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BIRD TRENDS

A report on results of national ornithological surveys in Canada

Since publication of the last issue of *Bird Trends* devoted to shorebirds (No. 3, winter 1993/94), a considerable amount of new information on shorebird populations has come to light, and a number of conservation initiatives to support this group of birds have arisen. Noteworthy among the latter are the Canadian Shorebird Conservation Plan and the U.S. Shorebird Conservation Plan. There is an urgent need to move forward with the work and research described in these plans, as preliminary updates of trend analyses in Canada depict alarmingly widespread declines in many shorebird species. Shorebird work will need to be a prominent component of integrated bird conservation measures that are being planned under the North American Bird Conservation Initiative (NABCI). This issue of *Bird Trends* aims to update information on shorebird populations and trends and describe some of the conservation initiatives and challenges facing this group of birds.

Inside:

Bird Trends **is available on-line at:** **http://www.cws-scf.ec.gc.ca/canbird/news/index.html**

Shorebird population trends and issues in Canada – an overview

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Shorebirds form a prominent, and spectacular, part of the Canadian avifauna, and are among the most traveled avian species. Some species migrate from breeding grounds in the middle Canadian Arctic to wintering areas at the tip of South America; other populations migrate from the northeastern Canadian Arctic to their winter homes in Europe, while some species from the western part of the North American Arctic journey across the Pacific Ocean to Australasia (Morrison 1984). Not only does Canada hold substantial portions of the breeding ranges of many of these North American species, but it also provides essential stopover areas where the birds refuel during their spectacular journeys. Obtaining information on populations of such highly mobile birds is not an easy matter. In the Arctic, birds are spread over enormous areas and often occur in small numbers at any given locality, so that conducting surveys is both logistically difficult and expensive. On migration areas, shorebirds can occur in large flocks, but numbers vary rapidly as the birds pass through the region, making sampling problematical. While numbers may be more stable on the wintering grounds, such regions are often remote and difficult to access, even for local inhabitants. All of these considerations underline the fact that international cooperation and coordination of effort will be essential for effective conservation of shorebirds.

Despite these difficulties, much new information on shorebird populations has been obtained. The perception that shorebird populations in North America are declining has been a driving force behind the creation of national conservation plans in Canada and the USA. New information has only strengthened this concern. The previous analyses of long-term counts on the east coast of Canada (Morrison *et al.* 1994) and the USA (Howe *et al.* 1989) both demonstrated that a number of shorebird populations showed significant declines. The preliminary update of the Maritimes Shorebird Surveys (MSS) conducted in the

Atlantic provinces indicate that these declines are continuing — counts in the 1990s were lower than those in both the 1980s and 1970s (see Morrison & Hicklin, p. 16). While interpretation of these changes in numbers may be complicated by apparent changes in distribution of the most numerous species (see Hicklin, p. 19), the widespread nature of the declines across many species remains impressive. Not only did a number of species show statistically significant declines, but the proportion with negative changes (either statistically significant or not) was significantly higher than those with positive values. Clark *et al.* (1993) described significant declines for two species of shorebirds passing northwards on migration through Delaware Bay, and Harrington (1995) drew attention to the number of declining shorebird species in eastern North America. Results from the Ontario Shorebird Surveys also showed disproportionate numbers of species with negative trend values (see Ross *et al.*, p. 24). Information from the Arctic provides evidence that declines have occurred in breeding populations in a number of areas, including the low Arctic (Churchill – Gratto-Trevor 1994), mid Arctic (Rasmussen Lowlands – Gratto-Trevor *et al.* 1998, Johnston *et al.* 2000) and High Arctic (Devon Island and Ellesmere Island – Pattie 1990, Gould 1988). On the Pacific coast, declines have also occurred in the two most abundant species passing through staging areas in the lower Fraser River delta (see Butler & Lemon, p. 36). Results from temperate breeding grounds, obtained from Breeding Bird Surveys (BBS), show significant declines in a number of species in the USA and Canada (see Morrison, p. 12, and Dunn *et al.* 2000). Page and Gill (1994) noted declines among a number of shorebirds from temperate breeding areas in western North America, especially species breeding in upland habitats.

While some of these analyses are preliminary in nature and will be subject to further assessment, the evidence points consistently towards widespread declines in shorebird populations, which appear to have taken place over the past three decades. Shorebirds join grassland birds and sea ducks as groups with populations that are clearly declining. This contrasts with some other species, such as the Lesser Snow Goose, increasing populations of which may now be causing widespread habitat destruction, and seabirds, whose populations appear to be stable or increasing (see Bird Trends No. 7, 1999). Causes of declines in shorebird populations are sometimes hard to pinpoint, if only because of their extensive migrations and their potential to be affected at many different stages of their annual cycle. Habitat loss, such as the conversion of natural grassland to agricultural land, has been implicated in the declines of a number of temperate species (Page & Gill 1994), and is likely a factor in other habitats. For instance, Maisonneuve (1993) suggested that extensive loss of the boreal breeding habitats of Short-billed Dowitchers from flooding or drought following hydroelectric power development may have caused the large declines noted in this species. Habitat destruction by expanding Lesser Snow Goose populations could potentially affect some species breeding in the same areas, at least on a local level. Toxic chemicals and pollution are another concern, especially in areas near industrial centres such as those around the Great Lakes or along the St. Lawrence River, though less is known about this topic. The potential for toxic chemicals to affect metabolic processes and perhaps navigational capabilities has been recognized, especially when the birds are going through rapid cycles of weight gain and loss during migration, and are thus actively metabolizing tissues in which toxic chemicals are likely to be stored. In the Bay of Fundy, changes in sedimentation patterns resulting from alterations of river discharge patterns, may have affected food resources, leading to changes in the birds' ability to put on weight successfully prior to migration (Shepherd *et al.* 1995). Increases in populations of predators, particularly the Peregrine Falcon, are also suspected of causing changes in the distribution and even abundance of shorebirds at stopover areas on both the Atlantic and Pacific coasts of Canada (see Hicklin, p. 19, and Butler & Lemon, p. 36).

Climate change is another major environmental issue that is likely to have significant effects on shorebirds. The Arctic is considered to be one of the regions most likely to be affected by climate change, so the many species of shorebirds occurring in Canada that breed principally in arctic and boreal regions will undoubtedly be affected by an altered climate. While it might appear at first thought that a milder climate would be less energetically challenging and perhaps even lead to increased food supplies, it is not clear that this would be advantageous to shorebirds. Species adapted to particular habitats, or to a particular climatic regime, could find their requirements are no longer met as landscapes gradually respond to climate change. Peaks in food abundance may no longer be timed optimally in relation to the breeding cycle (e.g., during chick rearing) or migration cycle (e.g., enabling birds to gain weight prior to migration) in both terrestrial and marine/coastal habitats. Changes in the amount of precipitation could also affect breeding performance: for instance, increases in winter snowfall might lead to later snow melt and delay the onset of breeding, or increased precipitation during brood rearing could increase mortality of chicks.

