

Calidrid spring migration on the east and west Canadian Prairie

J.B. Steeves & S. Holohan

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Northward migrating Calidrid shorebirds were systematically counted at far eastern (Winnipeg, Manitoba) and far western (Calgary, Alberta) sections of the Canadian prairie. A total of 204 Calidrid counts were made at two sites over a 10 year period from 1980 to 1990 at Winnipeg, whilst at Calgary, 143 counts at many small sites were made over an 11-year period from 1979 to 1989. The migration patterns established revealed differences in numbers and timing between the two areas as well as inconsistencies with published observations.

J. Steeves, Box 61086 Kensington Postal Outlet, Calgary Alberta T2N 4S6, Canada.
S. Holohan, 150 Woodland Drive, Midland Ontario L4E 4E3, Canada.

INTRODUCTION

Information concerning the Canadian prairie northward migration of the genus *Calidris* appears from the 1920s to the late 1970s in various publications (Bent 1927; Rand 1948; Salk & Wilk 1958; Kondel *et al.* 1960; Palmer 1967; Renaud & Renaud 1975; Salt & Salt 1976; Sadler & Myres 1976; Land *et al.* 1976; Harrington & Morrison 1979; Lister 1979). These sources mainly present continental summaries or local range-times. To augment observations and clarify inconsistencies, systematic observations were made at the prairie's eastern edge - 204 counts between 1980 and 1990 at Winnipeg, Manitoba, and at the western edge - 143 counts between 1979 and 1989 at Calgary, Alberta. This paper records the patterns of occurrence which were obtained, compares counts between areas and discussed the results in the light of publications prior to 1991.

During our counts other observers were collecting Canadian prairie data also. But Colwell *et al.* (1988) indicates a general lack of prairie data with the statement that their 1984 Saskatchewan study "... represents the first detailed account of shorebird migration in the northern prairie region of North America."

STUDY AREAS

The great plain of North America stretches ca. 2,500 km north from the Gulf of Mexico to the Arctic Ocean. A southern portion is often called the prairies. In Canada this area lies in the provinces of Manitoba, Saskatchewan and Alberta. It is an area of limited rainfall and most of its agriculture depends on rain in May and June. Such rainfall, however, varies not only from area to area but also between years, creating a habitat that is considered unstable. Thus long-term studies are needed to obtain meaningful perspectives and average values.

The studies were made at almost the extreme east and west section of the area-a distance of ca. 1,300 km.

Manitoba counts were made at two sites (ca. 50°N, 97°W - elevation ca. 250 m). Grassmere Greek, West St. Paul is a 43.7 ha sewage treatment area with 16 evaporating sludge ponds, whilst the Stonewall's Oak Hammock 1,953 ha marsh has four ponds (although most counts were made at the 150 ha north pond). Both areas were manipulated for considerations other than shorebirds but the shorebird habitat remained fairly stable.

Alberta counts were made within a rectangular undulating agricultural high prairie area east of Calgary (50°55' to 51°20' N, 113°10' to 113°55'W - elevation ca. 1,000 m). Waders were found in cultivated land, ephemeral pools, sloughs, lakes and irrigation reservoirs. The habitat was extremely unstable due to weather and human manipulation.

METHODS

The northward Calidrid count period was from ca. 15 April to 15 June each year except for extreme dates and 25 June for Winnipeg's Semipalmated Sandpiper *Calidris pusilla* data.

Manitoba counts were made by SH who made a systematic walking census around St. Paul sewage sludge ponds from 1981 to 1990 (a total of 138 counts-annual range 3-28) and Oak Hammock Marsh 1980 to 1990 (a total of 66 counts-annual range 2 to 11).

The Alberta data was gathered by JBS from 1979 to 1989. The principle method was to make a five hour count from a car along the grid road system. These roads were established in the late 1800s with the division of the prairie into agricultural land parcels with road allowances. The allowances run every 1.6 km east to west and every 3.2 km north to south. Counts took place along these roads at fields, sloughs, lakes and reservoirs. Second counts at any location took place at least six days later (a total of 143 counts-annual range 9 to 20).

