |
| 14 February 1975 | Sprague | ? | R.W. Nero (<u>in litt.</u> 1976) |

SPECIMEN RECORDS FOR MASSACHUSETTS.

| DATE | LOCATION | SEX | SOURCE |
|------------------|---------------|-----|---------------------------------|
| ? ? 1839 | Boston | ? | "2 taken" (Howe and Allen 1901) |
| 1842-1843 | ? | ? | "7 taken" (Forbush 1927) |
| ? ? 1847 | eastern Mass. | ? | HUMCZ #3253 |
| ? ? 1847 | Cambridge | ? | HUMCZ #3254 |
| ? ? 1859 | Wenham | ? | Townsend (1905) |
| ? ? 1864 | Salem | ? | Townsend (1905) |
| 10 November 1866 | Salem | ? | Howe and Allen (1901) |
| winter 1872 | Lynn | ? | Baird <u>et al.</u> (1905) |
| 21 February 1882 | Agawam | ? | Bagg and Eliot (1937) |
| ? ? 1889 | Taunton | ? | Cahoon (1889) |
| winter 1890-1891 | ? | ? | "a few taken" (Forbush 1927) |

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|------------------|-------------|---|-----------------------|
| winter 1890-1891 | Milton | ? | Howe and Allen (1901) |
| 16 February 1891 | Marblehead | ? | PMNH #6271 |
| 28 February 1891 | Princeton | ? | Churchill (1891) |
| 4 March 1896 | Hampden Co. | ? | Morris (1897) |
| ? October 1896 | Greenwich | ? | Bagg and Eliot (1937) |
| 22 February 1898 | Belmont | m | HUMCZ #246479 |
| ? October 1900 | Northampton | ? | SSM |
| 7 December 1901 | Longmeadow | ? | SSM |
| 18 February 1904 | Dover | f | HUMCZ #302252 |
| ? December 1906 | Concord | ? | Bagg and Eliot (1937) |

SPECIMEN RECORDS FOR MICHIGAN.

| DATE | LOCATION | SEX | SOURCE |
|------------------|-------------------|-----|-----------------------|
| fall 1893 | Elk Rapids | ? | Wood (1923a) |
| 15 November 1906 | Schoolcraft Co. | ? | Barrows (1912) |
| ? March 1907 | Marquette Co. | ? | USNMNH #204410 |
| fall 1913 | Sault Ste. Marie? | | Magee (1923) |
| fall 1916 | Sault Ste. Marie? | | Magee (1923) |
| ? October 1922 | Sault Ste. Marie? | | "6 shot" (Magee 1923) |
| 8 November 1922 | Luce Co. | ? | Magee (1923) |
| 17 November 1922 | Sault Ste. Marie? | | Magee (1923) |
| 25 November 1922 | Montmorency Co. | m | UMMZ #54426 |
| 10 November 1923 | Saginaw | ? | Wood (1951) |
| 31 March 1928 | Roscommon Co. | ? | Wood (1951) |

| | | | |
|------------------|--------------|---|-------------------------------|
| 18 November 1950 | Chippewa Co. | f | Zimmerman and Van Tyne (1959) |
| 25 February 1951 | Gould City | m | Zimmerman and Van Tyne (1959) |
| 4 October 1972 | Emmet Co. | ? | UMBS #2257 |

SPECIMEN RECORDS FOR MINNESOTA.

| DATE | LOCATION | SEX | SOURCE |
|------------------|--------------|-----|--|
| 22 March 1889 | Marshall Co. | f | JFBMNH #3559 |
| fall 1889 | Elk River | ? | USBBSA #11151 |
| ? January 1890 | Elk River | ? | USBBSA #1009 |
| 25 February 1896 | Kittson Co. | f | FM #138187 |
| ? December 1896 | Aitkin Co. | m | CU #30080 |
| 5 January 1897 | Aitkin Co. | f | JFBMNH #4113 |
| 27 January 1897 | Aitkin Co. | m | JFBMNH #4110 |
| 4 February 1897 | Itasca Co. | f | MPM #19298 |
| 3 March 1897 | Aitkin Co. | m | JFBMNH #4112 |
| 19 January 1898 | Aitkin Co. | f | JFBMNH #4114 |
| ? February 1898 | Itasca Co. | f | MPM #19299 |
| ? February 1898 | Itasca Co. | ? | USBBSA #27503 |
| ? February 1898 | Marshall Co. | m | FM #138188 |
| 23 November 1898 | Aitkin Co. | m | UCMVZ #106977 |
| ? January 1902 | Marshall Co. | f | FM #138189 |
| 20 October 1902 | Aitkin Co. | f | JFBMNH #4111 |
| 26 January 1903 | Aitkin Co. | m | ROM #42057 |
| winter 1906-1907 | Minnesota | ? | "13 reported by taxidermists" (Deane 1907a) |

| | | | |
|-------------------|---------------|---|----------------|
| ? November 1910 | Grygla | f | SBM |
| fall 1913 | Minneapolis | ? | UIMNH |
| fall 1913 | Minneapolis | ? | CCM #907 |
| 25 November 1914 | Roseau Co. | ? | USBBSA #125798 |
| 13 January 1915 | Roseau Co. | f | JFBMNH #2747 |
| 19 November 1919 | Watkeson | ? | USBBSA #155071 |
| 5 December 1919 | Roseau Co. | ? | USBBSA #159263 |
| 24 January 1920 | Roseau Co. | ? | USBBSA #179125 |
| 3 February 1920 | Roseau Co. | f | PMZ #16074 |
| 7 April 1920 | Roseau Co. | f | UMMZ #56180 |
| 20 April 1920 | Roseau Co. | f | UMMZ #56181 |
| 26 September 1920 | Roseau Co. | ? | USBBSA #159272 |
| 5 November 1920 | Roseau Co. | ? | USBBSA #179151 |
| 23 November 1920 | Roseau Co. | m | UCMVZ #145510 |
| 4 November 1922 | Roseau Co. | f | DMNH #5502 |
| 8 January 1923 | Roseau Co. | m | DMNH #5501 |
| 12 January 1923 | Roseau Co. | m | DMNH #5500 |
| 14 January 1923 | McLeod Co. | f | JFBMNH #7503 |
| 2 February 1923 | Roseau Co. | ? | UIMNH #1329 |
| 5 February 1923 | Roseau Co. | ? | UIMNH #1330 |
| 15 November 1923 | Roseau Co. | f | ISM #602791 |
| 4 January 1926 | Roseau Co. | ? | USBBSA #187018 |
| 22 January 1926 | Roseau Co. | ? | USBBSA #179123 |
| 24 January 1926 | Roseau Co. | f | DMNH #5503 |
| 25 January 1926 | Miskinock Co. | f | PMZ #16076 |
| 31 January 1926 | Roseau Co. | ? | USBBSA #179126 |

| | | | |
|-------------------|-----------------|---|-----------------------------------|
| 1 February 1926 | Roseau Co. | f | PMZ #16073 |
| 3 February 1926 | Roseau Co. | ? | USBBSA #179128 |
| 3 February 1926 | Roseau Co. | f | UMMZ #118802 |
| 8 February 1926 | Roseau Co. | m | PMZ #16075 |
| 10 February 1926 | Roseau Co. | m | SBCM |
| 10 February 1926 | Roseau Co. | ? | USBBSA #179130 |
| 10 February 1926 | Roseau Co. | ? | USBBSA #179131 |
| 22 February 1926 | Roseau Co. | f | UMMZ #57231 |
| 24 February 1926 | Roseau Co. | f | UCMVZ #145506 |
| 24 February 1926 | Roseau Co. | f | UCMVZ #151874 |
| 24 February 1926 | Roseau Co. | f | UCMVZ #47101 |
| 3 March 1926 | Miskinookla Co. | f | PMZ #16077 |
| 10 April 1926 | Roseau Co. | m | UMMZ #57232 |
| 11 April 1926 | Roseau Co. | m | UMMZ #118801 |
| 20 April 1926 | Roseau Co. | ? | UCMVZ #145508 |
| 25 April 1926 | Roseau Co. | f | R.W. Nero (<u>in litt.</u> 1976) |
| 17 September 1926 | Roseau Co. | m | FM #159616 |
| 10 October 1926 | Roseau Co. | m | FM #159614 |
| 20 October 1926 | Grygla | f | CU #4325 |
| 4 December 1926 | Roseau Co. | f | UCMVZ #145509 |
| 15 December 1926 | Grimstead | f | AMNH #754244 |
| 20 December 1926 | Roseau Co. | ? | USBBSA #179167 |
| 1 January 1927 | Roseau Co. | ? | USBBSA #187029 |
| 16 January 1927 | Roseau Co. | f | UCMVZ #151875 |
| 27 February 1927 | Roseau Co. | ? | USBBSA #187030 |
| 27 February 1927 | Roseau Co. | f | UCMVZ #145507 |

| | | | |
|------------------|------------|---|------------------|
| 28 February 1927 | Roseau Co. | ? | USBBSA #179200 |
| 28 February 1928 | Roseau Co. | f | CCM #906 |
| 17 March 1927 | Roseau Co. | ? | USBBSA #179211 |
| 7 April 1927 | Roseau Co. | ? | USBBSA #179214 |
| 7 April 1927 | Roseau Co. | f | FM #159617 |
| 23 April 1927 | Roseau Co. | f | JFBMNH #7366 |
| 23 April 1927 | Roseau Co. | ? | USBBSA #179216 |
| 24 April 1927 | Roseau Co. | f | FM #160910 |
| 3 November 1927 | Roseau Co. | m | FM #159615 |
| 28 October 1929 | Roseau Co. | ? | NYSMSS |
| 20 December 1931 | Roseau Co. | ? | USBBSA #194863 |
| 22 February 1932 | Roseau Co. | f | UMMZ #126046 |
| 1 March 1932 | Roseau Co. | f | JFBMNH #8259 |
| 15 March 1932 | Roseau Co. | ? | USBBSA #194869 |
| 20 March 1932 | Roseau Co. | f | CMSC #52.117.963 |
| 20 March 1932 | Roseau Co. | ? | USBBSA #194866 |
| 29 August 1932 | Roseau Co. | m | FM #159618 |
| 29 November 1932 | Roseau Co. | m | OSUMNH |
| 5 December 1932 | Roseau Co. | f | OSUMNH |
| 13 December 1932 | Roseau Co. | f | UMMZ #72853 |
| 13 December 1932 | Roseau Co. | m | DMNH #41121 |
| 16 December 1932 | Roseau Co. | f | UKMNH #20093 |
| 27 December 1932 | Roseau Co. | f | CMSC #52.117.962 |
| 7 January 1933 | Roseau Co. | m | UMMZ #126042 |
| 7 January 1933 | Roseau Co. | m | PMNH #1635 |
| 27 January 1933 | Roseau Co. | m | PMNH #1635 |

| | | | |
|------------------|--------------|---|---|
| 10 February 1933 | Roseau Co. | m | UMMZ #126044 |
| 8 March 1933 | Roseau Co. | f | CMNH #25003 |
| 16 March 1933 | Roseau Co. | m | UFSM #9086 |
| 30 December 1933 | Roseau Co. | ? | UMMZ #73512 |
| 7 March 1934 | Roseau Co. | ? | UMMZ #73215 |
| 15 December 1934 | Roseau Co. | f | UCMVZ #67004 |
| 11 January 1935 | Roseau Co. | m | CM #116312 |
| 20 January 1935 | Roseau Co. | f | CM #116313 |
| 22 February 1935 | Roseau Co. | f | UCMVZ #67013 |
| 30 November 1935 | Roseau Co. | f | UIMNH #29117 |
| 17 December 1935 | Roseau Co. | m | UMMZ #126045 |
| 3 January 1936 | Roseau Co. | f | UMMZ #126047 |
| 20 March 1936 | Roseau Co. | m | UIMNH #329771 |
| 28 December 1942 | Roseau Co. | f | LSUMZ #7981 |
| 2 February 1956 | Roosevelt | ? | JFBMNH #23885 |
| ? ? 1960 | Minnesota | ? | BSM #1136 |
| 20 March 1960 | Beltrami | f | JFBMNH #16081 |
| 23 April 1966 | Carlton Co. | ? | "35 found" (American Birds 20:427) |
| 21 December 1968 | Lake Co. | ? | American Birds 23: 485 |
| 28 February 1969 | Le Soeur Co. | ? | American Birds 23: 485 |
| 8 March 1969 | Wadena Co. | m | JFBMNH #26305 |
| 8 March 1969 | Wadena Co. | m | JFBMNH #27524 |
| 8 March 1969 | Wadena Co. | ? | "2 found" (American Birds 23: 485) |
| ? May 1971 | Itasca Co. | ? | J.S. Mahner (R.W. Nero <u>in litt.</u> 1976) |
| 23 November 1972 | Wadena Co. | f | JFBMNH |
| ? September 1974 | Duluth | ? | American Birds 29: 63 |

SPECIMEN RECORDS FOR MONTANA.