Climate change might also lead to negative consequences at migration and wintering areas. Changes in sea level caused by melting polar ice could inundate coastal mudflats currently identified as critically important habitats. The extent to which this would happen would depend on various factors, including the rate of crustal uplift or sinking at the sites concerned, and the rate at which change in sea level equilibrates with sedimentation patterns and colonization of the new mudflats by shorebird food organisms. No studies exist that attempt to model these processes in the detail required to make predictions concerning their likely effects on shorebirds.

High elevation winds appear to be very important in enabling many shorebirds to complete their migratory flights (Piersma & Jukema 1990, Butler *et al.* 1997). Climatic change altering the strength, direction and/or frequency of prevailing wind patterns could affect not only the ability of birds to complete flights, but also the timing of the migration (Clark & Butler 1999). Breeding seasons are very short in many Arctic areas, and the timing of migration is critical if the birds are to succeed in raising offspring in the brief summer.

It is also not known how climate change will affect patterns of primary productivity in the earth's oceans. Recent work (Butler, Morrison & Davidson, unpubl. manuscript) has shown that essentially all of the major coastal shorebird sites in the world (those sites supporting over 100 000 shorebirds) are situated adjacent to areas of high oceanic primary productivity. In some areas, such as the Bay of Panama, upwelling patterns which result in high productivity appear to be driven by prevailing wind patterns; disruptions of these patterns would likely have a negative impact on shorebird populations using these areas.

Clearly, shorebirds can be affected by a myriad of factors affecting their survival and reproduction at many points in their life cycles across ranges which can span nearly an entire hemisphere. It will be a major challenge to conduct research that will reveal the causes of the currently observed declines in shorebird populations.

Considerable progress has been made in assembling estimates of shorebird population sizes (see Morrison, p. 5, Morrison *et al.* 2000a, 2000b). While the accuracy of most estimates is unknown and probably rather low, the data indicate that population sizes range between a few tens and a few thousands for endangered species, to several million, with most falling in the low hundreds of thousands. In common with many organisms, population sizes of the smaller shorebird species tend to be much larger than those of larger species, and population size is related to the average weight of the species. Most endangered species have much lower populations than would be expected for their physical size. Knowledge of population size, while difficult to obtain for highly mobile shorebirds, may nevertheless be useful in assessing the ability of populations to persist and in setting targets for recovery of species that have shown consistent declines or that are at risk.

Over the past several years, considerable energy has been put into the development of national shorebird conservation plans in both Canada and the USA, culminating in the recent publication of the Canadian Shorebird Conservation Plan (Hyslop *et al*. in press) and the U.S. Shorebird Conservation Plan (Brown *et al*. 2000). Close cooperation has been maintained during the development of the plans between Canada and the U.S., especially in the areas of information gathering, priority setting and planning for future monitoring and research requirements. In Canada, regional shorebird conservation plans are being actively developed which will deliver on-the-ground shorebird conservation through partnerships between governments and non-government organizations. This landscape-oriented, scientifically based approach is modeled on the highly successful North American Waterfowl Management Plan, and there are many opportunities for integrating shorebird and waterfowl conservation in future initiatives developed under both plans. Conservation plans are also being actively developed for a number of other groups of birds, including landbirds (Partners in Flight), waterbirds (Wings Over Water) and sea ducks (Sea Duck Joint Venture); it will be important to pursue opportunities to integrate conservation activities to avoid "plan fatigue" overtaking funding sources. This need has led to the emergence of the North American Bird Conservation Initiative (NABCI), a means of facilitating integrated conservation for all species of birds throughout Canada, the United States and Mexico. The Canadian Shorebird Conservation Plan is one of the core programs of NABCI and will ensure that the specialized requirements of shorebirds are not lost during the integration process. The result should be a new era of coordinated conservation delivery at a time when environmental concerns continue to rise.

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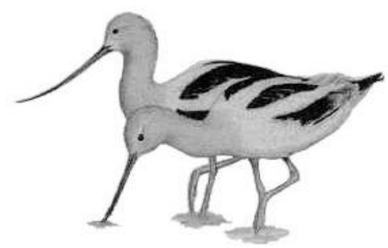

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Estimates of shorebird populations in North America

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Knowledge of the population size of birds has assumed considerable practical importance in conservation planning, especially for shorebirds and other waterbirds. Population estimates have been used, for instance, to assess the importance of sites for protection, and for setting targets for maintaining populations or for recovery of endangered species. The Ramsar Convention uses the criterion that a site should support 1% of a flyway population to be considered of international importance. The Western Hemisphere Shorebird Reserve Network (WHSRN) has adopted scaled criteria (5%, 15%, 30%) to determine increasing levels of importance for shorebird sites, from regional to hemispheric (Morrison *et al*. 1995; Frazier 1996; Rose and Scott 1997; MCCS 1999). Similar criteria have been adopted by the Important Bird Areas (IBAs) program of BirdLife International, launched in Canada in 1996 as a partnership between the Canadian Nature Federation and Bird Studies Canada (IBA 1998). Application of these criteria clearly requires a knowledge of the population sizes of the species being considered. Other conservation efforts in many parts of the world, including the Convention on Biological Diversity, the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) under the Bonn Convention, and the East Asian-Australasian Shorebird Reserve Network (EASRN), all require knowledge of population levels of the species with which they are concerned.

For endangered species, knowledge of the population size is necessary to assess the status of the species as well as to provide a criterion or target against which the success of management efforts may be measured.

The current population estimates have been assembled as part of the recently completed Canadian Shorebird Conservation Plan (Hyslop *et al*. in press) and U.S. Shorebird Conservation Plan (Brown *et al*. 2000).