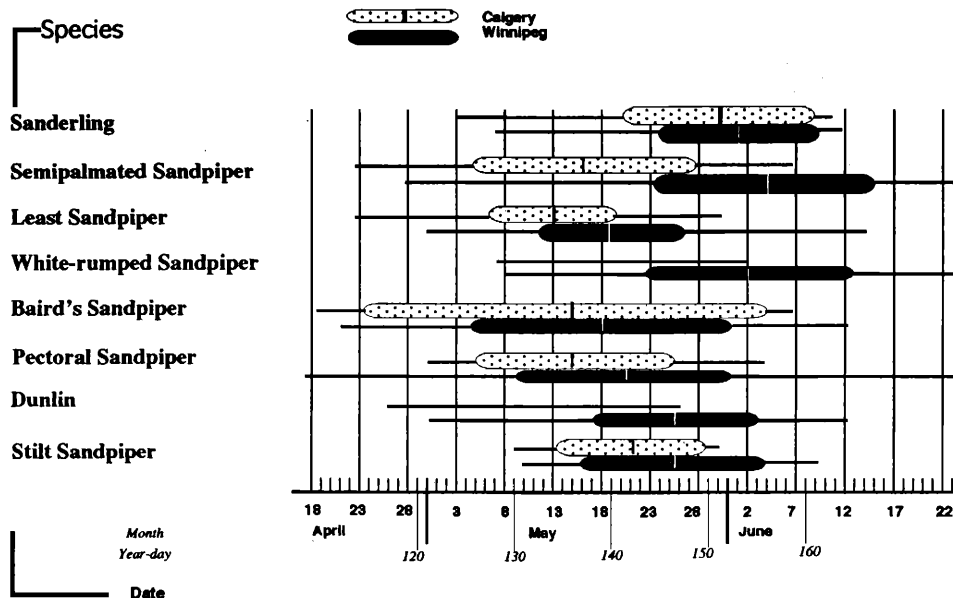


Figure 1. Range of occurrence of main Calidrids recorded on spring migration in the Canadian prairies: ellipsographs show two standard deviations around the mean date of occurrence for each species, with range of dates shown by lines.

Descriptive statistics figures were calculated, for both areas, after summarising the data for each year into five day periods.

RESULTS AND DISCUSSION

The species mix, except one rarity at each location, was almost identical. The Manitoba area, however, supported much larger total staging numbers due to greater numbers of Least Sandpiper *C. minutilla*, White-rumped Sandpiper *C. fuscicollis* and Dunlin *C. alpina*. There were noticeable differences in arrival and departure times for some species and Figure 2 illustrates this for the regular species. Table 1 summarises the data for all the species recorded.

An earlier movement through the Great Plain of the Alaskan Semipalmated Sandpiper population was mentioned by Harrington & Morrison (1979). Our data supports an earlier western plain movement for that species and most Calidrid species. The Alaskan climate permits a laying period for Calidrids from the third week of May to after the middle of June (Gabrielson & Lincoln 1959; Isleib & Kessel 1973; Kessel 1989). Melt and thaw conditions for many other North American Calidrid nesting areas permit laying from about mid to end of June (Jehl & Smith 1970; Hussell & Holroyd 1974). Thus at least part of the earlier movement through Calgary may be of populations migrating to Alaska.

An outline of migration schedules can be obtained from the various publications cited earlier. These have a tendency, however, to emphasise extreme dates and large concentrations to the exclusion of peaks. This lack of

information is, in part, the result of data collection difficulties. Many variables influence shorebird presence. Presence and numbers at staging sites are influenced by population numbers, the migratory urge, migration conditions, the physical conditions at each site as well as variations in food supply. The latter two factors can vary from adequate to ideal because both natural and human influences constantly alter the sites. Thus a large scale mosaic of different degrees of attractiveness can occur. The prairie drought cycle is an important factor that may alter a site toward ideal conditions. Sometimes these cycles last many years permitting habitats to change dramatically in their attractiveness to waders. Another important factor is the continuing habitat change due to modern agricultural practices which is reducing the number of natural habitats at an alarming rate. These examples illustrate the unpredictable prairie environment and partially explain the difficulties of systematic counting. We consider that at least ten years of systematic area counts are necessary for accurate results.