| DATE | LOCATION | SEX | SOURCE |
|-------------------|----------------|-----|-----------------------------------|
| 24 December 1900 | Columbia Falls | m | FM #138190 |
| 1 December 1901 | Flathead River | f | USNMNH |
| 31 December 1910 | Cornwallis | f | JFBMNH #5168 |
| 2 December 1911 | Cornwallis | f | JFBMNH #5169 |
| winter 1917-1918 | Billings | ? | Saunders (1921) |
| 17 December 1923 | Bozeman | f | ISM #602790 |
| 22 November 1949 | Missoula Co. | f | UMtZM #1830 |
| 29 March 1955 | Bozeman | m | MSUVM #1390 |
| 18 September 1955 | Missoula Co. | f | UMtZM #4102 |
| ? ? 1956 | Blackfoot | ? | MMW |
| 4 March 1965 | Bozeman | ? | MSUMR #4718 |
| 15 February 1971 | Bozeman | ? | MSUMR #5743 |
| 11 March 1974 | Bozeman | ? | MSUFGL |
| 24 July 1974 | Billings | ? | MSUFGL |
| ? May 1975 | Polson | ? | M. Bishop (<u>in litt.</u> 1976) |

SPECIMEN RECORDS FOR NEBRASKA.

| DATE | LOCATION | SEX | SOURCE |
|------------------|----------|-----|-------------|
| 17 December 1893 | Omaha | ? | Bent (1938) |

SPECIMEN RECORDS FOR NEW BRUNSWICK.

| DATE | LOCATION | SEX | SOURCE |
|----------------|-------------|-----|--------------|
| 7 January 1888 | Carlton Co. | m | FM #20937 |
| 22 March 1906 | Fredericton | f | Moore (1906) |

SPECIMEN RECORDS FOR NEWFOUNDLAND AND LABRADOR.

| DATE | LOCATION | SEX | SOURCE |
|------------------|----------|-----|--------------------------|
| 15 February 1935 | Red Bay | f | BCNH #5388 (Bailey 1939) |

SPECIMEN RECORDS FOR NEW HAMPSHIRE.

| DATE | LOCATION | SEX | SOURCE |
|-----------------|---------------|-----|--|
| ? ? 1891 | New Hampshire | ? | FMP |
| ? March 1904 | Manchester | ? | "reported by Goodhue" (M. Keith <u>in litt.</u> 1976) |
| ? December 1906 | Concord | ? | Griscom (1949) |
| ? December 1910 | Sudbury | ? | Griscom (1949) |
| 5 November 1922 | Webster | ? | "reported by Berwick" (M. Keith <u>in litt.</u> 1976) |
| 3 March 1971 | Franconia | ? | American Birds 25: 552 |

SPECIMEN RECORDS FOR NEW JERSEY.

| DATE | LOCATION | SEX | SOURCE |
|-----------------|------------|-----|-------------|
| ? December 1859 | Sussex Co. | ? | Bent (1938) |

SPECIMEN RECORDS FOR NEW YORK.

| DATE | LOCATION | SEX | SOURCE |
|------------------|-------------------|-----|---------------------------|
| ? February 1875 | Oneida Co. | ? | Yunick (1972) |
| ? March 1879 | Adirondacks | ? | PMNH #1637 |
| 15 March 1883 | Franklin Co. | ? | Stoner (1938) |
| 10 February 1887 | Steuben Co. | f | Wood (1888) |
| 17 December 1889 | Lewis Co. | f | Miller (1890) |
| 1890-1895 | St. Laurence Co.? | | "3 found" (Dutcher 1895) |
| ? February 1895 | Oneida Co. | ? | Yunick (1972) |
| 29 December 1902 | Orient | ? | Bull (1964) |
| 15 November 1906 | Fulton Co. | ? | Alexander (1907) |
| 16 December 1906 | Fulton Co. | ? | Alexander (1907) |
| 1 January 1907 | Malone | m | Deane (1907a) |
| 2 January 1907 | Champlain | m | Deane (1907a) |
| fall 1919 | St. Laurence Co.? | | NYSM #5967, Stoner (1938) |
| winter 1926-1927 | Madison Co. | ? | Stoner (1945) |
| ? December 1930 | Franklin Co. | ? | Stoner (1945) |
| 16 January 1931 | Westville | ? | Stoner (1945) |
| 5 March 1937 | Chile | ? | Yunick (1972) |

SPECIMEN RECORDS FOR NORTH DAKOTA.

| DATE | LOCATION | SEX | SOURCE |
|------------------|-------------|-----|--------------|
| ? January 1892 | Grand Forks | ? | Wood (1923b) |
| 3 February 1900 | Pembina | ? | Wood (1923b) |
| 21 November 1916 | Grafton | m | UNDM |

SPECIMEN RECORDS FOR NORTHWEST TERRITORIES.

| DATE | LOCATION | SEX | SOURCE |
|----------------|-------------------|-----|--|
| before 1831 | Great Bear L. | ? | "5 taken" (Swainson and Richardson 1831) |
| 4 May 1894 | Fort Rae | f | UIMNH #11085 |
| 22 April 1904 | Mackenzie River | f | Preble (1908) |
| 20 May 1904 | Ft. Providence | m | USNMNH #195470 |
| 22 May 1904 | Fort Simpson | f | USNMNH #195471 |
| 6 June 1904 | Nahanni River | f | USNMNH #195422 |
| ? January 1922 | Athabasca Landing | ? | Williams (1922) |
| winter 1948 | Reindeer Statn. | ? | Stevens and Höhn (1958) |

SPECIMEN RECORDS FOR NOVA SCOTIA.

| DATE | LOCATION | SEX | SOURCE |
|-------|----------|-----|-------------|
| ? ? ? | Halifax | ? | AMNH #45014 |

SPECIMEN RECORDS FOR OHIO.

| DATE | LOCATION | SEX | SOURCE |
|-----------------|--------------|-----|--------------|
| ? November 1898 | Trumbull Co. | ? | OSUMZ #16625 |

SPECIMEN RECORDS FOR ONTARIO.

| DATE | LOCATION | SEX | SOURCE |
|------------------|---------------|-----|-------------------------------|
| ? June 1772 | Severn River | ? | Forster (1772); type specimen |
| 25 June 1860 | James Bay | ? | Todd (1963) |
| ? ? 1862 | Moose Factory | m | USNMNH #32306 |
| 29 November 1877 | Ottawa | m | UIMNH #15819 |
| ? May 1882 | Lake Huron | ? | AMNH #450950 |
| 23 October 1889 | Sudbury | f | UCM #2340 |
| 24 October 1889 | L. Nipissing | ? | USBBSA #1008A |
| 2 December 1889 | Toronto | m | ROM #42065 |
| 20 December 1889 | Lone Park | f | ANSP #44371 |
| 20 December 1889 | Haliburton | ? | USBBSA #10805 |
| 27 December 1889 | Muskokie | ? | USBBSA #10806 |
| 29 January 1890 | Beaverton | ? | USBBSA #10807 |
| 13 March 1890 | Hastings Co. | f | ROM #42051 |
| ? December 1890 | Toronto | m | ROM #42064 |
| ? December 1890 | Hamilton | f | ROM #42058 |
| ? December 1893 | Muskoka | ? | McIlwraith (1894) |
| ? January 1894 | Toronto | ? | Fleming (1907) |

| | | | |
|------------------|--------------|---|-------------------------|
| ? January 1895 | Lake Simcoe | f | CM #20480 |
| ? January 1895 | Amcoe | m | FM #39861 |
| 15 January 1895 | Toronto | f | ROM #69288 |
| 25 January 1895 | Hamilton | m | ROM #42052 |
| ? February 1895 | Lake Simcoe | m | CM #20481 |
| 11 March 1895 | Toronto | m | ROM #42063 |
| 31 January 1896 | York County | m | ROM #42055 |
| 8 February 1896 | York County | m | ROM #42056 |
| 3 April 1896 | Ottawa | ? | Lloyd (1944) |
| 18 December 1899 | Lake Simcoe | f | CM #44.78.3 |
| ? January 1902 | Prescott Co. | ? | AMNH #360879 |
| ? ? 1903 | Toronto | ? | "2 taken" (Macoun 1903) |
| ? November 1905 | South March | ? | Eifrig (1906) |
| ? February 1906 | Ottawa | ? | Eifrig (1911) |
| ? January 1907 | Ottawa | ? | "2 taken" (Eifrig 1911) |
| 3 January 1907 | Port Credit | m | ROM #42046 |
| 1 February 1907 | York County | f | ROM #42049 |
| 8 March 1907 | Hastings Co. | m | ROM #42060 |
| 19 March 1908 | Ottawa | ? | Eifrig (1911) |
| 11 February 1911 | Toronto | ? | Fleming (1913) |
| 15 February 1911 | Toronto | ? | Fleming (1913) |
| 20 February 1911 | York County | f | ROM #42050 |
| 31 July 1911 | Nipissing | ? | ROM #42047 |
| 31 July 1911 | Nipissing | ? | NMNS #4761 |
| 19 October 1912 | Moosonee | f | CM #40601 |
| 28 October 1914 | Moosonee | f | CM #49875 |

| | | | |
|------------------|----------------|---|-------------------------|
| 28 October 1914 | Moose Factory | ? | USBBSA #132822 |
| 6 November 1914 | Dean Lake | ? | NMNS #7763 |
| 9 November 1914 | Moosonee | f | CM #49929 |
| ? ? 1914 | Prescott Co. | f | HUMCZ #252380 |
| 20 October 1915 | Abitibi River | f | CM #50579 |
| 17 January 1918 | Prescott Co. | m | UCLADC #27333 |
| ? December 1922 | Ottawa | ? | "2 taken" (Lloyd 1944) |
| 18 February 1926 | Mt. Albert | ? | USBBSA #11096 |
| fall 1927 | North Bay | ? | Ricker and Clark (1939) |
| ? ? 1927 | Moose Factory | ? | ROM |
| 9 February 1928 | Woodville | f | ROM |
| ? December 1932 | Thunder Bay | f | ROM #78424 |
| 27 January 1933 | Heaslip | m | ROM #69289 |
| ? December 1946 | Pembroke | m | ROM #74171 |
| 22 January 1947 | Aldershot | f | ROM #74090 |
| 21 February 1947 | Toronto Island | f | ROM #74101 |
| 13 May 1947 | Manitoulin | ? | ROM #74909 |
| 8 October 1950 | Thunder Bay | f | ROM #78424 |
| 23 November 1950 | Thunder Bay | f | DMNH #4122 |
| 8 December 1950 | Thunder Bay | m | ROM #77372 |
| 17 December 1951 | Thunder Bay | m | ROM #78847 |
| 25 February 1951 | Huntermville | ? | ROM #78688 |
| winter 1950-1951 | Swastika | ? | "36 found" (Todd 1963) |
| 20 November 1955 | North Bay | m | ROM #75118 |
| 19 October 1956 | Matheson | f | NMNS #40956 |
| ? March 1963 | Coldwater | f | ROM #93564 |

| | | | |
|-----------------|----------------|---|-------------|
| 20 March 1965 | Renfrew | m | NMNS #52873 |
| 8 February 1966 | Bruce Mines | f | NMNS #54827 |
| ? February 1966 | Huntsville | ? | ROM #96747 |
| 5 April 1966 | Carleton Place | f | NMNS #53661 |
| ? April 1966 | Stittsville | m | NMNS #53662 |

SPECIMEN RECORDS FOR OREGON.

| DATE | LOCATION | SEX | SOURCE |
|-------------------|-----------------|-----|------------------------------|
| ? ? 1897 | Milwaukie | f | Jewett and Gabrielson (1929) |
| 11 December 1914 | Sherwood | f | CSDNHM #22243 |
| 10 November 1915 | Morrow Co. | m | CSDNHM #22240 |
| 19 January 1916 | Pendleton Co. | m | HUMCZ #252381 |
| 18 October 1922 | Grant Co. | m | CSDNHM #22245 |
| 17 December 1925 | Williamette V. | ? | Gullion (1951) |
| 1 January 1927 | Jackson Co. | ? | UCMVZ #69985 |
| ? December 1929 | Jackson Co. | ? | Stevenson and Fitch (1933) |
| 13 September 1930 | Wallowa Co. | ? | CSDNHM #22241 |
| 8 October 1930 | Grant Co. | f | PMNH #9358 |
| 14 August 1932 | Morrow Co. | m | CSDNHM #22244 |
| 14 August 1932 | Morrow Co. | m | FWSFCC |
| 19 August 1934 | Wallowa Co. | m | CSDNHM #22242 |
| 4 June 1950 | Ft. Klamath Co. | f | UPSMNH |
| 8 November 1953 | Wheeler Co. | ? | OSUMNH |
| ? ? ? | Ft. Klamath | ? | OSUMNH |

SPECIMEN RECORDS FOR QUEBEC.