Data compilation

The current estimates have been assembled from a variety of sources, including: (1) count data from volunteer survey networks such as the Maritimes Shorebird Survey on the east coast of Canada, the International Shorebird Survey and the Pacific Flyway Project in the U.S.;(2) compilations of data from particular geographic regions, including the interior of North America, and Latin America; (3) aerial survey data from various projects and areas, particularly the Canadian Wildlife Service “Atlas” projects conducted in South America, Panama and Mexico, as well as by various agencies in James Bay, Delaware Bay and Pacific northwest Mexico; (4) data from individual species investigations (e.g., Piping Plover, Mountain Plover, Black Turnstone); (5) investigations from breeding areas in temperate North America, as well as in the Arctic, where historical exploratory work and more recent work using remote sensing have provided population estimates for specific regions; and (6) supplementary estimates derived from schemes such as the Breeding Bird Survey and Christmas Bird Counts. Data were assembled from all available sources for each of four seasons (northward migration, southward migration, breeding grounds, wintering grounds) for particular flyways or regions, to avoid overlap or duplication of records of the same birds as much as possible. The sum of the maximum numbers found in all regions in any of the four seasons was taken as a minimum estimate of the population. More details on the derivation of population estimates and results are presented by Morrison *et al*. (2000a, 2000b).

Population Estimates

Current estimates for population sizes of 53 species of shorebirds occurring in North America are summarized in Table 1, with an assessment of the likely accuracies of the counts. The population estimates ranged

Table 1. Sizes, ranges and likely accuracy of population estimates for North American shorebirds.

			Estimated Population		Accuracy
Code	Species	Scientific name	N America	Canada	rating
BBPL	Black-bellied Plover	*Pluvialis squatarola*	200000	200000	2
AGPL	American Golden-Plover	*Pluvialis dominicus*	150000+	150000+	2
PGPL	Pacific Golden-Plover	*Pluvialis fulva*	16000		2
SNPL	**Snowy Plover**	***Charadrius alexandrinus***	**16000**	**-**	**4**
WIPL	Wilson's Plover	*Charadrius wilsonia*	6000	-	2
CRPL	Common Ringed Plover	*Charadrius hiaticula*	<10000?	<10000?	1
SEPL	Semipalmated Plover	*Charadrius semipalmatus*	150000	150000	2
PIPL	**Piping Plover**	***Charadrius melodus***	**5913**	**2110**	**5**
KILL	Killdeer	*Charadrius vociferus*	1000000	366000	2
MOUP	**Mountain Plover**	***Charadrius montanus***	**9000**	**10**	**4**
AMOY	American Oystercatcher	*Haematopus palliatus*	7500	4	3
BLOY	Black Oystercatcher	*Haematopus bachmani*	8900	8000	3
BNST	Black-necked Stilt	*Himantopus mexicanus mexicanus*	150000	400	2
HAST	**Hawaiian Stilt**	***Himantopus mexicanus knudseni***	**-1650**	**-**	**5**
AMAV	American Avocet	*Recurvirostra americana*	450000	63000	3
GRYE	Greater Yellowlegs	*Tringa melanoleuca*	100000	100000	2
LEYE	Lesser Yellowlegs	*Tringa flavipes*	500000	500000	2
SOSA	Solitary Sandpiper	*Tringa solitaria*	25000	25000	1
WILL	Willet	*Catoptrophorus semipalmatus*	250000	25000	2
WATA	Wandering Tattler	*Heteroscelus incanus*	10000	5000	1
SPSA	Spotted Sandpiper	*Actitis macularia*	150000	113000	1
UPSA	Upland Sandpiper	*Bartramia longicauda*	350000	10000?	2
ESCU	**Eskimo Curlew**	***Numenius borealis***	**<50**	**<50**	**1**
WHIM	Whimbrel	*Numenius phaeopus*	57000	57000	2
BTCU	Bristle-thighed Curlew	*Numenius tahitiensis*	10000		4
LBCU	**Long-billed Curlew**	***Numenius americana***	**20000**	**(1000s?)**	**3**
HUGO	Hudsonian Godwit	*Limosa haemastica*	50000	50000	3
BTGO	Bar-tailed Godwit	*Limosa lapponica*	100000		3
MAGO	Marbled Godwit	*Limosa fedoa*	171500	103000	3
RUTU	Ruddy Turnstone	*Arenaria interpres*	235000	235000	3
BLTU	Black Turnstone	*Arenaria melanocephala*	80000	80000	4
SURF	Surfbird	*Aphriza virgata*	70000	70000	3
REKN	Red Knot	*Calidris canutus*	400000	256000	3
SAND	Sanderling	*Calidris alba*	300000	300000	2
SESA	Semipalmated Sandpiper	*Calidris pusilla*	3500000	3500000	2
WESA	Western Sandpiper	*Calidris mauri*	3500000	3500000	4
LESA	Least Sandpiper	*Calidris minutilla*	600000	600000	1
WRSA	White-rumped Sandpiper	*Calidris fuscicollis*	400000	400000	3
BASA	Baird's Sandpiper	*Calidris bairdii*	300000	300000	3
PESA	Pectoral Sandpiper	*Calidris melanotos*	400000	400000	1
SHAS	Sharp-tailed Sandpiper	*Calidris acuminata*	3000	1000	1
PUSA	Purple Sandpiper	*Calidris maritima*	15000	15000	3
ROSA	Rock Sandpiper	*Calidris ptilocnemis*	150000	1000s?	2
DUNL	Dunlin	*Calidris alpina*	1525000	775000	2
STSA	Stilt Sandpiper	*Calidris himantopus*	200000	200000	2
BBSA	Buff-breasted Sandpiper	*Tryngites subruficollis*	15000	15000	2
SBDO	Short-billed Dowitcher	*Limnodromus griseus*	320000	320000	2
LBDO	Long-billed Dowitcher	*Limnodromus scolopaceus*	500000	500000	1
COSN	Common Snipe	*Gallinago gallinago*	2000000	2000000	1
AMWO	American Woodcock	*Scolopax minor*	5000000	1000000	2
WIPH	Wilson's Phalarope	*Phalaropus tricolor*	1500000	680000	2
RNPH	Red-necked Phalarope	*Phalaropus lobatus*	2500000	2500000	1
REPH	Red Phalarope	*Phalaropus fulicaria*	1000000	920000	1

Table 1. Notes

Population Estimate Accuracy Rating:

1 (Poor): A population estimate based on an educated guess. Score 1 also given to ESCU which has not been reliably seen in recent years.

2 (Low): A population estimate based on broad-scale surveys where estimated population size is likely to be in right order of magnitude.

3 (Moderate): A population estimate based on a special survey or on broad-scale surveys of a narrowly distributed species whose populations tend to concentrate to a high degree either a) in a restricted habitat, or b) at a small number of favoured sites. Estimate thought to be within 50% of the true number.

4 (Good): A calculated estimate based on broad-scale mark:recapture ratios or other systematic estimating effort resulting in estimates on which confidence limits can be placed.