Counts at Manitoba sites produced a census type data-set at fixed locations. In contrast, Calgary data were obtained by sampling constantly changing sites. Data comparison from different methods indicates that count methods can be flexible and yet results still comparable. The problem remains of how to utilise and centralise data for an understanding of the prairie-wide system.

Some Alberta publications, particularly Salt & Salt (1976) reflect many years of shorebird observation at the Beaverhills Lake regional reserve but yet give a very general outline. For some species, migration schedules seem significantly different from those of Sadler & Myres (1976). Pinel *et al.* (1991) clarify some of these

Table 1. Summarizes the data for the count areas and gives noteworthy dates.

Species	Mean	SD*	Mode	Total records/Individuals**	Noteworthy Dates
Calagry					
Red Knot				7-50, 10 to 27 May	18 May 1979-20 & 27 May 1987-18
Sanderling	30-May	5	2-Jun	25-30	3 June 1972-72 & 26 May 1984-65
Semipalmated Sandpiper	16-May	5.8	13-May	105-25,400	12 May 1985-2,000 & 12 May 1989-725
Western Sandpiper				5,7, 2-13 May	
Least Sandpiper	13-May	3.3	13-May	74-1,400	9 May 1981-57 & 11 May 1985-63
White-rumped Sandpiper				10-40	30 May 1979-17 & 20 May 1985-6
Baird's Sandpiper	18-May	10.8	8-May	85-1,850	8 May 1982-250 & 7 May 1989-100
Pectoral Sandpiper	15-May	4.5	18-May	77-4,700	20 May 1979-640 & 20 May 1984-260
Dunlin				6-9	9 May 1982-3 & 27 April 1986-2
Stilt Sandpiper	21-May	3.8	18-May	41-1,300	20 May 1979-180 & 16 May 1982-150
Winnipeg***					
Red Knot				1-1	9 June 1983-1
Sanderling	1-Jun	4.2	2-Jun	15,55, 21 May to 11 June	23 May 1983-6 & 4 June 1985-7
Semipalmated Sandpiper	4-Jun	5.7		31-129	9 June 1985-18 & 28 May 1989-10
Least Sandpiper	19-May	3.9		15-70	6 June 1981-14 & 23 May 1983-7
White-rumped Sandpiper	2-Jun	5.2		92-6,200	29 May 1982-700 & 2 June 1985-700
Baird's Sandpiper	15-May	6.8		48-16,300	2 June 1982-790 & 3 June 1983-1000
Pectoral Sandpiper	21-May	5.7		74-2,100	19 May 1985-230 & 23 May 1988-60
Dunlin	26-May	4.2	23-May	36-7,500	19 May 1982-1000 & 21 May 1985-400
Curlew Sandpiper	26-May	4.5		75-2,000	4 June 1985-300 & 3 June 1989-100
Stilt Sandpiper				84-875	26 May 1981-7,000 & 1 June 1986-1,5000
				29-400	21 May 1984-52 & 2 May 1985-76.
				71-670	1 June 1981-30 & 23 May 1983-35
				40-2,600	1 May 1988-40 & 22 May 1989-55
				50-1,000	10 May 1981-600 & 14 May 1983-500
				47-12,300	23 May 1985-285 & 28 May 1989-100
					31 May 1983-2,200 & 24 May 1986-2,000
					1 June 1981-1 male
				30-416	19 May 1985-30 & 28 May 1989-60
				36-1,900	19 May 1985-30 & 28 May 1989-60

* SD is that number of days on each side of the mean in which ca. 68 percent of the birds passed.