| DATE | LOCATION | SEX | SOURCE |
|--------------------|----------------|-----|-----------------------------------|
| winter 1873 | Quebec | ? | HUMCZ #315349 |
| 18 November 1904 | Riv. du Canard | f | LMC/JPCM #2341 |
| 1 February 1906 | Templeton | ? | Eifrig (1906) |
| 19 January 1911 | Ayers Cliff | ? | Mousely (1918) |
| ? ? 1920 | Quebec | m | MURM #537 |
| 5 November 1922 | Lanoraie | f | MURM #539 |
| 11 December 1922 | Tenager | ? | USBBSA #166931 |
| 5 January 1928 | Ile aux Grues | m | NMNS #60784 |
| 23 May 1928 | Pt. Natashquan | ? | Todd (1963) |
| 10 January 1937 | Chicoutimi | f | GQCS #4219 |
| 16 February 1939 | Beaupré | m | GQCS #4230 |
| 21 January 1940 | Ile aux Grues | m | GQCS #4231 |
| 25 December 1946 | Cap à L'Aige | ? | CSAP |
| ? December 1962 | Lac de l'Est | ? | CSAP |
| ? February 1967 | Cap Tourment | ? | Bulletin Ornithologie 12: 12 |
| 15 December 1968 | Tadoussac | ? | CSAP |
| January-March 1973 | Hull | ? | "2 found" (American Birds 27:594) |
| 26 January 1974 | Cap Tourmente | ? | Bulletin Ornithologie 19: 7 |

SPECIMEN RECORDS FOR RHODE ISLAND.

| DATE | LOCATION | SEX | SOURCE |
|------------------|--------------|---------|---------|
| ? ? 1870 | Rhode Island | ? Deane | (1907b) |
| 19 November 1906 | Providence | m Deane | (1907b) |

SPECIMEN RECORDS FOR SASKATCHEWAN.

| DATE | LOCATION | SEX | SOURCE |
|------------------|--------------|-------------|----------------|
| ? ? 1896 | Duck Lake | ? USNMNH | #154429 |
| ? March 1899 | St. Louis | m USNMNH | #175257 |
| ? March 1906 | Saskatchewan | m ROM | |
| ? ? 1925 | Tisdale | ? Houston | (1957) |
| ? ? 1936 | Sintaluta | ? Houston | (1957) |
| 25 February 1938 | Carrot River | ? Houston | (1957) |
| winter 1938 | Carrot River | ? Houston | (1957) |
| ? ? 1939 | Torch River | ? Francis | (1948) |
| ? ? 1940 | Moosedale | ? Missler | (1948) |
| ? July 1951 | Sylvania | ? Houston | (1957) |
| 29 March 1952 | Watapi Lake | f RMNH | |
| 27 March 1954 | Spirit Lake | ? RMNH | |
| spring 1954 | Pleasantdale | ? NYZS | |
| winter 1955 | Candle Lake | ? Houston | (1957) |
| ? December 1955 | Codette | ? Houston | (1959) |
| ? January 1956 | Reserve | ? "2 found" | (Houston 1957) |

| | | | |
|------------------|----------------|---|------------------------------------|
| ? November 1959 | Cader | f | RMNH #7360 |
| winter 1959-1960 | Etomani | ? | Houston (1962) |
| 8 November 1962 | Pelly | ? | RMNH #8645 |
| 9 November 1968 | Red Earth Res. | ? | RMNH #12040 |
| winter 1970 | Emma Lake | f | R. Gehlert (<u>in litt.</u> 1976) |

SPECIMEN RECORDS FOR UTAH.

| DATE | LOCATION | SEX | SOURCE |
|--------------|----------|-----|------------------------|
| 6 March 1960 | Logan | ? | American Birds 14: 329 |

SPECIMEN RECORDS FOR VERMONT.

| DATE | LOCATION | SEX | SOURCE |
|-----------------|-----------------|-----|---------------|
| ? January 1889 | Franklin Co. | ? | Brush (1890) |
| ? January 1889 | Chittenden Co. | ? | Brush (1890) |
| ? ? 1891 | Vermont | f | FMP |
| 2 January 1907 | Shelburne | f | Deane (1907a) |
| 2 February 1907 | Sth. Burlington | f | Deane (1907a) |
| 7 February 1907 | Colchester | f | Deane (1907a) |
| 7 February 1907 | Colchester | m | Deane (1907a) |

SPECIMEN RECORDS FOR WASHINGTON.

| DATE | LOCATION | SEX | SOURCE |
|-------------------|---------------|-----|-----------------------------|
| ? May 1896 | Lake Whatcom | ? | Jewett <u>et al.</u> (1953) |
| 19 November 1897 | Seattle | ? | TBMWSM #16557 |
| 19 November 1899 | Seattle | f | Jewett <u>et al.</u> (1953) |
| 21 November 1899 | Seattle | ? | Rathburn (1902) |
| 27 December 1908 | Wilkenson | m | UCLADC #21005 |
| 27 December 1908 | Wilkenson | m | Jewett <u>et al.</u> (1953) |
| ? December 1914 | Dayton | ? | Dice (1918) |
| ? November 1926 | Ferry Co. | ? | TBMWSM #7925 |
| ? October 1937 | Tonasket | ? | Jewett <u>et al.</u> (1953) |
| ? November 1937 | Lewis Co. | ? | Jewett <u>et al.</u> (1953) |
| 16 September 1939 | Tunk Mountain | ? | Jewett <u>et al.</u> (1953) |
| 14 February 1953 | Whitman Co. | m | CMs #54-1 |

SPECIMEN RECORDS FOR WISCONSIN.

| DATE | LOCATION | SEX | SOURCE |
|-----------------|--------------|-----|---------------------------|
| 12 March 1916 | Beaver Dam | ? | USBBSA #136263 |
| 1 November 1965 | Douglas Co. | ? | Bernard and Klugow (1966) |
| ? January 1969 | Clark Co. | ? | ISUM |
| ? February 1969 | Chippewa Co. | ? | Passenger Pigeon 31: 181 |

SPECIMEN RECORDS FOR WYOMING.

| DATE | LOCATION | SEX | SOURCE |
|------------------|-----------------|-----|--------------|
| ? December 1910 | St. Anthony | ? | Bent (1938) |
| 27 August 1931 | Yellowstone Pk. | ? | Long (1941) |
| 28 August 1931 | Yellowstone Pk. | ? | Long (1941) |
| 2 December 1931 | Yellowstone Pk. | ? | Long (1941) |
| 19 November 1946 | Jackson | f | UMMZ #114459 |
| 15 October 1949 | Grand Teton Pk. | ? | GINPM #512 |
| ? ? 1956 | Yellowstone Pk. | f | YNPM |
| 16 August 1961 | Yellowstone Pk. | f | UMtZM #7000 |
| summer 1964 | Yellowstone Pk. | ? | UMtZM #12382 |

SPECIMEN RECORDS FOR YUKON TERRITORIES.

| DATE | LOCATION | SEX | SOURCE |
|-------------------|---------------|-----|--------------|
| 15 February 1898 | Yukon | m | UCMVZ #4972 |
| 10 September 1900 | Yukon | m | UCMVZ #4973 |
| 10 December 1900 | Yukon | f | UCMVZ #4974 |
| 2 September 1912 | Teslin Lake | f | USNMNH #6558 |
| 2 September 1912 | Teslin Lake | m | USNMNH #6557 |
| 15 September 1912 | Teslin Lake | m | USNMNH #6589 |
| 9 October 1912 | Lower Hoot R. | f | USNMNH #6661 |
| 24 June 1916 | Dawson | f | CASM #19437 |
| 28 June 1926 | Old Crow | m | USNMNH |

| | | | |
|------------------|------------|---|----------------|
| 14 June 1940 | Old Crow | m | PWRC |
| 2 September 1944 | Flat Creek | m | ROM #71328 |
| 3 May 1957 | Old Crow | f | USNMNH #468080 |

¹The museums providing some of these data were: Alberta Provincial Museum and Archives (APMA), American Museum of Natural History (AMNH), Bailey Collection of Natural History (BCNH), Bemidji State Museum (BSM), Boston Museum of Science and Hayden Planetarium (BMSHP), British Columbia Provincial Museum (BCPM), United States Bureau of Biological Surveys Accessions (USBBSA), California Academy of Science Museum (CASM), Canadian National Museum of Natural Sciences (NMNS), Carnegie Museum (CM), Charleston Museum of South Carolina (CMSC), Cincinnati Museum of Natural History (CMNH), Cleveland Museum of Natural History (CMH), Coe College Museum (CCM), College de Sainte-Anne-de-la-Pocatiere (CSAP), Conner Museum (CMs), Cornell University (CU), Delaware Museum of Natural History (DMNH), Fairbanks Museum and Planetarium (FMP), Field Museum (FM), Gouvernement du Quebec Complexe Scientifique (GQCS), Grand Teton National Park Museum (GTNPM), Harvard University Museum of Comparative Zoology (HUMCZ), Illinois State Museum (ISM), Iowa State University Museum (ISUM), James Ford Bell Museum of Natural History (JFBMNH), Kingman Museum of Natural History (KMNH), Little Northern Museum (LNM), Los Angeles County Natural History Museum (LACNHM), Louisiana State University Museum of Zoology (LSUMZ), Loye Miller College/Jean Poitras College Museum (LMC/JPCM), Manitoba Museum of Man and Nature (MMN), McGill University Redpath Museum (MURM), Milwaukee Public Museum (MPM), Montana State University Fish and Game Lab (MSUFG), Montana State University Museum of the Rockies (MSUMR), Montana State University Vertebrate Museum (MSUVM), Museum of Montana Wildlife (MMW), New Hampshire Fish and Game Department (NHFGD), New York State Museum and Science Service (NYSMSS), North Carolina State Museum of Natural History (NCSMNH), Ohio State University Museum of Zoology (OSUMZ), Oregon State University Museum of Natural History (OSUMNH), Patuxent Wildlife Research Center (PWRC), Peabody Museum of Natural History (PMNH), Philadelphia Academy of Natural Sciences (PANS), Princeton Museum of Zoology (PMZ), Regina Museum of Natural History (RMNH), Rogers Environmental Education Center (REEC), Royal Ontario Museum (ROM), St. Bonaventure University Museum (SBM), San Bernardino County Museum (SBCM), San Diego County Natural History Museum (SDCNHM), Springfield Science Museum (SSM), Strecker Museum (SM), Thomas Burke Memorial Washington State Museum (TBMWSM), United States National Museum of Natural History (USNMNH), University of Alberta Museum of Zoology (UAMZ), University of Arizona Museum (UAM), University of British Columbia Zoology Museum (UBCZM), University of California at Los Angeles Dickey Collection (UCLADC), University of California Museum of Vertebrate Zoology (UCMVZ), University of Colorado Museum (UCM), University of Florida State Museum (UFSM), University of Idaho Museum (UIM), University of Iowa Museum of Natural History (UIMNH), University of

Kansas Museum of Natural History (UKMNH), University of Manitoba Zoology
Musuem (UMZM), University of Michigan Biological Station (UMBS),
University of Michigan Museum of Zoology (UMMZ), University of Montana
Zoology Museum (IMtZM), University of North Dakota Museum (UNDM),
University of Puget Sound Museum of Natural History (UPSMNH), Western
Foundation of Vertebrate Zoology (WVZ), Yellowstone National Park
Museum (YNPM).

Appendix IV. Great Gray Owl sight records in North
America.

SIGHT RECORDS FOR ALASKA.

| DATE | LOCATION | SOURCE |
|-------------------|-------------------|--|
| 28 July 1936 | Yukutat | 1 seen (Shortt 1939) |
| 2 August 1959 | Brooks Range | 1 seen (Campbell 1969) |
| 4-6 February 1971 | Kenai Moose Range | 1 seen (L.N. Ellison <u>in litt.</u> 1976) |
| 16 August 1971 | North Gulf Coast | 1 seen (Isleib and Kessel 1973) |
| ? August 1972 | Mi. 1408 Ak. Hwy. | 1 seen (L.G. Swartz <u>in litt.</u> 1976) |

SIGHT RECORDS FOR ALBERTA.

| DATE | LOCATION | SOURCE |
|-------------------|-------------------|---|
| ? ? 1903 | Lesser Slave Lake | 1 seen (Macoun and Macoun 1909) |
| ? ? 1903 | Peace R. Landing | 1 seen (Macoun and Macoun 1909) |
| 1 May 1954 | Corbett Creek | 1 seen (E.T. Jones <u>in litt.</u> 1976) |
| 27 November 1966 | Nojack | 1 seen (E.T. Jones <u>in litt.</u> 1976) |
| winter 1973-1974 | Elk Island Park | 13 seen (American Birds 28: 654) |
| 27 December 1973 | Bearberry | 1 seen (American Birds 28: 654) |
| 3 February 1974 | Edson | 15 seen (American Birds 28: 654) |
| 9 February 1974 | Edson | 9 seen (American Birds 28: 654) |
| 10 February 1974 | Edson | 13 seen (American Birds 28: 654) |
| 6 March 1974 | Timeu | 1 seen (A.F. Oeming <u>in litt.</u> 1976) |
| 9 March 1974 | Corbett Creek | 2 seen (A.F. Oeming <u>in litt.</u> 1976) |
| 9 March 1974 | Vega River Flats | 2 seen (A.F. Oeming <u>in litt.</u> 1976) |
| 27 September 1975 | Cremona | 1 seen (American Birds 30: 89) |
| 2 April 1976 | Wood Buffalo Park | 2 seen (K. Walker pers. comm. 1976) |

SIGHT RECORDS FOR BRITISH COLUMBIA.