5 (High): Number obtained from a dedicated census effort and thought to be accurate and precise. In some cases, an indication of the estimated % accuracy is also given in the range/notes column.

Boldface indicates species that are considered "at risk" in Canada and the United States (endangered, threatened, or vulnerable/special concern).

? indicates a guess.

from a few tens (50 for the endangered, possibly extinct, Eskimo Curlew [see Table 1 for scientific names]) to several millions (maximum 5 000 000 for the American Woodcock). Overall, the population estimates most commonly fell in the range of hundreds of thousands; large shorebird species currently all fall below 500 000, while smaller species tend to have larger populations. The proportion of population estimates over 100 000 is 10/12 (83.3%) for small, 19/28 (67.9%) for medium-sized, and 4/13 (30.8%) for large species. The sum of all the populations came to 27 646 000.

If mass (in grams, taken principally from Dunning 1984) is taken as a measure of size, then a log-log plot of population size (number of individuals) against mass reveals a statistically significant negative relationship between population size and mass (Fig. 1; $\log_e$(population [individuals])=16.479 (± 1.517 SE) - 1.030 (± 0.319 SE) * $\log_e$(mass [g]), r=-0.41, n=53, p=0.002).

Discussion

The most common population sizes for individual species fell in the hundreds of thousands, with highest estimates extending into the low millions. This range of population sizes is similar to that found for various shorebird species wintering and breeding in Europe (Smit & Piersma 1989; Piersma 1986) and occurring in the Australasian region (D. Watkins, pers. comm.).

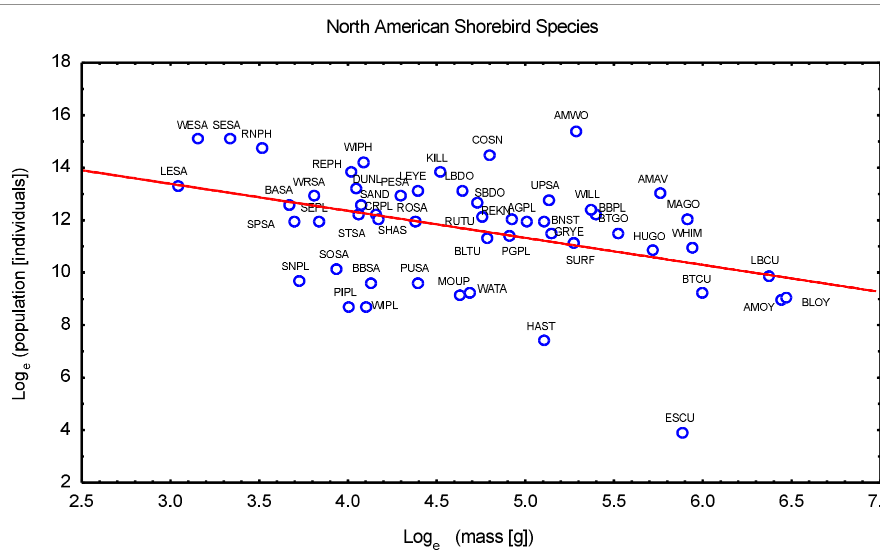


Figure 1. Relationship between log(population size) and log(mass (g)) for shorebirds occurring in North America.

The estimated total number of individual shorebirds using North American flyways (27.6 million) appears to be larger than populations occurring in other major geographical regions. The total using the East Atlantic flyway in Europe was estimated at more than 7.5 million birds by Smit and Piersma (1989), and estimates of breeding populations of all European shorebird species approached 6.6 million pairs (Piersma 1986). Current estimates for shorebird populations occurring in Australasia total some 14.4 million birds (D. Watkins, pers. comm.): these include estimates for 217 populations of 141 species of shorebirds.

Shorebirds apparently have somewhat higher mean population sizes compared to global populations of waterfowl (Anseriformes) though not significantly so (Gaston & Blackburn 1996, Morrison *et al.* 2000b). The largest North American shorebird populations were less than 10 million, while those of global waterfowl populations ranged over 10 million; global populations of some North American shorebird species, however, may well range into the tens of millions (e.g., Common Snipe, Rose & Scott 1997; Morrison *et al.* 2000a). Rather less information is available for total populations of other groups of birds, though those of many of the smaller passerine species are apparently orders of magnitude higher: deaths from window strikes alone in North America have been estimated at anywhere from 3.5 to 976 million (Banks 1979; Klem, 1990; Dunn 1993) and fall bird populations in the USA may reach as high as 20 billion (AOU 1975).

Several features of the log(population) vs log(mass) graph (Fig. 1) are of interest. In addition to the main bundle of points lying along the regression line, two groups of outlying points may be distinguished: (1) a group of ten species below the line (Snowy Plover, Solitary Sandpiper, Buff-breasted Sandpiper, Piping Plover, Wilson's Plover, Purple Sandpiper, Mountain Plover, Wandering Tattler, Hawaiian Stilt, Eskimo Curlew), and (2) two outlying points above the line (Common Snipe, American Woodcock). The species below the line, whose populations are generally lower than others of similar mass, incudes two broad categories of shorebirds:

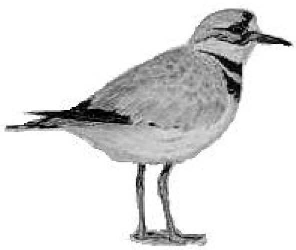
(a) Species at risk. This group contains five of the six species considered to be "at risk" in Canada and the USA, including Eskimo Curlew (ESCU), Mountain Plover (MOPL), Snowy Plover (SNPL), Piping Plover (PIPL), and Hawaiian Stilt (HAST) (the sixth species, Long-billed Curlew (LBCU) falls on the line). Since these species have in many cases been the subject of specialized counts or investigations, it appears likely that the populations are depressed rather than poorly counted.

(b) Difficult-to-count species. The other species in the group below the regression line include Solitary Sandpiper (SOSA), Buff-breasted Sandpiper (BBSA), Wilson's Plover (WIPL), Purple Sandpiper (PUSA), and Wandering Tattler (WATA). These species are often poorly studied, and tend to be either dispersed (SOSA) and/or occur in upland (BBSA), beach (WIPL) or rocky habitats (PUSA, WATA), all situations in which it is difficult to obtain shorebird counts over extensive areas, suggesting that the population estimates may be too low.

The two outliers above the regression line, Common Snipe (COSN) and American Woodcock (AMWO) are both cryptic species that are difficult to count and observe, and whose estimates have been derived from extrapolations that may be subject to large errors. They are also, however, the only species in the shorebird group that are regularly hunted, and are thus susceptible to different population pressures than the others.