** Also for some irregular species the range dates.

*** First line are data for Grassmere Creek and the second line are data for Oak Hammock Marsh.

differences but still mainly present range dates for the 1970s. They comment on significant new areas found during the 1980s. Steeves & Steeves (1985) reported Calgary's annual shorebird migration (1979-1983: 260 counts) by histogram patterns, mean dates of arrival and departure and comparative abundance. Dekker (1991) emphasises that wader abundance at Beaverhills Lake varies tremendously from year to year and seems to be in a declining phase.

The Manitoba reference (Cleveland *et al.* 1980) reflects years of observations at the Oak Hammock regional reserve.

During the mid 1980s the Canadian Wildlife Service supported prairie studies by Colwell *et al.* (1988) and Dickson & Smith (1988). This last study was an aerial survey to determine major staging areas. These studies present numbers that, from some areas, appear much greater than indicated by previous Saskatchewan literature (Renaud & Renaud 1975; Gollop & Gilliland 1982; Adam *et al.* 1985). It remains a problem to compare these new short-term studies, which may represent limited-time stagings with the published long term observations. Future studies will reveal if the prairie drought cycle was such that temporary concentrating effects were in operation or if these recently discovered large staging sites are stable in the long-term. If they are stable they probably represent major staging sites. However, we consider, that a minimum of 10 years is needed at prairie sites for reliable data.

The following discussion of individual species briefly compares the present study with previously published data.

Red Knot *Calidris canutus*

Our count data agrees with past information. Most Red Knot stop at the east coast's Delaware Bay (Morrison 1984) and then migrate mainly west of Quebec and James and Hudson Bay (Godfrey 1986). Rowan at Beaverhills Lake, Alberta (in Bent 1927) suggested that small numbers use an interior plains route and Palmer (1962) regarding the interior route, suggested a mainly Alberta interior route. Cramp (1983) suggested a plains overflight, and that records there may be due to drop-outs. Recently Colwell *et al.* (1988) and Dickson & Smith (1989) presented Saskatchewan data that also indicated a central plains route - Colwell's 1984 census averaged 53 Knot with a maximum flock of 82 birds and an occurrence range from 28 May to 3 June 9 (Dickson's aerial survey of 24 May 1987 found 349 and 20 Knot on Chaplin Lake and Old Wives Lake respectively).

These brief studies lead to speculation of Great Plain flights - these may yet be determined to consist of large passage numbers with the occasional drop-out or merely minor flights. At Calgary most birds were seen after inclement weather, which supports Cramp's drop-out idea. Hobson on Ellesmere Island (in Nethersole-Thompson 1979) found Red Knot nesting on 14 June 1968, although these birds are of course *C. c. islandica* rather than *C. c.*

rufa.

Sanderling *C. alba*

Rowan (in Lister 1979) recorded that the main passage was from the last week of May to the first few days of June. Marchant *et al.* (1986) considered it as an inland vagrant. Dickson & Smith reported 13,944 and 1,541 on two Saskatchewan lakes on 24 May 1987. Colwell *et al.* (1988) at another Saskatchewan lake recorded 66 birds from 30 April to 6 May 1984 - a very early record and then no reports until 28 May to 3 June with eight recorded. The last Colwell data is similar to the Rowan summary and our Calgary/Winnipeg schedules. Parmelle *et al.* (in Nethersole-Thompson 1979) on Bathurst Island found Sanderling laying its first egg 25 June and that date further supports our schedule data.

Semipalmated Sandpiper *C. pusilla*

Among the evolving knowledge of this species are the contributions of Manning *et al.* (1956) who considered there to be three disjunct populations and of Harrington & Morrison (1979) who considered that there were elliptical routes for the central/eastern group whilst the Alaska group used the same north and south route. They also suggested that the Alaskan/central populations migrated earlier in spring. Our study showed that the Calgary migration is almost finished just as staging numbers at Winnipeg are starting to build to a peak.