| DATE | LOCATION | SOURCE |
|------------------|------------------|--|
| ? November 1887 | Chilliwack | reported by Macoun (1903) |
| ? January 1890 | Sumas | 1 seen (Macoun 1903) |
| winter 1938 | Lake Tetana | 1 seen (Fletcher 1943) |
| 24 February 1939 | Moyie | 1 seen (Johnstone 1949) |
| 27 February 1939 | Moyie | 1 seen (Johnstone 1949) |
| ? December 1958 | 100-Mile House | 1 seen (Can. Field-Nat. 73: 29-47) |
| 11 May 1959 | Clearwater River | 1 seen (Edwards and Ritcey 1967) |
| ? June 1962 | Wonowon | 2 seen (BCPM Photo-File) |
| 6 November 1964 | Big Creek | 1 seen (BCPM Photo-File) |
| 7 June 1969 | Prince George | 1 seen (J. Grant <u>in litt.</u> 1976) |
| 12, 14 June 1969 | Prince George | 1 seen (J. Grant <u>in litt.</u> 1976) |
| 20 December 1969 | Mt. Robson | 1 seen (E.T. Jones <u>in litt.</u> 1976) |
| 26 January 1970 | Prince George | 1 seen (J. Grant <u>in litt.</u> 1976) |
| 10-14 June 1970 | Prince George | 2 seen (American Birds 24: 700) |
| 3 July 1972 | Driftwood River | 2 seen (BCPM Photo-File) |
| ? February 1973 | Mt. Robson | 1 seen (BCPM Photo-File) |
| 23 March 1973 | Cranbrook | 1 seen (BCPM records) |
| 1 June 1973 | Chilcotin | 1 seen (BCPM Photo-File) |
| 1 June 1973 | Merritt | 1 seen (BCPM Photo-File) |
| 14 February 1974 | Maple Ridge | 1 seen (BCPM Photo-File) |
| 25 February 1974 | Haney | 1 seen (BCPM records) |
| 8 November 1974 | Aspen Grove | 1 seen (J. Grant <u>in litt.</u> 1976) |
| 26 January 1975 | Aldergrove | 1 seen (BCPM records) |

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| 12 June 1975 | Kootenay Park | 1 seen (R.W. Campbell <u>in litt.</u> 1976) |
| 20 June 1975 | Atlin | 1 seen (R.W. Campbell <u>in litt.</u> 1976) |
| 23 June 1975 | Garibaldi Park | 1 seen (BCPM records) |
| 30 June 1975 | Garibaldi Park | 1 seen (BCPM records) |
| 9 July 1975 | Garibaldi Park | 1 seen (BCPM records) |
| 24 August 1975 | Boucher Creek | 2 seen (R.W. Campbell <u>in litt.</u> 1976) |

SIGHT RECORDS FOR CALIFORNIA.

| DATE | LOCATION | SOURCE |
|-------------------|--------------------|---|
| 1854-1855 | Sacramento Co. | 1 seen (Grinnell 1915) |
| ? ? 1890 | Butte Co. | 1 seen (Grinnell 1915) |
| 12 May 1894 | Plumas Co. | 1 seen (Grinnell and Miller 1944) |
| 1 July 1915 | Yosemite Nat. Park | 1 seen (Grinnell 1924) |
| ? July 1931 | Yosemite Nat. Park | 1 seen (Jensen 1931) |
| 22 July 1941 | Yosemite Nat. Park | 1 seen (Grinnell and Miller 1944) |
| 17 September 1941 | Yosemite Nat. Park | 1 seen (Grinnell and Miller 1944) |
| 23 June 1944 | Yosemite Nat. Park | 1 seen (Dixon 1944) |
| 26 August 1960 | Mono Co. | 2 seen (Billeb 1962) |
| 27 April 1972 | Yosemite Nat. Park | 1 seen (K. Smith <u>in litt.</u> 1976) |
| ? April 1974 | Del Norte Co. | 1 seen (S.W. Harris <u>in litt.</u> 1976) |

SIGHT RECORDS FOR CONNECTICUT.

| DATE | LOCATION | SOURCE |
|-----------------|-----------|------------------------|
| 4 February 1934 | New Haven | 1 seen (Eliot 1934) |
| 12 January 1938 | Hartford | 1 seen (Griswold 1938) |

SIGHT RECORDS FOR IDAHO.

| DATE | LOCATION | SOURCE |
|------------------|----------------|--|
| ? December 1910 | Fremont Co. | 1 reported (Bent 1938) |
| 21 February 1970 | Fremont Co. | 1 seen (C.H. Trost <u>in litt.</u> 1976) |
| 5 September 1970 | Jefereson Co. | 1 seen (C.H. Trost <u>in litt.</u> 1976) |
| 8 January 1972 | Bingham Co. | 1 seen (C.H. Trost <u>in litt.</u> 1976) |
| 4 September 1972 | Caribou Co. | 1 seen (C.H. Trost <u>in litt.</u> 1976) |
| 28 January 1973 | Bingham Co. | 1 seen (C.H. Trost <u>in litt.</u> 1976) |
| ? September 1974 | Bonneville Co. | 1 seen (R. Drewien <u>in litt.</u> 1976) |
| ? October 1974 | Caribou Co. | 1 seen (R. Drewien <u>in litt.</u> 1976) |

SIGHT RECORDS FOR MAINE.

| DATE | LOCATION | SOURCE |
|------------------|----------------|---------------------------------|
| ? March 1943 | Portland | 1 reported (Palmer 1949) |
| 19 February 1971 | Biddeford Pool | 1 seen (American Birds 25: 552) |
| 20 January 1972 | Hancock Co. | 1 seen (American Birds 26: 579) |

SIGHT RECORDS FOR MANITOBA.

| DATE | LOCATION | SOURCE |
|-------------------|----------------|--|
| ? ? 1911 | Winnipeg | 1 seen (Lawrence 1928) |
| ? February 1918 | Kalevala | 1 seen (Norman 1920) |
| 14 February 1928 | Teulon | 1 seen (Lawrence 1928) |
| ? January 1933 | Whitemouth | 2 seen (Lawrence 1933) |
| ? January 1934 | Whitemouth | 4 seen (Lawrence 1934) |
| 27 December 1936 | Stonewall | 1 seen (Nero 1969) |
| 1948 or 1949 | Selkirk | 1 seen (Nero 1969) |
| 2-3 December 1950 | Petersfield | 2 seen (Lawrence 1950) |
| 12 January 1951 | Stonewall | 1 seen (Shortt 1951) |
| 24 October 1952 | Clarkleigh | 1 seen (Nero 1969) |
| 8 December 1955 | Marchand | 2 seen (Mossop 1956) |
| 21 November 1959 | ? | reported by Shortt (1959) |
| 30 November 1959 | Woodridge | 1 seen (Nero 1969) |
| 16 December 1962 | Beausejour | 1 seen (Manitoba Natural History Society Newsletter No. 2, 1962) |
| winter 1962 | Riverton | many seen (Nero 1969) |
| winter 1963 | Riverton | many seen (Nero 1969) |
| 15 February 1963 | Gypsumville | 1 seen (Nero 1969) |
| 23 March 1963 | Gypsumville | 1 seen (Nero 1969) |
| ? November 1964 | Sprague | 2 seen (Mossop 1965) |
| ? April 1965 | Sprague | 1 seen (Mossop 1965) |
| 16 November 1965 | Steepprock | 1 seen (Nero 1969) |
| ? October 1967 | East Braintree | 1 seen (Nero 1969) |

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| ? November 1967 | Hadashville | 1 seen (Nero 1969) |
| 23-30 October 1968 | Hadashville | 1 seen (Nero 1969) |
| 9 November 1968 | Elma | 2 seen (Nero 1969) |
| 11 November 1968 | Nutimik | 2 seen (Nero 1969) |
| 20 November 1968 | Falcon Lake | 3 or 4 seen (Nero 1969) |
| 23 November 1968 | Elma | 1 seen (Nero 1969) |
| 25 November 1968 | Falcon Lake | 4 or 5 seen (Nero 1969) |
| 1 December 1968 | Richer-Falcon Lake | 7 seen (Nero 1969) |
| 2 December 1968 | Richer-Falcon Lake | 12 seen (Nero 1969) |
| 5 December 1968 | Richer-Falcon Lake | 5 seen (Nero 1969) |
| 1-7 December 1968 | East Braintree | 1 seen (Nero 1969) |
| 14 December 1968 | Falcon Lake | 2 seen (Nero 1969) |
| 15 December 1968 | Hadashville - Falcon Lake | 3 seen (Nero 1969) |
| 20 December 1968 | East Braintree | 3 seen (Nero 1969) |
| 21 December 1968 | Prawda-Moose Lake | 2 seen (Nero 1969) |
| 28 December 1968 | Steinbach | 1 seen (Nero 1969) |
| 29 December 1968 | Pointe du Bois | 1 seen (Nero 1969) |
| 29 December 1968 | Prawda-Falcon Lake | 2 seen (Nero 1969) |
| ? December 1968 | Rennie | 8 seen (Nero 1969) |
| ? December 1968 | Oakbank | 1 seen (Nero 1969) |
| 5 January 1969 | Birch River - Falcon Lake | 11 seen (Nero 1969) |
| 5 January 1969 | Hadashville | 1 seen (Nero 1969) |
| 5 January 1969 | East Braintree | 1 seen (Nero 1969) |
| 8 January 1969 | Winnipeg | 1 seen (Nero 1969) |
| 11 January 1969 | Winnipeg | 1 seen (Nero 1969) |

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| 12 January 1969 | Birch R.-Falcon L. | 6 seen (Nero 1969) |
| 12 January 1969 | Ste. Rita | 3 seen (Nero 1969) |
| 13 January 1969 | Birch River | 8 seen (Nero 1969) |
| 18 January 1969 | Birch R.-Prawda | 9 seen (Nero 1969) |
| 21 January 1969 | Ste. Rita | 1 seen (Nero 1969) |
| 22 January 1969 | Seven Sisters | 1 seen (Nero 1969) |
| 23 January 1969 | Birch River | 1 seen (Nero 1969) |
| ? January 1969 | Oakbank | 1 seen (Nero 1969) |
| ? January 1969 | Falcon Lake | 2 seen (Nero 1969) |
| 1-7 February 1969 | Steinbach | 1 seen (Nero 1969) |
| 8 February 1969 | Richer | 1 seen (Nero 1969) |
| 17-18 February 1969 | Beausejour | 1 seen (Nero 1969) |
| 19 February 1969 | Betula Lake | 1 seen (Nero 1969) |
| 22 February 1969 | Lac du Bonnet | 1 seen (Nero 1969) |
| 20-27 February 1969 | East Selkirk | 1 seen (Nero 1969) |
| ? February 1969 | Steinbach | 1 seen (Nero 1969) |
| ? February 1969 | Arnaud | 3 seen (Nero 1969) |
| 5 April 1969 | Whitemouth | 1 seen (Nero 1969) |
| 14 April 1969 | Riding Mountain | 1 seen (Nero 1969) |
| 23-30 April 1969 | Rennie-Whitemouth | 2 seen (Nero 1969) |
| 2-3 May 1969 | Elma | 1 seen (Nero 1969) |
| 12 May 1969 | Selkirk | 1 seen (Nero 1969) |
| 15 May 1969 | Hazel Creek | 1 seen (Nero 1969) |
| 17 May 1969 | Hazel Creek | 1 seen (Nero 1969) |
| 5 October 1969 | Makinak | 1 seen (Nero 1970a) |
| 1 December 1969 | East Braintree | 1 seen (Nero 1970a) |

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| 7 December 1969 | Richer | 1 seen (Nero 1970a) |
| 11 December 1969 | East Braintree | 1 seen (Nero 1970a) |
| 28 December 1969 | Pinawa | 1 seen (Nero 1970a) |
| 2 January 1970 | Richer | 1 seen (Nero 1970a) |
| 15 January 1970 | Duck Mountains | 1 seen (Nero 1970a) |
| 18 January 1970 | Seven Sisters | 1 seen (Nero 1970a) |
| 7 February 1970 | Pinawa | 1 seen (Nero 1970a) |
| 7 March 1970 | Pinawa | 1 seen (Nero 1970a) |
| 1 April 1970 | Sprague | 8 seen (Nero 1970a) |
| 2 April 1970 | Sprague | 1 seen (Nero 1970a) |
| 4 April 1970 | Sprague | 2 seen (Nero 1970a) |
| 5 April 1970 | Anola | 1 seen (Nero 1970a) |
| 7 April 1970 | Sprague | 1 seen (Nero 1970a) |
| 9 April 1970 | Sprague | 1 seen (Nero 1970a) |
| 12 April 1970 | Sprague | 1 seen (Nero 1970a) |
| 21 April 1970 | East Braintree | 1 seen (Nero 1970a) |
| 19 May 1970 | Pinawa | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 May 1970 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 2 June 1970 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? June 1970 | Pinawa | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 7 June 1970 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 7 June 1970 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 13 June 1970 | Richer | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 13 June 1970 | Lewis | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 13 August 1970 | Piney | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 10 December 1970 | Piney | 2 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 20 December 1970 | Stead | 4 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? December 1970 | Pine Falls | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 2 February 1971 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 8 February 1971 | Richer | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 20 March 1971 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 25 March 1971 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 26 March 1971 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 27 March 1971 | East Braintree | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 27 March 1971 | South Junction | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 March 1971 | South Junction | 2 heard (R.W. Nero <u>in litt.</u> 1976) |
| 30 March 1971 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 9 April 1971 | East Braintree | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 9 April 1971 | Elma | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 16 April 1971 | Elma | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 April 1971 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 April 1971 | East Braintree | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 25 April 1971 | Hadashville | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 16 May 1971 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 May 1971 | Pine Falls | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 May 1971 | Hadashville | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 25 May 1971 | Caddy Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 25 May 1971 | Prawda | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 30 May 1971 | Gardenton | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? May 1971 | Elma | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 12 June 1971 | Eleanor Lake | 4 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 September 1971 | Dallas | 2 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 11 October 1971 | Arnes | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 21-22 October 1971 | Long Point | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 13 November 1971 | Marchand | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 21 November 1971 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 6 December 1971 | Moose Lake | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 6 December 1971 | Lac du Bonnet | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 22 December 1971 | Beaverlodge Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 3 January 1972 | The Pas | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 11 January 1972 | Moose Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 January 1972 | Sundown | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 11 February 1972 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 13 February 1972 | Sprague | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 February 1972 | Mafeking | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 27 February 1972 | Moose Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 6 March 1972 | Overflowing River | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 March 1972 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 March 1972 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 19 March 1972 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 March 1972 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? March 1972 | Snow Lake | many seen (R.W. Nero <u>in litt.</u> 1976) |
| 9 April 1972 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 April 1972 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 22 April 1972 | Moose Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 24 April 1972 | East Braintree | 1 heard (R.W. Nero <u>in litt.</u> 1976) |
| 25 April 1972 | East Braintree | 1 heard (R.W. Nero <u>in litt.</u> 1976) |
| 30 April 1972 | East Braintree | 1 heard (R.W. Nero <u>in litt.</u> 1976) |