These results suggest that the pattern of the regression may identify species whose populations are either artificially lower or higher than might be anticipated. Use of the relationship for other purposes, however, such as identifying potential target population levels for conservation, would remain debatable, since the biological reasons underlying the observed relationship are not presently well understood, and may reflect other factors such as the range of the species involved (Gaston & Blackburn 1996).

An indication of the likely accuracy of the population estimate for each species is given in Table 1. Estimates range from those based on an educated guess to those that have been derived from a dedicated census effort. The majority (62.2%) of accuracy estimates fall in the poor (22.6%) or low (39.6%) categories, with only about one quarter (24.5%) being considered of moderate accuracy, and fewer still being considered of good (9.4%) or high (3.8%) accuracy. This emphasizes the need for considerable caution in using the estimates for conservation purposes.



Monitoring and regular updating of population estimates will be necessary to keep information used for conservation purposes current. Where large changes in numbers are detected, supporting research will be needed to identify causes. For instance, huge decreases in numbers of Red-necked Phalaropes have occurred in the Bay of Fundy over the past 25 years and it is not known if this represents a true population crash or whether the birds have moved elsewhere (see Dunn *et al*. p. 39). Increasing evidence from many parts of North America suggests that a majority of shorebird populations are in decline (Howe *et al*. 1989; Page and Gill 1994; Morrison *et al*. 1994; Harrington 1995), emphasizing the need for future monitoring and updating of shorebird population numbers and trends.

Acknowledgements

Thanks to the many people who have contributed to counting and monitoring shorebird populations in the Americas through various survey activities referred to in this report. Thanks also to Lew Oring for his critical assessments of the merits of different methods of determining population numbers, and to Doug Watkins for information on shorebird populations in Australasia. A special thanks to Stephen Brown for encouraging the U.S. to grapple with the process of attempting to know the seemingly unknowable.

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Shorebird monitoring activities and requirements in Canada

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Knowledge of the size of shorebird populations, and more particularly of population trends, is essential for the conservation and management of shorebirds. Establishing monitoring protocols that provide this information has been identified as a key requirement under both the Canadian and U.S. Shorebird Conservation Plans. This article briefly reviews some of the current shorebird monitoring programs occurring in Canada (and the USA) and indicates possible directions for future activities.

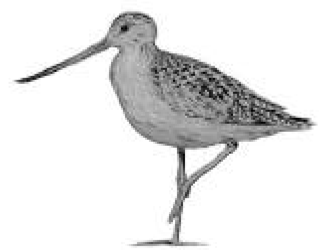
Current shorebird monitoring activities in Canada

The **Maritimes Shorebird Surveys** (MSS) is a volunteer program started by CWS in 1974 that currently provides the longest run of data on shorebird numbers passing through any region of Canada. Volunteers count shorebirds at two-week intervals during the fall migration at their choice of site in the Atlantic Provinces; a more limited series of spring counts has also been conducted. Although initially organized to obtain information on shorebird distribution and migration periods, the MSS has also been used to provide valuable information on shorebird population trends (see Morrison & Hicklin, p. 16). The International Shorebird Survey (ISS) is the equivalent scheme in the USA, is organized by Brian Harrington at the Manomet Center for Conservation Sciences, Massachusetts.

The **Étude des populations d'oiseaux du Québec** (EPOQ) program analyses checklists sent in by volunteer birdwatchers across the province. Although information is collected on all species throughout the year, shorebirds are primarily noted during fall migration. Shorebird population trends from the period 1976-98 are summarized by Aubry and Cotter (p. 21).

The **Ontario Shorebird Surveys** (OSS) were started in 1974 in conjunction with the MSS. Since 1992, they have been organized as a separate survey using similar methodology (see Ross *et al.*, p. 24). Aerial surveys to count shorebirds on migration in James Bay are also periodically conducted by CWS staff.

The **Breeding Bird Survey** (BBS) is a well-known roadside survey that measures trends in breeding bird populations by recording birds detected at a timed series of defined stops along a planned route. While this has been the principal method for examining population trends of passerines, it is useful for only about 15 shorebird species, as the breeding grounds of most shorebirds lie in the Boreal and Arctic regions far to the north of the road systems required to run the BBS. Shorebird trends from this survey are discussed by Morrison (p. 12).



An **Arctic** checklist program was started in 1995, to collect information on distribution, numbers and eventually trends of birds breeding in Arctic (and Boreal) regions. Observers (scientists, tourists, park staff, etc.) fill in checklist forms recording numbers of birds seen in a given locality over a maximum period of 24 hours, as well as information on weather conditions and predators (see Johnston, p. 26). Some information is available on changes in numbers over a 20 year period (see Gratto-Trevor *et al.*, p. 27) in one Arctic area.

Prairie surveys are conducted periodically by Canadian Wildlife Service staff at important shorebird habitats; volunteer programs equivalent to the MSS and OSS do not currently exist in central Canada.

Pacific coast surveys of shorebirds are made during the course of data collection for research programs of staff and students at the Canadian Wildlife Service and Simon Fraser University (see Butler & Lemon, p. 36). The B.C . Coastal Waterbird Survey, implemented by Bird Studies Canada in 1999, is a monthly volunteer survey of waterbirds and other species in coastal habitats. The survey aims to provide long-term population trends and seasonal habitat use information for numerous waterbird species. Results from the first year are available at: http://www.bsc-eoc.org/bcwaterbirds.html

Christmas Bird Counts, organized by the National Audubon Society, provide a very limited amount of data on shorebirds wintering in Canada as few shorebird species are present during the Canadian counts. This scheme, which has been in place for 100 years, produces more information from sites in the USA. Results are available at: http://www.birdsource.org/cbc/

Specialized surveys, like the International Piping Plover Survey, are organized periodically to determine the population size of the endangered Piping Plover. Results of the 1996 survey are summarized at: http://www2.interconnect.net/lelliott/summary.htm

Future plans

How to monitor all shorebird species was an important consideration during the development of the U.S. Shorebird Conservation Plan. A technical report, in which 30 monitoring protocols were listed ranging from single-species programs to surveys such as the MSS and ISS that cover multiple species, resulted from the planning process (Howe et al. 2000). Adopting all of the comprehensive monitoring protocols would result in coverage of about 88% of the 72 identifiable shorebird populations (47 species, of which 17 had two or more identifiable subspecies or sub-populations). The estimated cost of implementing these programs and providing supporting organizational structures is approximately $1.5 million/year.