Two reports support findings of an earlier Alberta migration; first, a central Alberta (lat. 54°) peak on 20 May (Salt & Salt 1976); and second an early to mid-May Alberta migration (Sadler & Myres 1976). Kessel (1989) also states that arrival at Seward Peninsula in Alaska occurs from the second week of May and peaks during the last third of May. Her information supports the idea that it is an earlier migrating Alaskan population that passes through the Calgary area.

Salt & Salt (1976) supported the later Manitoba migration by indicating peak abundance in the second week of June at Churchill, Manitoba (ca. 60° N), whilst Cleveland *et al.* (1980) for southern Manitoba show, by a bar graph, a peak from mid-May to about the end of the first week of June. Renaud & Renaud (1975) in a Saskatchewan study east of Saskatoon show a peak in the third and fourth week of May. Adam *et al.* (1985) at Regina suggest, by a bar graph, a main migration from the beginning of May to the end of the third week. Colwell *et al.* (1984) presents a two peak pattern of 7-13 May and 4-17 June. This suggests that two groups may be staging at this central Canadian plains province.

The Winnipeg peak seems similar to that obtained at Long Point, Lake Erie, Ontario by Bradstreet *et al.* (1977), and at Montreal, Quebec by Holohan (1983) suggesting that the central population migration time is more similar to the eastern population than that of the Alaskan group.

Least Sandpiper *C. minutilla*

The literature seems vague regarding peak times. Cramp (1983) stated that they cross Canada mainly in second half of May. Salt & Salt (1976) tend to agree and reported, for central Alberta, most passing in the last week of May. Colwell *et al.* (1984) in Saskatchewan recorded the main passage during 21-27 May. The current Alberta study clearly indicates a much earlier passage than Salt & Salt suggest and even our results from Manitoba are earlier than they report. As with most species an earlier migration pattern is indicated for Calgary but with greater numbers passing through Manitoba.

White-rumped Sandpiper *C. fuscicollis*

The broad picture presented by Morrison (1984), Marchant *et al.* (1986), and Cramp (1983) is of an elliptical migration - northward through the interior plains and then southward to the northeast Atlantic coast before crossing the Atlantic to South America. The Canadian migration reported by Godfrey (1986) indicates it is a transient species east of the Rockies (mainly spring) and west of western Quebec - rarely occurring in Alberta. Saskatchewan data (Gollop & Gilliland 1982; Colwell 1988; Smith & Dickson 1989) indicate that peak migration times are about the same as in Winnipeg but in smaller numbers than other Calidrid species. The conclusion from available data is that the main migration goes through Manitoba. It was the most abundant shorebird species at Oak Hammock. At West St. Paul it fell just behind Semipalmated and Least Sandpipers as the most abundant shorebird. The Winnipeg pattern of occurrence was identical at West St. Paul and Oak Hammock Marsh.

Baird's Sandpiper *C. bairdii*

Godfrey (1986) indicated a broad front migration across the Canadian Plain from mid-April to mid-May (Palmer 1967). Provincial data regarding numbers and timing is

contradictory, however, (Renaud & Renaud 1975; Cleveland 1980; Gollop 1980; Salt & Salt 1976; Sadler & Myres 1976). One possible reason is that the species is somewhat selective in its habitat choice and certain areas have not been extensively watched. Two indications of this were a 24 May 1987 count of over 16,000 at Chaplin Lake, Saskatchewan (Dickson *et al.* 1989) and a report by Pinel *et al.* (1991) of large numbers at Provost/Chauvin AB. Possibly Alaskan bound migrants come and go earlier leading to a lack of recognition of two population groups. There is some indication of this as the Calgary data is bimodal with a large standard deviation. It is the only species which has both an earlier and a later time at Calgary. Kessel (1989), at Seward Peninsula Alaska, indicated that early spring migrants arrive by the second week of May, but most do not arrive until the third week and continue arriving until the end of the month. On average it arrives a few days later than Semipalmated Sandpiper which suggests that two groups move through the Calgary area.