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| 5 May 1972 | Whitemouth | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 9 May 1972 | St. Labre | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 9 May 1972 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 May 1972 | Matlock | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 27 May 1972 | Matlock | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 28 May 1972 | Hecla Island | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 13 July 1972 | Moose Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 July 1972 | Seven Sisters | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 31 July 1972 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 26 September 1972 | Waterhen River | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 October 1972 | Kawinaw Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 November 1972 | Piney | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 2 December 1972 | Pinawa | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 December 1972 | Whiteshell Park | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 January 1973 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 11 January 1973 | Rennie | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 12 January 1973 | Caddy Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 13 January 1973 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 30 January 1973 | Lundar | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 31 January 1973 | Hansen Creek | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 3 February 1973 | Gardenton | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 February 1973 | Middlebro | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 10 February 1973 | Winnipeg | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 February 1973 | Prawda | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 February 1973 | Nutimik Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 February 1973 | Betula Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 16 March 1973 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? April 1973 | Birds Hill | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 8 April 1973 | Sundown | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 April 1973 | Piney | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 May 1976 | Richer | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 31 May 1973 | Richer | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 June 1973 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 June 1973 | Spruce Woods Park | 1 seen (C. Cuthbert <u>in litt.</u> 1976) |
| 22 June 1973 | Simmonhouse Lake | 1 feather found (R.W. Nero <u>in litt.</u> 1976) |
| 8 August 1973 | Hecla Island | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 September 1973 | Hecla Island | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 October 1973 | Hecla Island | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 November 1973 | Pinawa | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 20 November 1973 | Sprague | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 20 November 1973 | Little Limestone L. | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 20 November 1973 | Pine Falls | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 22 November 1973 | Pinawa | 4 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 November 1973 | Pinawa | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 24 November 1973 | Marchand | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 1 December 1973 | Red Deer River | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 3 December 1973 | Dawson Bay | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 December 1973 | Mawdsley Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 December 1973 | Washow Bay | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 December 1973 | Red Deer River | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 7 December 1973 | Riverton | 1 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 13 December 1973 | Pine Falls | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 December 1973 | Pine Falls | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15-16 December 1973 | Pinawa | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? December 1973 | Pinawa | 4 seen (R.W. Nero <u>in litt.</u> 1976) |
| 20 December 1973 | The Pas | 5 seen (R.W. Nero <u>in litt.</u> 1976) |
| 26 December 1973 | Lac du Bonnet | 5 seen (R.W. Nero <u>in litt.</u> 1976) |
| 2 January 1974 | Big Bog | 4 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 January 1974 | St. George | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 January 1974 | Red Deer River | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 January 1974 | Traverse Bay | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 20 January 1974 | Mafeking | 11 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 January 1974 | Riverton | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 January 1974 | Bowsman | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 24 January 1974 | St. George | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 25 January 1974 | Meadow Portage | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 26 January 1974 | Bowsman | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 27 January 1974 | Bowsman | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| Jan.-Feb. 1974 | Stead-Pine Falls | 4 seen (R.W. Nero <u>in litt.</u> 1976) |
| 1 February 1974 | Marchand | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 5 February 1974 | Belaire | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 5 February 1974 | Lac du Bonnet | 7 seen (R.W. Nero <u>in litt.</u> 1976) |
| 6 February 1974 | Riverton | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 6 February 1974 | Ethelbert | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 6 February 1974 | Duck Bay | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 7 February 1974 | Pinawa | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 7 February 1974 | Lac du Bonnet | 7 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 9 February 1974 | Lac du Bonnet | 4 seen (R.W. Nero <u>in litt.</u> 1976) |
| 10 February 1974 | Lac du Bonnet | 8 seen (R.W. Nero <u>in litt.</u> 1976) |
| 10 February 1974 | Great Falls | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 10 February 1974 | Pine Falls | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 11 February 1974 | Great Falls | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 12 February 1974 | Devil's Lake | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 12 February 1974 | Devil's Lake | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 12 February 1974 | Grand Rapids | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 12 February 1974 | Grand Rapids | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 12 February 1974 | Toutes Aide | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 February 1974 | Thompson | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 February 1974 | Thompson | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 February 1974 | Grand Rapids | 4 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 February 1974 | Grand Rapids | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 February 1974 | Steep Rock | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 February 1974 | Moosehorn | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 February 1974 | Lac du Bonnet | 9 seen (R.W. Nero <u>in litt.</u> 1976) |
| 16 February 1974 | Lac du Bonnet | 12 seen (R.W. Nero <u>in litt.</u> 1976) |
| 16 February 1974 | Whitemouth Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 February 1974 | Lac du Bonnet | 18 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 February 1974 | Marchand | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 February 1974 | Spruce Siding | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 February 1974 | Minitonas | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 February 1974 | Bowsman | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 February 1974 | Bowsman | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 19 February 1974 | Chatfield | 2 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 20 February 1974 | St. George | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 21 February 1974 | Minitonas | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 22 February 1974 | Camperville | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 22 February 1974 | Cowan | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 February 1974 | Lac du Bonnet | 18 seen (R.W. Nero <u>in litt.</u> 1976) |
| 24 February 1974 | Richer | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 25 February 1974 | Grandview | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 26 February 1974 | Bowsman | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 27 February 1974 | Leyond River | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 27 February 1974 | Bloodvein River | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? February 1974 | Poplar-Black River | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? February 1974 | Riverton | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? February 1974 | Riverton | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| late February 1974 | Lac du Bonnet | 18 seen (R.W. Nero <u>in litt.</u> 1976) |
| 2 March 1974 | Lac du Bonnet | 7 seen (R.W. Nero <u>in litt.</u> 1976) |
| 2 March 1974 | Lac du Bonnet | 17 seen (R.W. Nero <u>in litt.</u> 1976) |
| 3 March 1974 | Lac du Bonnet | 10 seen (R.W. Nero <u>in litt.</u> 1976) |
| 7 March 1974 | Whitemouth River | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 10 March 1974 | Lac du Bonnet | 11 seen (R.W. Nero <u>in litt.</u> 1976) |
| 10 March 1974 | Red Deer Point | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 12 March 1974 | South Junction | 5 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 March 1974 | Prawda | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 16 March 1974 | Lac du Bonnet | 6 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 March 1974 | South Junction | 5 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 March 1974 | Spruce Siding | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 March 1974 | Bissett | 1 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 18 March 1974 | The Pas | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? March 1974 | Selkirk | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| ? March 1974 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 March 1974 | South Junction | 5 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 March 1974 | Piney Creek | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 24 March 1974 | Lac du Bonnet | 5 seen (R.W. Nero <u>in litt.</u> 1976) |
| 28 March 1974 | Sundown | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 March 1974 | South Junction | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 March 1974 | Piney Creek | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 30 March 1974 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 30 March 1974 | Menisino | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 30 March 1974 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 30 March 1974 | Lac du Bonnet | 8 seen (R.W. Nero <u>in litt.</u> 1976) |
| 31 March 1974 | Moose Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 31 March 1974 | Sprague | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 1 April 1974 | Sundown | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 1 April 1974 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 1 April 1974 | Marchand | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 1 April 1974 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 2 April 1974 | Meadow Portage | 4 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 April 1974 | Sundown | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 April 1974 | Swan River | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 April 1974 | Meadow Portage | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 April 1974 | Lac du Bonnet | 12 seen (R.W. Nero <u>in litt.</u> 1976) |
| 5 April 1974 | Piney | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 5 April 1974 | Lac du Bonnet | 1 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 6 April 1974 | Lac du Bonnet | 4 seen (R.W. Nero <u>in litt.</u> 1976) |
| 6 April 1974 | Menisino-Sundown | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 6 April 1976 | South Junction | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 7 April 1974 | Lac du Bonnet | 10 seen (R.W. Nero <u>in litt.</u> 1976) |
| 7 April 1974 | Sundown-Piney | 6 seen (R.W. Nero <u>in litt.</u> 1976) |
| 7 April 1974 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 9 April 1974 | Sundown-Piney | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 9 April 1974 | Menisino | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 11 April 1974 | Sundown-Piney | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 11 April 1974 | Grand Rapids | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 11 April 1974 | Pinawa | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 April 1974 | Lac du Bonnet | 17 seen (R.W. Nero <u>in litt.</u> 1976) |
| 20 April 1974 | Lac du Bonnet | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 24 April 1974 | Lac du Bonnet | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 26 April 1974 | Spruce Siding | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 28 April 1974 | Lac du Bonnet | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 April 1974 | Lac du Bonnet | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 30 April 1974 | Lac du Bonnet | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 May 1974 | Spruce Siding | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 7 May 1974 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 11 May 1974 | South Junction | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 12 May 1974 | Arnes | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 16 May 1974 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 20 May 1974 | Hazel Creek | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 26 May 1974 | Powerview | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 1 June 1974 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 12 June 1974 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 12 June 1974 | Gillam | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 16 June 1974 | Red Deer Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 June 1974 | Camperville | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 22 June 1974 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 8 July 1974 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 9 July 1974 | Atik | 1 seen (D.A. Sexton <u>in litt.</u> 1976) |
| 14 July 1974 | Seven Sisters | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15-17 Sept. 1974 | Mantago River | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 September 1974 | Duck Mountains | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 10 November 1974 | Richer | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 November 1974 | Lac du Bonnet | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 22 November 1974 | Whitemouth Lake | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| late November 1974 | Hadashville | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 December 1974 | Richer | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 December 1974 | Spruce Siding | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 December 1974 | Lewis | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 December 1974 | Vassar | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 December 1974 | Jenpeg | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 19 December 1974 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 December 1974 | Whiteshell Park | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 December 1974 | Whiteshell Park | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 December 1974 | Pinawa | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 3 January 1975 | Winnipeg | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 3 January 1975 | Richer | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 10 January 1975 | Winnipeg | 1 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 13 January 1975 | Marchand | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 January 1975 | Lac du Bonnet | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 January 1975 | Sprague | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 January 1975 | Rosa | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 January 1975 | Riverton | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 24 January 1975 | Vassar | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 January 1975 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 29 January 1975 | Sprague | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 30 January 1975 | Vogar | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 31 January 1975 | Hadashville | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 31 January 1975 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 31 January 1975 | South Junction | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 1 February 1975 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 2 February 1975 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 2 February 1975 | Richer | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 February 1975 | Sprague | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 4 February 1975 | Spruce Siding | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 5 February 1975 | Sprague | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 6 February 1975 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 8 February 1975 | Lewis | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 9 February 1975 | Vivian | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 9 February 1975 | Hadashville | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 11 February 1975 | Sprague | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 13 February 1975 | South Junction | 3 seen (R.W. Nero <u>in litt.</u> 1976) |
| 13 February 1975 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 14 February 1975 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |

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| 14 February 1975 | Sprague | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 February 1975 | East Braintree | 2 seen (R.W. Nero <u>in litt.</u> 1976) |
| 15 February 1975 | Marchand | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 16 February 1975 | Riding Mtn. Park | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 16 February 1975 | Spruce Siding | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 17 February 1975 | South Junction | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 18 February 1975 | Marchand | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 19 February 1975 | Sprague | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 20 February 1975 | Sprague | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 20 February 1975 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 21 February 1975 | East Braintree | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 23 February 1975 | Marchand | 1 seen (R.W. Nero <u>in litt.</u> 1976) |
| 3 May 1975 | Seven Sisters | 1 seen (this study) |
| 21 May 1975 | Spruce Siding | 1 seen (this study) |
| 28 May 1975 | Marshy Point | 1 seen (R.A. Wishart pers. comm.) |
| 3 January 1976 | Falcon Lake | 1 seen (W. Keller pers. comm.) |
| 12 January 1976 | Ile des Chenes | 1 seen (G. Enns pers. comm.) |
| 13 January 1976 | Pinawa | 1 seen (R. Stardom pers. comm.) |
| 14 January 1976 | Marchand | 1 seen (J. Kowalchuk pers. comm.) |
| 14 January 1976 | Spruce Siding | 1 seen (J. Nielson pers. comm.) |
| 15 January 1976 | Spruce Siding | 1 seen (W. Urbanski pers. comm.) |
| 20 January 1976 | Hadashville | 1 seen (W. Nakka pers. comm.) |
| 23 January 1976 | Marchand | 1 seen (T. Galloway pers. comm.) |
| 23 January 1976 | Spruce Siding | 1 seen (this study) |
| 26 January 1976 | Blumenort | 2 seen (H. Bergman pers. comm.) |
| 27 January 1976 | East Braintree | 1 seen (this study) |

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| 29 January 1976 | Spruce Siding | 3 seen (J. Nielson pers. comm.) |
| 30 January 1976 | Spruce Siding | 4 seen (J. Neilson pers. comm.) |
| 31 January 1976 | Marchand | 1 seen (A. Gowryluk pers. comm.) |
| ? January 1976 | Wallace Lake | 1 seen (R. Leonard pers. comm.) |
| 5 February 1976 | Rennie | 1 seen (A. Hood pers. comm.) |
| 12 February 1976 | Scanterbury | 1 seen (J. Johnson pers. comm.) |
| 13 February 1976 | Rennie | 1 seen (A. Hood pers. comm.) |
| 14 February 1976 | Hadashville | 1 seen (this study) |
| 15 February 1976 | Marchand | 1 seen (H. Tirschman pers. comm.) |
| 16 February 1976 | Marchand | 1 seen (S. Mulder pers. comm.) |
| 21 February 1976 | Marchand | 1 seen (R.W. Nero pers. comm.) |
| 22 February 1976 | Marchand | 1 seen (this study) |
| 7 March 1976 | Marchand | 1 seen (J. Searle pers. comm.) |
| 8 March 1976 | Marchand | 1 seen (this study) |
| 9 March 1976 | Marchand | 1 seen (this study) |
| 12 March 1976 | Marchand | 1 seen (S. Mulder pers. comm.) |
| 13 March 1976 | Richer | 1 seen (J. Kowalchuk pers. comm.) |
| 14 March 1976 | East Braintree | 1 seen (W. Urbanski pers. comm.) |
| 17 March 1976 | Ste. Rita | 1 seen (E. Fast pers. comm.) |
| 17 March 1976 | Spruce Siding | 1 seen (this study) |
| 17 March 1976 | East Braintree | 1 seen (L. Fielberg pers. comm.) |
| 17 March 1976 | Hadashville | 1 seen (this study) |
| 18 March 1976 | East Braintree | 1 seen (this study) |
| 21 March 1976 | Marchand | 1 seen (S. Mulder pers. comm.) |
| 21 March 1976 | South Junction | 1 seen (R.W. Nero pers. comm.) |
| 22 March 1976 | Marchand | 1 seen (this study) |

23 March 1976 Marchand 2 seen (this study)

SIGHT RECORDS FOR MASSACHUSETTS.

| DATE | LOCATION | SOURCE |
|------------------|---------------|--------------------------------------|
| ? February 1831 | Marblehead | 1 seen (Baird <u>et al.</u> 1905) |
| winter 1832 | Boston | 1 reported (Audubon 1937) |
| ? January 1835 | Marblehead | 1 reported (Townsend 1905) |
| winter 1842-1843 | Massachusetts | 7 reported (Palmer 1949) |
| ? ? 1864 | Bristol Co. | 1 reported (Howe and Allen 1901) |
| 10 November 1866 | Salem | 1 reported (Townsend 1905) |
| prior to 1884 | Middlesex | 1 reported (Howe and Allen 1901) |
| ? ? 1888 | Marblehead | 1 reported (Griscom and Snyder 1955) |
| ? ? 1890 | Townsend | 1 reported (Griscom and Snyder 1955) |
| ? ? 1890-1891 | eastern Mass. | 1 reported (Griscom and Snyder 1955) |
| ? ? 1890-1891 | Milton | 1 reported (Howe and Allen 1901) |
| ? ? 1890-1891 | Winchendon | 1 reported (Blodget 1973) |
| ? ? 1891 | Groton | 1 reported (Griscom and Snyder 1955) |
| ? ? 1894 | Middlesex | 1 reported (Griscom and Snyder 1955) |
| 6 January 1894 | Essex Co. | 1 reported (Bagg and Eliot 1937) |
| prior to 1896 | Westfield | 1 reported (Howe and Allen 1901) |
| prior to 1901 | Hampshire | 1 reported (Howe and Allen 1901) |
| 7 February 1904 | Dedham | 1 reported (Allen 1904) |
| ? ? 1910 | Middlesex | 1 reported (Griscom 1949) |
| 11 November 1936 | Ashfield | 1 reported (Bagg and Eliot 1937) |

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| winter 1960-1961 | Petersham | 1 seen (R.A. Clark <u>in litt.</u> 1976) |
| 20 October to 27 November 1961 | West Beckett | 1 seen (American Birds 16: 13) |
| 8-11 March 1962 | North Egremont - Williamstown | 1 seen (American Birds 16: 315) |
| 22 January 1973 | Gill | 1 seen (R.A. Forster <u>in litt.</u> 1976) |

SIGHT RECORDS FOR MICHIGAN.

| DATE | LOCATION | SOURCE |
|------------------|------------------|---|
| ? December 1881 | Missaukee Co. | 1 reported (Barrows 1912) |
| ? November 1891 | Alger Co. | 1 reported (Barrows 1912) |
| ? January 1897 | Mackinac Co. | 1 reported (Barrows 1912) |
| ? November 1897 | Chippewa Co. | 1 reported (Selous 1897) |
| 31 March 1927 | Sault Ste. Marie | 1 reported (Wood 1951) |
| 27 October 1946 | Mackinac Co. | 1 reported (Zimmerman and Van Tyne 1959) |
| 13 October 1947 | Huron Mountains | 1 seen (J. McGraw <u>in litt.</u> 1976) |
| 7 November 1950 | Chippewa Co. | 1 reported (Zimmerman and Van Tyne 1959) |
| 10 October 1952 | Huron Mountains | 1 seen (J. McGraw <u>in litt.</u> 1976) |
| 15 October 1962 | Huron Mountains | 1 seen (J. McGraw <u>in litt.</u> 1976) |
| 10 October 1966 | Alger Co. | 1 seen (Jack-Pine Warbler 45: 21) |
| 28 April 1968 | Chippewa Co. | 1 seen (Jack-Pine Warbler 49: 65- 70, 50: 69-75) |
| 6 May 1972 | Chippewa Co. | 1 seen (Jack-Pine Warbler 50: 80) |
| 18 February 1973 | Luce Co. | 1 seen (Jack-Pine Warbler 51: 84) |
| 1 February 1974 | Ingham Co. | 1 seen (Jack-Pine Warbler 52: 85) |

SIGHT RECORDS FOR MINNESOTA.

| DATE | LOCATION | SOURCE |
|--------------------|---------------|---|
| ? December 1902 | Steele Co. | 1 seen (Roberts 1932) |
| 21 November 1905 | Anoka Co. | 1 reported (Deane 1906) |
| 11 December 1905 | Ramsey Co. | 1 reported (Deane 1906) |
| 18 December 1905 | Itasca Co. | 1 reported (Deane 1906) |
| 3 January 1906 | St. Louis Co. | 1 reported (Deane 1906) |
| 22 January 1906 | Hennepin Co. | 1 reported (Deane 1906) |
| 24 January 1906 | Anoka Co. | 1 reported (Deane 1906) |
| 29 January 1906 | Anoka Co. | 1 reported (Deane 1906) |
| 21 February 1906 | Hennepin Co. | 1 reported (Deane 1906) |
| 11 February 1914 | Itasca Co. | 1 reported (Cohn 1920) |
| 14 January 1923 | McLeod Co. | 1 reported (Roberts 1932) |
| 12 July 1928 | Itasca Co. | 1 reported (Roberts 1932) |
| 12 July 1928 | Itasca Co. | 1 reported (Roberts 1932) |
| summer 1960 | Basswood Lake | 1 seen (B. Brooks <u>in litt.</u> 1976) |
| 29 December 1964 | Detroit Lake | 1 seen (Krause 1965) |
| 27 June 1965 | Cook Co. | 1 seen (American Birds 19: 549) |
| 2 December 1965 | Aitkin Co. | 34+ seen (American Birds 20: 427) |
| 23 April 1966 | Cook Co. | 1 seen (American Birds 20: 512) |
| winter 1968-1969 | Duluth | 15 seen (American Birds 23: 485) |
| winter 1968-1969 | St. Paul | 20 seen (American Birds 23: 485) |
| ? January 1969 | Crow Wing Co. | 1 seen (American Birds 23: 485) |
| 2-24 February 1969 | Aitkin Co. | 1 seen (American Birds 23: 485) |
| 1 March 1969 | Isanti Co. | 1 seen (American Birds 23: 485) |

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| 25 March 1969 | St. Louis Co. | 1 seen (American Birds 23: 485) |
| 6 April 1969 | St. Louis Co. | 1 seen (American Birds 23: 485) |
| 23 January 1971 | Cook Co. | 1 seen (American Birds 25: 583) |
| 30 January 1972 | Cook Co. | 2 seen (Carr and Carr 1972) |
| early March 1972 | Sandstone | 1 seen (J.M. Link <u>in litt.</u> 1976) |
| ? January 1974 | Duluth | 1 seen (F. Johr <u>in litt.</u> 1976) |
| ? September 1974 | Two Harbours | 1 seen (F. Johr <u>in litt.</u> 1976) |
| ? October 1974 | Cloquet Valley | 1 seen (F. Johr <u>in litt.</u> 1976) |
| ? July 1975 | Kelly Lakes | 1 reported (P. Hofslund <u>in litt.</u> 1976) |
| ? November 1975 | Cass Co. | 1 seen (J.E. Mathisen <u>in litt.</u> 1976) |
| 3 November 1975 | Warroad | 1 seen (R. Young <u>in litt.</u> 1976) |

SIGHT RECORDS FOR MONTANA.

| DATE | LOCATION | SOURCE |
|------------------|-------------------|--|
| ? November 1916 | Gallatin Co. | 1 seen (Saunders 1921) |
| 4 July 1931 | Stryker | 3 seen (Weydemeyer 1932) |
| 8 October 1934 | Yellowstone Park | 1 seen (Tryon 1943) |
| prior to 1938 | ? | 6 seen (Bent 1938) |
| 9 June 1941 | Bridger Mountains | 1 seen (Tryon 1943) |
| 4 July 1941 | Bridger Mountains | 1 seen (Tryon 1943) |
| 9 August 1942 | Bridger Mountains | 1 seen (Tryon 1943) |
| ? July 1956 | Bridger Mountains | 3 seen (P.D. Skaar <u>in litt.</u> 1976) |
| 24 February 1963 | Glasgow | 1 seen (Audubon Field Notes 17:333) |

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| 6 September 1963 | Mission Range | 2 seen (P.D. Skaar <u>in litt.</u> 1976) |
| 25 November 1963 | Squaw Creek | 1 seen (P.D. Skaar <u>in litt.</u> 1976) |
| 5 August 1966 | Ravalli Co. | 1 seen (Audubon Field Notes: 21:61) |
| fall 1966 | Bridger Mountains | 1 seen (P.D. Skaar <u>in litt.</u> 1976) |
| 5 November 1968 | Bozeman | 1 seen (P.D. Skaar <u>in litt.</u> 1976) |
| 18 May 1969 | Pattee Canyon | 1 seen (Audubon Field Notes 23:609) |
| 15 July 1969 | Bozeman | 3 seen (P.D. Skaar <u>in litt.</u> 1976) |
| 27 June 1970 | Bozeman | 1 seen (American Birds 24: 700) |
| spring 1971 | Yaak River Valley | 1 seen (P.D. Skaar <u>in litt.</u> 1976) |
| 5 November 1972 | Gallatin Co. | 1 seen (P.D. Skaar <u>in litt.</u> 1976) |
| 3 February 1974 | Gallatin Co. | 1 seen (P.D. Skaar <u>in litt.</u> 1976) |
| 29 March 1975 | Gallatin Co. | 1 seen (P.D. Skaar <u>in litt.</u> 1976) |

SIGHT RECORDS FOR NEVADA.

| DATE | LOCATION | SOURCE |
|-------------|----------|---|
| summer 1971 | Reno | 1 seen (A.C. Risser Jr. <u>in litt.</u> 1976) |

SIGHT RECORDS FOR NEW BRUNSWICK.

| DATE | LOCATION | SOURCE |
|---------------------|--------------|---------------------------------|
| 22-26 December 1971 | Kings Co. | 1 seen (American Birds 26:579) |
| 12 November 1972 | Kings Co. | 1 seen (American Birds 27: 28) |
| 22 January 1972 | Victoria Co. | 1 seen (American Birds 26: 579) |