This issue of *Bird Trends* presents recent trend analyses derived nearly entirely from multiple species programs, for about 35 (or three-quarters) of the 47 species of shorebirds occurring regularly in Canada. Given the long run of data already accumulated in programs such as the MSS and ISS, it makes sense to build on this investment by continuing these programs, while incorporating design improvements to make the data collection more statistically robust. This should be a priority for future shorebird population monitoring in both Canada and the USA.

Also a priority is the development of surveys to monitor breeding populations in the Arctic. Because of the expense and logistics of working in the Arctic, this would probably involve sampling a series of sites over several seasons with repeat surveys at suitable intervals or when surveys carried out at more southerly locations indicate a disturbing trend. Surveys on the breeding grounds have the advantage of assessing trends in known (breeding) segments of the population. Plans for a joint Canada-U.S. project to undertake pilot surveys within the next two years are in progress.

To complement the above approaches, one or more single species could be selected for detailed investigation to assess and confirm current trend estimates and identify reasons for population declines. Suitable species would include:

- the Red Knot, a long distance arctic-breeding migrant that tends to occur in large numbers at a restricted number of sites, and for which significant population declines are evident; the species is already the subject of investigation by an international team, and well-directed research would have a high chance of producing successful results;
- Wilson's Phalarope, another long distance migrant, for which a directed survey program would be able to assess population changes with considerable accuracy.

In summary, ongoing monitoring programs are an essential and integral part of future shorebird work carried out under the Canadian and U.S. Shorebird Conservation Plans, and are needed to assess the ongoing health of shorebird populations and the effectiveness of conservation initiatives.

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Trends in shorebird populations in North America using Breeding Bird Survey data

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For the majority of North American shorebird species whose breeding grounds lie in the arctic or sub-arctic regions of the continent, assessment of population trends from surveys conducted on the nesting areas has proven impractical to date owing to the logistical and financial aspects of carrying out work in such remote areas. Only a small amount of information on population trends or changes is available from arctic breeding grounds (Gould 1988, Pattie 1990, Gratto-Trevor 1994, Hitchcock & Gratto-Trevor 1997, Gratto-Trevor *et al.* 1998). For northern breeders, most information on population trends has, in fact, come from long-term surveys and counts carried out at migration stopover areas (Howe *et al.* 1989, Morrison *et al.* 1994, 1997). Some 15 species, however, have breeding distributions that include interior areas of the USA and southern Canada, and occur in large enough numbers to be recorded regularly on Breeding Bird Survey (BBS) routes. This article briefly describes the results of trend analyses for these species.

The BBS is a roadside survey, conducted annually since 1966, during which observers make 50 3-minute stops at 0.8 km intervals on secondary roads. All birds seen or heard within 0.4 km of the stop point are counted. The surveys are carried out once per year during the breeding season, normally during June. Route starting points and direction are randomly selected to sample habitats representative of each region. Currently, nearly 2900 routes throughout North America are surveyed annually (Sauer *et al.* 1997), 400 of which are in Canada (Dunn *et al.* 2000).

Of the 15 species presented for Canada and the lower 48 states (Table 2), ten species were distributed widely enough for trends to be calculated separately for each country. Of the remaining five species, three (Greater Yellowlegs, Lesser Yellowlegs and Solitary Sandpiper) breed principally in Canada and two (Mountain Plover and Black-necked Stilt) occur mainly in the U.S., allowing trend estimates for a total of 13 species in Canada and 12 in the USA.

Survey wide trends (U.S. and Canada)

Over the entire period of the BBS (1966-1999) 4 of the 15 species of shorebirds showed significant population trends (Table 2): three declining (Killdeer, Lesser Yellowlegs and Wilson's Phalarope)

Table 2. Trends in shorebird populations for Canada and the lower 48 United States calculated from BBS data for the periods shown. Data are from B.T. Collins (pers. Comm.) and Dunn *et al.* 2000.

	1966-1999						1966-1979			1980-1999		
Species	Trend	P	N	95%	CI	R.A.	Trend	P	N	Trend	P	N
Killdeer	**-0.3**	0.05	3156	-0.7	0.0	5.40	**3.4**	<0.001	1815	**-1.0**	<0.001	2967
Mountain Plover	-0.9	0.64	37	-4.6	2.8	0.31	2.2	0.33	9	**8.8**	0.05	33
Black-necked Stilt	0.6	0.84	110	-4.8	5.9	2.21	-0.1	0.99	33	1.3	0.51	100
American Avocet	-0.2	0.82	208	-2.3	1.8	1.76	**6.2**	0.02	60	0.3	0.82	186
Greater Yellowlegs	12.8	0.34	16	-12.6	38.1	0.70	13.3	0.43	7	18.1	0.45	11
Lesser Yellowlegs	**-8.2**	<0.001	28	-11.6	-4.9	0.29	5.6	0.46	11	**-17.9**	<0.001	24
Solitary Sandpiper	-10.2	0.13	12	-22.1	1.6	0.04	4.3	0.61	7	-5.3	0.35	5
Willet	-0.6	0.27	289	-1.6	0.4	1.49	1.2	0.23	119	0.7	0.38	266
Spotted Sandpiper	-0.5	0.50	877	-1.9	0.9	0.44	1.1	0.43	393	-1.5	0.12	689
Upland Sandpiper	**1.0**	0.01	581	0.2	1.7	2.25	**2.7**	0.02	297	**-1.5**	0.01	493
Long-billed Curlew	-1.5	0.13	221	-3.6	0.5	1.39	1.6	0.27	68	-1.8	0.10	205
Marbled Godwit	-0.5	0.50	198	-1.9	0.9	2.51	**4.2**	0.01	78	-0.4	0.77	180
Common Snipe	0.0	0.94	1059	-0.7	0.7	2.34	**3.0**	<0.001	431	-0.2	0.63	954
American Woodcock	-2.3	0.28	143	-6.4	1.9	0.03	**-7.4**	0.01	61	-1.6	0.45	84
Wilson's Phalarope	**-2.2**	0.02	257	-4.1	-0.3	0.99	-1.3	0.60	90	-2.1	0.18	219

Trend=% change per year; p<0.05=statistical significance; N=number of routes; 95% CI=95% confidence limits; R.A.=relative abundance, bold=statistical significance.

and one increasing (Upland Sandpiper). In these analyses, the tendency of all trends within a region is considered statistically significant if the proportion of negative and positive trends is not equal. Excluding the one species (Common Snipe) where the measured trend was zero, 11 of the 14 remaining species showed negative trend values (significant: $\chi^2=4.57$, df=1, p=0.03).