Pectoral Sandpiper *C. melanotos*

Cramp & Simmons (1979) indicated continental movement in early May and Salt & Salt (1976) recorded an early May passage in Alberta. Our study in Manitoba however, recorded peak abundance on 23 May and during mid-May in Alberta. An early May date appears satisfactory for USA south of 49° N but seems too early for the main migration in Alberta. Palmer (1967) reported arrival times on the breeding ground in early June and therefore mid-May seems correct for prairie Canada. Kessel (1989) noted that Alaskan birds arrive in mid-May (with most from 20-22 May) and that they continue to arrive throughout May dependant on the persistence of snow cover.

Dunlin *C. alpina*

Godfrey (1986) recorded Dunlin as locally common in Manitoba, uncommon in Saskatchewan and rare in Alberta. Cleveland *et al.* (1980), at Winnipeg, recorded the species as common during May. However we found increasing numbers during May, peaking on 23 May. Most Calgary records are from the end of April suggesting a movement to Alaska although with small numbers. There are a few Regina records at the end of April (Adam *et al.* 1985). This study had an early record on 20 April at Winnipeg.

Stilt Sandpiper *C. himantopus*

The literature reveals that the main passage is over the plains. In Manitoba it is uncommon during May (Cleveland *et al.* 1980) but this study indicated a peak near the end of May and maxima of 300, which might not be uncommon. In Saskatchewan it is common (Adam *et al.* 1985; Gollop & Gilliland 1982; Renaud & Renaud 1975). Colwell (1984) indicated peak numbers between 28 May to 3 June, with numbers over 500. Dickson & Smith (1989) found maxima of 2,450 and 821 near the end of May during an aerial survey. In Alberta it was common at Beaverhills (Salt & Salt 1976), whilst being

uncommon in the south (Sadler & Myres 1976) but it may have been overlooked. Cramp (1983) speculates that since Stilt Sandpipers normally travel in small numbers, a large flock at Regina (Palmer 1967) may indicate major staging in Saskatchewan. Palmer speculated that increased reports may reflect greater observation effort, an increase in population size or a developing tendency for concentration on the western plain.