SIGHT RECORDS FOR NEWFOUNDLAND AND LABRADOR.

| DATE | LOCATION | SOURCE |
|----------------|--------------|--------------------------|
| 28 August 1899 | Humber River | 1 reported (Macoun 1903) |

SIGHT RECORDS FOR NEW HAMPSHIRE.

| DATE | LOCATION | SOURCE |
|------------------|--------------|--|
| ? September 1892 | Lake Umbagog | 1 reported (Bagg and Eliot 1937) |
| 8 February 1969 | Grafton Co. | 1 seen (K.S. Anderson <u>in litt.</u> 1976) |

SIGHT RECORDS FOR NEW YORK.

| DATE | LOCATION | SOURCE |
|-----------------|-----------------|--|
| 6 February 1948 | Churchville | 1 seen (Yunick 1972) |
| 9 April 1950 | Dunkirk Harbour | 1 seen (Yunick 1972) |
| 5 March 1955 | Tupper Lake | 1 seen (Yunick 1972) |
| 20 January 1962 | Pulaski | 2 seen (N.R. Spofford <u>in litt.</u> 1976) |
| ? February 1971 | Schenectady | 1 seen (American Birds 25: 1) |

SIGHT RECORDS FOR NORTH DAKOTA.

| DATE | LOCATION | SOURCE |
|-----------------|----------|-------------------------|
| prior to 1914 | Mandan | 1 reported (Wood 1923b) |
| ? December 1922 | Pembina | 1 seen (Wood 1923b) |
| 14 January 1923 | Pembina | 1 seen (Wood 1923b) |

SIGHT RECORDS FOR THE NORTHWEST TERRITORIES.

| DATE | LOCATION | SOURCE |
|------------------|------------------|--|
| ? May 1835 | Fort Resolution | 1 seen (King 1836) |
| ? November 1903 | Laird River | 1 reported (Preble 1908) |
| 26 February 1904 | Laird River | 1 reported (Preble 1908) |
| 20 May 1904 | Willow River | 1 reported (Preble 1908) |
| ? ? 1904 | Fort Good Hope | 1 reported (Preble 1908) |
| 11 July 1907 | Fort Resolution | 1 seen (Seton 1908) |
| 28 July 1921 | Fort Wrigley | 1 seen (Williams 1922) |
| 4 September 1954 | Mackenzie River | 1 seen (E.T. Jones <u>in litt.</u> 1976) |
| 18 July 1969 | Yellowknife Hwy. | 2 seen (R.G. Bromley <u>in litt.</u> 1976) |
| 21 June 1972 | Talston River | 1 reported (D.L. Trauger <u>in litt.</u> 1976) |
| 3 July 1972 | Rat River | 2 reported (D.L. Trauger <u>in litt.</u> 1976) |

SIGHT RECORDS FOR NOVA SCOTIA.

| DATE | LOCATION | SOURCE |
|---------------|----------------|--------------------------|
| prior to 1882 | Pictou Co. | 1 reported (Macoun 1903) |
| ? June 1903 | Cumberland Co. | 1 reported (Tufts 1973) |

SIGHT RECORDS FOR OHIO.

| DATE | LOCATION | SOURCE |
|-----------------|---------------|------------------------|
| 30 October 1947 | Starve Island | 1 seen (Trautman 1956) |

SIGHT RECORDS FOR ONTARIO.

| DATE | LOCATION | SOURCE |
|------------------|-----------------|--|
| winter 1889-1891 | Barrie | large "flight" reported (Fleming 1907) |
| 18 February 1890 | Mt. Albert | 1 reported (Fisher 1893) |
| ? ? 1891 | Leeds Co. | 1 reported (Toner <u>et al.</u> 1942) |
| 26 February 1896 | Toronto Island | 1 reported (Macoun 1903) |
| ? February 1897 | Scotia Junction | 2 reported (Macoun 1903) |
| ? December 1898 | Parry Sound | 1 seen (Macoun 1903) |
| ? ? 1907 | Lake Ontario | 1 reported (Bent 1938) |
| 1 October 1917 | Ottawa | 1 reported (Lloyd 1944) |
| winter 1918 | Lindsay | 1 reported (Calvert 1925) |
| winter 1922-1923 | North Bay | many reported (Fleming 1930) |

| | | |
|-----------------------------|---|---|
| 20 July 1926 | Hudson Bay | 1 reported (Todd 1963) |
| 20 April 1935 | North Bay | 1 reported (Ricker and Clark 1939) |
| 18 January 1947 | Toronto | 2 seen (Lambert 1947) |
| 22 April 1951 | Kingston | 1 reported (H. Quilliam <u>in litt.</u> 1976) |
| ? December 1953 | Thunder Bay | 1 seen (Can. Field-Nat. 68: 18-27) |
| ? December 1955 | Sault Ste. Marie | 1 seen (Can. Field-Nat. 70: 85-91) |
| 3 April 1960 | Presquille Park | 1 seen (D. Sadler <u>in litt.</u> 1976) |
| 3 June 1961 | Atikokan | 1 seen (S. Peruniak <u>in litt.</u> 1976) |
| 6 April 1962 | Kingston | 1 reported (H. Quilliam <u>in litt.</u> 1976) |
| 23 November 1962 | Atikokan | 1 seen (S. Peruniak <u>in litt.</u> 1976) |
| 17 January 1963 | Atikokan | 1 seen (S. Peruniak <u>in litt.</u> 1976) |
| 16 February 1963 | Atikokan | 1 seen (S. Peruniak <u>in litt.</u> 1976) |
| 23 March 1963 | Atikokan | 1 seen (S. Peruniak <u>in litt.</u> 1976) |
| 30 April 1963 | Atikokan | 1 seen (S. Peruniak <u>in litt.</u> 1976) |
| 17 May 1963 | Atikokan | 1 seen (S. Peruniak <u>in litt.</u> 1976) |
| 18&24 Feb. 1964 | Atikokan | 1 seen (S. Peruniak <u>in litt.</u> 1976) |
| 6 June 1964 | Quetico Park | 1 seen (D. Strickland <u>in litt.</u> 1976) |
| ? October 1965 | Spruce River Road | 1 seen (A. Walshe <u>in litt.</u> 1976) |
| ? November 1965 | Sucker Lake | 1 reported (D. Sadler <u>in litt.</u> 1976) |
| 7 December 1965 | Geraldton | 7 seen (D. Elder <u>in litt.</u> 1976) |
| December 1965 to March 1966 | Dryden, Thunder Bay Ottawa, Kingston | 30+ seen (American Birds 20: 417) |
| winter 1965-1966 | Owen Sound, Kingston | many seen (Godfrey 1967) |
| 12 January 1966 | Carleton Place | 1 seen (Godfrey 1967) |

| | | |
|------------------|-----------------|---|
| 12-17 March 1966 | Kingston | 1 reported (H. Quilliam <u>in litt.</u> 1976) |
| 29 April 1966 | Kingston | 1 reported (H. Quilliam <u>in litt.</u> 1976) |
| 9 April 1966 | Ramsayville | 1 reported (Godfrey 1967) |
| 12 April 1966 | Huntsville | 1 seen (G.K. Peck <u>in litt.</u> 1976) |
| 8 June 1966 | Atikokan | 1 seen (S. Peruniak <u>in litt.</u> 1976) |
| 27 December 1968 | Kingston | 1 seen (American Birds 23: 475) |
| 20 January 1969 | Thunder Bay | 1 seen (American Birds 23: 475) |
| 4 February 1969 | Paipoonge Twp. | 1 seen (American Birds 23: 475) |
| ? February 1969 | Wellington | 1 seen (American Birds 23: 475) |
| 5 June 1969 | Geraldton | 1 seen (D. Elder <u>in litt.</u> 1976) |
| 13 December 1970 | Geraldton | 1 seen (D. Elder <u>in litt.</u> 1976) |
| 30 January 1971 | Ottawa | 1 seen (American Birds 25: 573) |
| 31 January 1971 | Ottawa | 1 reported (Brunton and Pittaway 1971) |
| 11 February 1971 | Huntsville | 1 seen (American Birds 25: 573) |
| 14 February 1971 | Presquille Park | 1 seen (American Birds 25: 573) |
| 14 February 1971 | Codrington | 2 seen (American Birds 25: 573) |
| 20 February 1971 | Azilda | 1 seen (American Birds 25: 573) |
| 20 February 1971 | Barrie | 1 seen (American Birds 25: 573) |
| 21 February 1971 | South Baymouth | 1 seen (American Birds 25: 573) |
| 24 February 1971 | Sudbury | 1 seen (American Birds 25: 573) |
| 1 March 1971 | Kingston | 1 seen (American Birds 25: 573) |
| 15 March 1971 | Leith | 2 seen (American Birds 25: 573) |
| 23 March 1971 | Brighton Twp. | 2 seen (D. Sadler <u>in litt.</u> 1976) |
| 19 March 1971 | Waller's Falls | 1 seen (American Birds 25: 573) |

| | | |
|------------------|---------------|---|
| 21 March 1971 | Sibley Park | 1 seen (R.W. Knapton <u>in litt.</u> 1975) |
| 21 March 1971 | McGregor Twp. | 1 seen (American Birds 25: 573) |
| Jan.-March 1972 | Ottawa | 1+ seen (D.F. Brunton <u>in litt.</u> 1976) |
| 1 April 1972 | Port Hope | 1 seen (D.F. Brunton <u>in litt.</u> 1976) |
| 25 February 1973 | Naponee | 1 reported (H. Quilliam <u>in litt.</u> 1976) |
| 18 April 1973 | Atikokan | 1 reported (S. Peruniak <u>in litt.</u> 1976) |
| 18 June 1973 | Atikokan | 1 reported (S. Peruniak <u>in litt.</u> 1976) |
| 4 November 1973 | Lansdowne | 1 reported (H. Quilliam <u>in litt.</u> 1976) |
| 7 January 1974 | Pine Road | 1 seen (Morin 1974) |
| 10 February 1974 | Munster | 1 seen (Morin 1974) |
| 10 February 1974 | Carp Hills | 1 seen (Morin 1974) |
| 12 February 1974 | Constance Bay | 1 seen (Morin 1974) |
| 24 February 1974 | Ottawa | 1 seen (Morin 1974) |
| 4 June 1974 | Atikokan | 1 seen (R.W. Knapton <u>in litt.</u> 1976) |
| 16 October 1975 | Moosonee | 1 seen (R. Stitt <u>in litt.</u> 1976) |
| 18 March 1976 | Moosonee | 1 seen (R. Stitt <u>in litt.</u> 1976) |

SIGHT RECORDS FOR OREGON.

| DATE | LOCATION | SOURCE |
|-----------|--------------------|---|
| 1854-1855 | Cascade Mountains | 1 reported (Gabrielson and Jewett 1970) |
| 1880 | Williamette Valley | 1 reported (Johnson 1880) |

| | | |
|------------------|-------------------|---|
| 1917 | Diamond Peak | 1 reported (Shelton 1917) |
| 16 December 1932 | Jackson Co. | 1 seen (Stevenson and Fitch 1933) |
| 3 September 1957 | Red Cone Springs | 1 seen (Audubon Warbler 21: 3) |
| 26 January 1959 | Rogue River | 1 seen (Audubon Warbler 23: 2) |
| 4 June 1960 | Portland | 1 heard (American Birds 20: 594) |
| ? November 1965 | Toledo | 1 seen (D. Faxon <u>in litt.</u> 1976) |
| 1965-1975 | Wallowa Co. | 10+ seen (R. Anderson <u>in litt.</u> 1976) |
| 4 June 1966 | Portland | 1 heard (H.B. Nehls <u>in litt.</u> 1976) |
| 7 May 1973 | Umatilla Co. | 1 seen (E. Bull <u>in litt.</u> 1976) |
| 13 August 1973 | Crater Lake | 1 seen (L. Scott <u>in litt.</u> 1976) |
| ? June 1975 | Twp. 9S, R37EWM. | 1 seen (R. Anderson <u>in litt.</u> 1976) |
| ? July 1975 | Twp. 3N, R45EWM. | 1 seen (V. Coggins <u>in litt.</u> 1976) |
| ? November 1975 | Twp. 3N, R43EWM. | 1 seen (R. Anderson <u>in litt.</u> 1976) |
| ? ? 1975 | Twp. 33S, R10EWM. | 1 seen (C. Bruce <u>in litt.</u> 1976) |
| ? ? 1975 | Twp. 33S, R7EWM. | 3 seen (C. Bruce <u>in litt.</u> 1976) |

SIGHT RECORDS FOR PENNSYLVANIA.

| DATE | LOCATION | SOURCE |
|---------------|----------------|-------------------------|
| 1870 | Chester Co. | 1 reported (Poole 1965) |
| 1882 | Lackawanna Co. | 1 reported (Poole 1965) |
| prior to 1890 | Erie | 1 reported (Poole 1965) |
| 1898 | Greene Co. | 1 reported (Poole 1965) |
| 1900 | Erie | 1 reported (Poole 1965) |

SIGHT RECORDS FOR QUEBEC.