Results differed, however, between the earlier and later parts of the survey period. From 1966-1979, 5 of the 15 species had statistically significant positive trends (Killdeer, American Avocet, Upland Sandpiper, Marbled Godwit and Common Snipe) while only one was significantly negative (American Woodcock). Overall, there were 12 positive trends versus 3 negative ones, (significant: $\chi^2=5.40$, df=1, p=0.02). From 1980-1999, the pattern reversed: 3 trends declined significantly (Killdeer, Lesser Yellowlegs, Upland Sandpiper) and only the Mountain Plover significantly increased. Ten of the 15 species had negative trend values compared to 5 positive values (not significant: $\chi^2=1.67$, df=1, p=0.20).

Trends within Canada

Trends within Canada (Table 3) were generally similar to those described for the entire survey area. Over the period 1966-1999, the only trends of statistical significance were negative (Killdeer, Lesser Yellowlegs and Willet). Ten of the 13 species showed negative trend values (marginally significant: $\chi^2=3.77$, df=1, p=0.052). During the early period of the surveys (1966-1979), increasing trends predominated, with 3 significant increases (Killdeer, Upland Sandpiper, Common Snipe) and only one significant decrease (American Woodcock). Overall, 10 of 13 trends had positive values, (marginally significant: $\chi^2=3.77$, df=1, p=0.052). From 1980-1999, the only significant trends were negative (Killdeer and Lesser Yellowlegs), and declines (9) exceeded increases (3) (with one measured trend of zero), (marginally significant: $\chi^2=3.00$, df=1, p=0.08).

Trends in the USA

For the 12 species analyzed for BBS routes in the USA (Table 4), trend values were evenly split with 6 negative and 6 positive over the entire survey period, but only one negative trend (Wilson's Phalarope) and two positive trends were significant (Willet and Upland Sandpiper). Positive values tended to predominate among trends from 1966-1979, with 9 of 12 values positive (marginally significant: $\chi^2=3.00$, df=1, p=0.08), including all of the significant trends (Killdeer, American Avocet, Upland Sandpiper, Marbled Godwit, and Common Snipe. From 1980-1999, however, negative trend values were more common (8 of 12) though not significant ($\chi^2=1.33$, df=1,

Table 3. Trends in shorebird populations in Canada calculated from BBS data for the periods shown. Data are from B.T. Collins (pers. comm.), and Dunn *et al.* 2000.

	1966-1999						1966-1979			1980-1999		
Species	Trend	P	N	95%	CI	R.A.	Trend	P	N	Trend	P	N
Killdeer	**-2.4**	<0.001	457	-3.0	-1.7	3.92	**3.5**	<0.001	222	**-3.7**	<0.001	419
American Avocet	0.8	0.61	61	-2.2	3.7	1.38	2.0	0.78	19	4.6	0.20	53
Greater Yellowlegs	12.0	0.34	16	-11.8	35.8	0.7	13.7	0.39	7	18.6	0.43	11
Lesser Yellowlegs	**-8.4**	<0.001	28	-11.8	-5.0	0.29	4.8	0.54	11	**-17.6**	<0.001	24
Solitary Sandpiper	-10.2	0.13	12	-22.1	1.7	0.04	4.6	0.58	7	-5.9	0.34	5
Willet	**-1.6**	0.01	122	-2.7	-0.5	2.45	0.5	0.75	49	-0.3	0.82	110
Spotted Sandpiper	-0.4	0.70	308	-2.3	1.5	0.61	2.6	0.18	150	-2.1	0.16	252
Upland Sandpiper	1.0	0.62	134	-2.9	5.0	0.86	**3.7**	0.03	49	-1.1	0.57	121
Long-billed Curlew	-1.0	0.60	38	-4.5	2.6	1.25	-7.4	0.21	10	-2.1	0.32	35
Marbled Godwit	-1.0	0.22	128	-2.5	0.6	4.13	2.5	0.13	47	-0.8	0.62	116
Common Snipe	-0.1	0.76	428	-1.0	0.7	2.87	**3.0**	<0.001	206	0.0	0.99	384
American Woodcock	-1.3	0.69	40	-7.7	5.1	0.06	**-12.6**	<0.001	20	1.0	0.62	23
Wilson's Phalarope	-0.9	0.57	78	-4.0	2.2	1.09	-1.3	0.83	31	-2.4	0.45	65

Trend=% change per year; p<0.05=statistical significance; N=number of routes; 95% CI=95% confidence limits; R.A.=relative abundance.
bold=statistical significance.

p=0.25), among them the two significant negative trends for Upland Sandpiper and American Woodcock.

Trend values in both Canada and the USA, as well as for the two countries combined, were generally positive in the 1960s and 1970s and generally negative during the 1980s and 1990s. Differences in the distribution of negative and positive values between the two periods were statistically significant for Canada and overall, and of borderline significance for the USA (Fisher exact test, two-tailed, p=0.02, p=0.03, and p=0.10, respectively).

Interpreting the Results

Morrison *et al.* (1994) also noted that patterns of trends varied considerably among species counted by the Maritimes Shorebird Survey on the east coast of Canada between 1974 and 1991. Declines there predominated during the late 1970s, increases were most common during the first half of the 1980s, with less pronounced declines occurring during the latter half of the 1980s. A series of cold breeding seasons in the arctic during the 1970s may have been a common factor affecting populations of the 13 species for which MSS analyses could be carried out. Declines also predominated among species occurring on the Ontario Shorebird Surveys, most of which were arctic or boreal breeders (see Ross *et al.*, p. 24). Of the three boreal breeders occurring on BBS routes, one had a significant decline, at least in the part of their ranges in which BBS routes were found.

Three species of shorebirds, the Mountain Plover, Upland Sandpiper and Long-billed Curlew may be classified as grassland species. BBS analyses have shown that over 70%, a statistically significant proportion, of the 27 bird species included in this group are declining (Sauer *et al.* 1995). Reasons for these widespread declines are thought to include destruction of suitable habitats as well as increased mowing of remaining grasslands for hay production. Long-billed Curlews showed a survey-wide decline of borderline statistical significance, though regional trends were somewhat variable. Mountain Plovers showed a non-significant decline, with small sample sizes indicating most regional trend estimates were unreliable, especially for a species that is inconspicuous and easily overlooked and therefore probably poorly sampled by the BBS roadside protocol. Upland Sandpipers appear to have increased significantly over the period of the surveys, especially in central regions of the continent, though eastern populations appear to have declined. The overall increase may reflect a continuing recovery from the heavy losses exacted by market hunting from the 1880s to 1916 (Sauer *et al.* 1995).