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REFERENCES

- Adam, C.I.G., Riffel, T.B., Luterbach, R.A. & Kreba, R.H. 1985. *A birdfinding guide to the Regina Area*. Special Pub. No. 16. Regina, Saskatchewan.
- American Ornithologists' Union. 1983. *Check-list of North American Birds* (Sixth Ed. Amer. Ornith Union).
- Bent, A.C. 1927. *Life Histories of North American Shorebirds*. Part 1. (Dover Reprint, New York. 1962).
- Bradstreet, M.S.W., Page, G.W. & Johnston, W.G. 1977. Shorebirds at Long Point, Lake Erie, 1966-1971: seasonal occurrence, habitat preference, and variation in abundance. *Can. Field Nat.* 91(3): 225-236.
- Colwell, M.A., Fellow S.D. & Oring L.W. 1988. Chronology of shorebird migration at Last Mountain National Wildlife Area, Saskatchewan. *Wader Study Group Bull.* 52: 18-22
- Cleveland, N.J., Cuthbert, C.W., Grief, G.D., Holland, G.E., Horch, P.A., Knapton, R.W., Koes, R.F., Murdock, N.F., Neily W.P.O. & Ward, I.A. 1980. *Birder's Guide to Southeastern Manitoba Man*. Natl. Soc. Winnipeg.
- Cramp, S & Simmons, K.E.L. 1979. *The birds of the western Palearctic*. Vol. 3. Oxford University Press, Oxford.
- Dekker, D. 1991. *Prairie Water*. BST Pub., Edmonton, Alberta.
- Dickson, H.L. & Smith, A.R. 1989. Canadian Prairie Shorebird Program update. *Wader Study Group Bull.* 52: 23-27.
- Gabrielson, I.N. & Lincoln, F.C. 1959. *The Birds of Alaska*. Wildlife Management Institute, Washington, D.C.
- Godfrey, W.E. 1986. *The birds of Canada*. Revised edition, Nat. Mus. of Canada.
- Gollop, B. & Gilliland, M. 1982. *Revised Data list of Saskatoon birds*. (3rd edition). Saskatchewan.
- Harrington, B.A. & Morrison, R.I.G. 1979. Semipalmated Sandpiper migration in North America. (Pitelka, Frank A. ed.). *Studies in Avian Biology*. No. 2. Cooper Ornith. Society. Pp 83-100.
- Holohan, S. 1983. Shorebird migration at Montreal, Canada. *Wader Study Group Bull.* 38: 37-40.
- Holohan, S. 1985. Observations on wader communities in Central Canada and Eastern Siberia. *Victorian Wader Study Group Bull.* 9: 18-26.
- Hussell, D.J.T. & Holroyd, G.L. 1974. Birds of the Truelove Lowland and adjacent areas of Northeastern Devon Island, N.W.T. *Can. Field-Nat.* 88: 197-212.
- Isleib, M.E. & Kessel, B. 1973. Birds of the North Gulf Coast-Prince William Sound Region, Alaska. *Bio. Paper. Univ. Alaska*, No 14.
- Jehi, J.R. Jr. & Smith, B.A. 1970. *Birds of the Churchill Region, Manitoba*. Manitoba Mus. of Man and Nature, Special Pub. 1 1-87.
- Kessel, B. 1989. *Birds of the Seward Peninsula, Alaska*. Univ. of Alaska Press.
- Kondla, N.G., Pinel, H., Wallis, C.A. & Wershler, C.R. 1973. Avifauna of the Drumheller area, Alberta. *Can. Field-Nat.* 87: 377-393.
- Land, B., Lang, V., Pinel, H. & Smith, W. 1976. *Check-list of the birds of the Calgary Region*. Calgary Field Naturalist's Society.
- Lister, R. 1979. *The birds and birders of Beaverhills Lake*. Edmonton Bird Club.
- Marchant, J., Prater, T. & Hayman, P. 1986. *Shorebirds-an identification guide to the waders of the world*. Benton Ross Pub. Auckland, New Zealand.
- Morrison, R.I.G. 1984. Migration systems of some New World shorebirds. *Behavior of Marine Animals* (Burger, J. & Olla, B.L. eds.). Plenum Press.
- Nethersole-Thompson, D. & M. 1979. *Greenshanks*. Poyser, Calton.
- Palmer, R.S. 1967. Species accounts. *The shorebirds of North America*. (Stout, G.D. ed.). pp 143-267. Viking Press, New York.
- Pinel, H.W., Smith, W.W., Wershler, C.R. 1991. *Alberta Birds 1971-1980*. Vol 1., Non-passerines. Prov. Mus. of Alberta. Occas. Paper No 13.
- Rand, A.L. 1948. *Birds of Southern Alberta*. Nat. Mus. of Canada. Bull. No. 111.
- Renaud, W.E. & Renaud, D.H. 1975. *Birds of the Rosetown-Biggart District, Saskatchewan*. Pub. No. 9. Sask. Nat. Hist. Soc. Regina, SK.
- Sadler, T.S. & Myres, M.T. 1976. *Alberta Birds 1961-1970*. Prov. Mus. of Alberta, Natural Hist. Section. Occas. Paper No. 1.
- Salt, W.R. & Wilk, A.L. 1958. *The Birds of Alberta*. Department of Economic Affairs, Edmonton, 511 pp.
- Salt, W.R. & Salt, J.R. 1976. *The Birds of Alberta*. Hurtig Pub., Edmonton. 498 pp.
- Steeves, J.B. & M.E. 1985. A five-year shorebird migration study at Calgary Alberta. *Alberta Bird Record* 3 (4): 45-53.