| DATE | LOCATION | SOURCE |
|---------------------------------|-----------------------|---|
| winter 1889-1890 | Montreal | many reported (Macoun 1903) |
| 26 November 1923 | Hatley | 1 seen (Mousley 1924) |
| 16 August 1924 | Gaspé Co. | 1 reported (Bent 1938) |
| 10 August 1925 | Rivière Madelaine | 1 seen (Demille 1926) |
| 12 February 1928 | Montreal | 1 seen (Smith 1929) |
| Feb.-March 1938 | Verdun | 1 reported (M. McIntosh <u>in litt.</u> 1976) |
| 11 June 1938 | Trois Pistoles | 1 reported (M. McIntosh <u>in litt.</u> 1976) |
| 15 August 1938 | Lac Tremblant | 1 reported (M. McIntosh <u>in litt.</u> 1976) |
| 15 November 1938 | Piedmont | 1 reported (M. McIntosh <u>in litt.</u> 1976) |
| 21 February 1947 | Montreal | 1 reported (M. McIntosh <u>in litt.</u> 1976) |
| 10 February 1956 | Notre Dame du Nord | 1 reported (M. Gosselin <u>in litt.</u> 1976) |
| 19 January 1957 | Ste. Therese de Laval | 1 seen (American Birds 12: 256) |
| 11 January 1958 | Ste. Therese de Laval | 1 seen (Bull. Ornithol. 3: 3) |
| 31 January - 2 February 1959 | Senneville | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 1-15 February 1959 | Montreal | 1 seen (American Birds 13: 279) |
| 2-4 February 1959 | Yamaska | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 18 August 1959 | Matamac | 1 seen (Bull. Ornithol. 4: 6) |
| 5 December 1960 | Pointe Claire | 1 seen (M. McIntosh <u>in litt.</u> 1976) |

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|-------------------------|-----------------------|---|
| 15 March 1965 | Dowal | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 21 March 1965 | Cap Tourmente | 1 seen (Bull. Ornithol. 10: 3) |
| 3 Feb.-20 March 1966 | Aylmer - Luskville | 6 seen (American Birds 20: 405) |
| 13 Feb.-March 1966 | Dorval | 4 seen (American Birds 20: 405) |
| 13 Feb. - 23 March 1966 | Dorval | 3 seen (M. McIntosh <u>in litt.</u> 1976) |
| 15 Feb. - 3 March 1966 | Como | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 24-26 Feb. 1966 | Cap Tourmente | 4 seen (Bull. Ornithol. 11: 3) |
| 24 Feb. - 19 March 1966 | Cap Tourmente | 4 seen (American Birds 20: 405) |
| 26 February 1966 | Aylmer | 3 seen (R. Buenten <u>in litt.</u> 1976) |
| 27 February 1966 | Dorval | 2 seen (Bull. Ornithol. 11: 3) |
| 23&24 April 1966 | Alstonvale | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 21 May 1966 | Lac St. Paul | 1 seen (Bull. Ornithol. 11: 7) |
| 18&19 Jan. 1967 | Doxion | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 24 March 1967 | Cap Tourmente | 1 seen (Bull. Ornithol. 12: 17) |
| 6 February 1968 | Mt. Royal | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 28 December 1968 | Couer de Marie | 1 seen (American Birds 23: 460) |
| 15 Feb.-2 March 1969 | Aylmer | 4 seen (Pittaway and Brunton 1969) |
| 10-21 February | Grenville | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 20 February 1971 | Grenville | 1 seen (Bull. Ornithol. 16: 5) |
| 28 Feb.-12 March 1971 | Cap Tourmente | 1 seen (Bull. Ornithol. 16: 5) |
| 27 March 1971 | Ile Peniot | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 6&9 April 1971 | Lucerne | 1 seen (D. Brunton <u>in litt.</u> 1976) |
| 4 February 1973 | Cap Tourmente | 1 seen (Bull. Ornithol. 18: 6) |

| | | |
|--------------------------|------------------------------------|---|
| 13 Feb.-19 March 1973 | Montreal | 3 seen (M. McIntosh <u>in litt.</u> 1976) |
| 17 February 1973 | Cap Tourmente | 1 seen (N. Neily <u>in litt.</u> 1976) |
| 3-18 March 1973 | Dollard des Ormeaux | 4 seen (American Birds 27: 594) |
| 31 March 1973 | Yamaska | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 31 March 1973 | Ile Penrot | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 31 March 1973 | Yamaska | 1 seen (Bull. Ornithol. 18: 6) |
| 25&26 Dec. 1973 | St. Edward de Maskinonge | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 26 December 1973 | Chicoutimi | 1 seen (Bull. Ornithol. 19: 7) |
| 16 February 1974 | Papineauville | 1 seen (M. McIntosh <u>in litt.</u> 1976) |
| 16 February 1974 | Ile Bouchard | 4 seen (M. McIntosh <u>in litt.</u> 1976) |
| 24 Feb.-3 March 1974 | Choisey | 2 seen (M. McIntosh <u>in litt.</u> 1976) |
| 24 Feb.-3 March 1974 | Hudson | 1 seen (Bull. Ornithol. 19: 7&25) |
| 24 Feb.-3 March 1974 | Ile Bouchard & L'Assumption Co. | 3 seen (Bull. Ornithol. 19: 7&25) |
| ? March 1974 | Rigaud Mountain | 1 seen (M. McIntosh <u>in litt.</u> 1976) |

SIGHT RECORDS FOR RHODE ISLAND.

| DATE | LOCATION | SOURCE |
|---------------|------------|----------------------------------|
| 25 March 1883 | Fox Island | 1 reported (Bagg and Eliot 1937) |

SIGHT RECORDS FOR SASKATCHEWAN.

| DATE | LOCATION | SOURCE |
|------------------|------------------|----------------------------|
| winter 1890 | Indian Head | 1 reported (Mitchell 1924) |
| winter 1916 | Indian Head | 1 reported (Mitchell 1924) |
| winter 1917 | Indian Head | 1 reported (Mitchell 1924) |
| ? ? 1926 | Prairie | 1 reported (Houston 1957) |
| 20 November 1939 | Nipawin | 1 seen (Street 1960) |
| 17 December 1939 | Nipawin | 1 seen (Street 1960) |
| 9 January 1951 | Fort a la Corne | 1 seen (Matthews 1951) |
| ? July 1951 | Sylvania | 3 seen (Houston 1957) |
| fall 1952 | Fort a la Corne | 1 reported (Houston 1957) |
| 17 November 1955 | Love | 3 reported (Houston 1957) |
| ? November 1955 | Love | 1 reported (Houston 1957) |
| 11 December 1955 | Nipawin | 1 reported (Houston 1957) |
| 29 December 1955 | Young | 1 reported (Houston 1957) |
| 1 January 1956 | Armley | 1 reported (Houston 1957) |
| 7 January 1957 | Beaver Creek | 1 seen (Houston 1956) |
| 19 February 1956 | High Hill | 1 reported (Houston 1957) |
| 10 March 1956 | High Hill | 1 seen (Houston 1957) |
| 8&9 Feb. 1957 | Pathlow | 1 reported (RMNH records) |
| 7 March 1957 | Pathlow | 1 reported (RMNH records) |
| 13 January 1958 | Peesane | 1 seen (Baines 1958) |
| fall 1959 | Torch River | 1 seen (Francis 1960) |
| ? October 1959 | Beaverlodge Lake | 1 seen (Nero 1963) |
| ? November 1959 | Torch River | 1 seen (Street 1960) |

| | | |
|-------------------------|--------------------|--|
| ? December 1957 | Choiceland | 4 seen (Law 1960) |
| ? December 1957 | Torch River | 1 reported (Street 1960) |
| 1 January 1960 | Warner Lake | 1 reported (Houston 1962) |
| fall 1960 | S.E. Hudson Bay | 1 reported (Houston 1962) |
| 5 September 1960 | Kelvington | 4 reported (Houston 1962) |
| ? July 1961 | Torch River | 2 reported (Nero 1965) |
| 7&8 July 1961 | Spirit Lake | 1 seen (Anaka 1961) |
| 28 August 1961 | Spirit Lake | 1 seen (Anaka 1961) |
| 31 August 1961 | Spirit Lake | 1 seen (Anaka 1961) |
| 8, 14, 19 Sept. 1961 | Missinipi | 1 seen (Wade and Wade 1962) |
| 26 May 1963 | Hansen Lake Road | 1 seen (G.G. Anweiler <u>in litt.</u> 1976) |
| 27 May 1965 | Little Buffalo R. | 4 seen (Stewart 1966) |
| 31 December 1966 | Cowan River | 1 seen (Houston 1967) |
| 27 December 1966 | Nipawin | 1 reported (Houston 1967) |
| 26 December 1968 | Saltcoats | 1 reported (Houston 1969) |
| 28 January 1970 | Emma Lake | 1 seen (R.E. Gehlert <u>in litt.</u> 1976) |
| ? July 1970 | La Ronge | 1 seen (W. Renaud <u>in litt.</u> 1976) |
| 7 July 1970 | Last Mountain Lake | 1 seen (L. Woods <u>in litt.</u> 1976) |
| summer 1970 | White Fox | 1 seen (W. Matthews <u>in litt.</u> 1976) |
| 29 December 1970 | Nipawin | 2 reported (R. Riome <u>in litt.</u> 1976) |
| 20 January 1971 | Nipawin | 1 reported (R. Riome <u>in litt.</u> 1976) |
| 14 March 1971 | White Fox | 1 seen (R. Riome <u>in litt.</u> 1976) |
| summer 1971 | White Fox | 1 seen (W. Matthews <u>in litt.</u> 1976) |
| 25 Nov.-19 Jan. 1973 | Nipawin | 7 seen (American Birds 28: 654) |

| | | |
|-------------------------|-------------------|--|
| 6 Feb.-12 March 1974 | Spirit Lake | 1 seen (American Birds 28: 654) |
| ? July 1975 | Hanson Lake | 1 seen (K.S. Yonge <u>in litt.</u> 1976) |
| 16 December 1975 | Little Amyot Lake | 1 seen (American Birds 30: 89) |

SIGHT RECORDS FOR UTAH.

| DATE | LOCATION | SOURCE |
|--------------|-------------|-----------------------------------|
| 30 July 1962 | Spirit Lake | 1 reported (Behle and Perry 1975) |

SIGHT RECORDS FOR WASHINGTON.

| DATE | LOCATION | SOURCE |
|------------------|----------------|--|
| ? ? 1896 | Sumas | 1 reported (Jewett <u>et al.</u> 1953) |
| 14 November 1919 | Eatonville | 1 reported (Jewett <u>et al.</u> 1953) |
| ? January 1974 | North Cascades | 1 reported (Angell 1974) |

SIGHT RECORDS FOR WISCONSIN.

| DATE | LOCATION | SOURCE |
|-----------------|------------|---|
| ? ? 1848 | Racine | 1 reported (Kumlien and Hollister 1951) |
| ? November 1891 | Iron River | 1 reported (Kumlien and Hollister 1951) |
| 14 March 1966 | Superior | 1 seen (American Birds 20: 427) |

| | | |
|------------------|--------------|---|
| 26-28 Feb. 1968 | Iron Co. | 1 reported (S. Postupalsky <u>in litt.</u> 1976) |
| 21 January 1969 | Taylor Co. | 1 seen (American Birds 23: 485) |
| ? February 1969 | Chippewa Co. | 1 seen (American Birds 23: 485) |
| 8 February 1969 | Juneau Co. | 1 reported (S. Postupalsky <u>in litt.</u> 1976) |
| 8-27 Feb. 1969 | Wood Co. | 1 seen (American Birds 23: 485) |
| 9-20 Feb. 1969 | Sauk Co. | 1 seen (American Birds 23: 485) |
| 12-20 Feb. 1969 | Sauk Co. | 1 reported (S. Postupalsky <u>in litt.</u> 1976) |
| 26 December 1974 | Brule River | 1 seen (Klugow 1975) |

SIGHT RECORDS FOR WYOMING.

| DATE | LOCATION | SOURCE |
|------------------|------------------|---------------------------------|
| fall 1930 | Yellowstone Park | 1 reported (Kemsies 1935) |
| 3 July 1940 | Yellowstone Park | 1 seen (Long 1941) |
| 9 September 1940 | Yellowstone Park | 1 seen (Test 1941) |
| ? August 1970 | Grand Teton Park | 1 seen (American Birds 24: 703) |

SIGHT RECORDS FOR THE YUKON TERRITORIES.

| DATE | LOCATION | SOURCE |
|---------------|-------------------|---|
| 15 March 1971 | Chilkat Pass | 1 seen (D. Mossop <u>in litt.</u> 1976) |
| ? July 1972 | Slims River Delta | 1 seen (M. Hoefs <u>in litt.</u> 1976) |
| ? July 1972 | Quill Creek | 1 seen (M. Hoefs <u>in litt.</u> 1976) |

| | | |
|-----------------|---------------|--|
| 15 April 1974 | Teslin Lake | 1 heard (D. Mossop <u>in litt.</u> 1976) |
| 18 April 1975 | Teslin Lake | 1 seen (D. Mossop <u>in litt.</u> 1976) |
| 2 December 1975 | Burwash Creek | 1 seen (W. Neiley <u>in litt.</u> 1976) |