Table 4. Trends in shorebird populations in the USA calculated from BBS data for the periods shown. Data are from Sauer *et al.* 2000.

	1966-1999						1966-1979			1980-1999		
Species	Trend	P	N	95%	CI	R.A.	Trend	P	N	Trend	P	N
Killdeer	0.3	0.14	2699	-0.1	0.6	5.88	**3.3**	<0.001	1593	-0.3	0.23	2548
Mountain Plover	-0.9	0.65	37	-5.0	3.1	0.31	2.2	0.36	9	8.6	0.08	33
Black-necked Stilt	0.6	0.83	110	-4.8	6.0	2.21	-0.5	0.93	33	1.2	0.46	100
American Avocet	-0.5	0.69	147	-3.2	2.2	1.85	**7.9**	0.01	41	-0.4	0.79	133
Willet	**1.2**	0.03	167	0.2	2.3	1.13	2.8	0.09	70	1.5	0.10	156
Spotted Sandpiper	-0.7	0.26	569	-2.0	0.5	0.35	-2.4	0.14	243	-0.4	0.61	437
Upland Sandpiper	**0.9**	0.02	447	0.2	1.7	2.68	**2.6**	0.03	248	**-1.5**	0.01	372
Long-billed Curlew	-1.5	0.23	183	-3.9	0.9	1.43	2.3	0.15	58	-1.7	0.17	170
Marbled Godwit	1.6	0.11	70	-0.3	3.5	1.20	**10.4**	<0.001	31	1.6	0.07	64
Common Snipe	0.3	0.65	631	-1.0	1.5	1.96	**3.4**	<0.001	225	-0.4	0.56	570
American Woodcock	-3.6	0.10	103	-7.8	0.6	0.02	1.6	0.77	41	**-7.5**	0.02	61
Wilson's Phalarope	**-2.9**	0.02	179	-5.3	-0.5	0.95	-1.4	0.54	59	-2.0	0.35	154

Trend=% change per year; p<0.05=statistical significance; N=number of routes; 95% CI=95% confidence limits; R.A.=relative abundance.
bold=statistical significance.

Does the BBS provide a suitable survey methodology for measuring trends in shorebird populations? Biases in the methodology as well as problems in analyses of the data have been recognized. For instance, BBS surveys sample roadside habitats that do not necessarily represent the overall habitat composition of a region or population changes in habitats away from roads. In addition, the BBS poorly samples the boreal, wetland and arctic habitats used by shorebirds (Sauer *et al*. 2000). For boreal species in particular, trends really only reflect local changes because of the limited portion of the range sampled. Loud obvious species, such as Killdeer, will be more readily detectable on roadside surveys than more cryptic, less easily observed species, such as American Woodcock, Mountain Plover or Solitary Sandpiper. BBS data analysis for shorebirds can be problematic as low sample sizes, low relative abundances, highly variable occurrence and missing data may lead to imprecise trend estimates. The likely reliability of BBS trend measurements are assessed through a "regional credibility measure"; of the 15 shorebird species measured, 3 were considered to have important data deficiencies, 9 had some sort of deficiency, and only 3 had at least moderately reliable estimates.

Notwithstanding these reservations, the results from the BBS analyses do appear to reflect a preponderance of declining species in a manner consistent with other survey schemes, including the Maritimes Shorebird Surveys, International Shorebird Surveys and various studies on arctic and more southerly breeding grounds (Harrington 1995).

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Recent trends in shorebird populations in the Atlantic Provinces

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The shorelines of the Atlantic Provinces of Canada include some of the most important habitats for shorebirds on the northeastern coast of North America (Morrison 1977, Morrison & Harrington 1979, Hicklin 1987). The extensive mudflats found in the upper parts of the Bay of Fundy (~15 000 ha at low tide) attract concentrations of tens to hundreds of thousands of shorebirds at some sites during fall migration, and the cumulative number of individuals passing through the area during the course of the season involves approximately 2.5–3 million birds. The most important areas in the regions of the upper Bay of Fundy in New Brunswick (Chignecto Bay) and Nova Scotia (Southern Bight and Minas Basin) were designated in 1987 and 1998, respectively, as Hemispheric Reserves under the Western Hemisphere Shorebird Reserve Network (Hicklin 1988a, 1988b, Morrison *et al*. 1995). While the vast mudflats uncovered by the exceptionally large tides in the Bay of Fundy may attract the most spectacular concentrations of shorebirds, smaller sites around the Atlantic and Gulf coasts also support substantial numbers of shorebirds and a wide diversity of species. The Atlantic Provinces also hold a significant number of breeding sites for the endangered Piping Plover (Plissner & Haig 2000).

The Maritimes Shorebird Survey (MSS) has provided extensive information on the numbers of shorebirds using roosting and foraging sites in Atlantic Canada, which, in turn, has helped identify key areas for different species as well as migration periods. Operating since 1974, the survey involves a network of observers who count shorebirds using marshes and intertidal areas as often as possible during the spring and fall migration periods. The information generated by the surveys has been useful for identifying key sites and also provides one of the longest running sources of data for assessing shorebird population trends in Canada. This is becoming increasingly valuable at a time when ongoing concerns are being expressed concerning the health of the environment, and in particular the health of wetland and coastal habitats.

Previous analyses of MSS data up to 1991 (Morrison 1994, Morrison *et al*. 1994, 1997) showed that a number of shorebird species using the Maritime Provinces were declining, some significantly. The general pattern appeared to be that most species had undergone a period of decline in the latter part of the 1970s, that most increased in the first part of the 1980s, and that declines had again occurred in the latter part of the 1980s up to 1991, with overall declines for most species over the entire period. Analyses of data from the International Shorebird Survey (operated from the Manomet Center for Conservation Sciences in Massachusetts) which covers areas on the east coast of the United States, among others, also showed declines in a number of shorebird species between 1973 and 1984 (Howe *et al*. 1989). Information from a variety of other sources also indicates that many shorebird populations are declining (Harrington 1995), as noted in the recently completed Canadian and U.S. Shorebird Conservation Plans (Hyslop *et al*. in press, Brown *et al*. 2000).

This article provides some initial analyses of the entire MSS dataset, including seven years (1992-1998) of additional data, to assess and update current trend information on the east coast of Canada. The data are divided into three "decade" periods of observations, (1970s, 1980s and 1990s), to allow comparison of counts of various species occurring at the same sites in each of those periods. Data from all sites up to 1991 were graphed by species and the main migration "windows", or passage periods, for adults and juveniles identified from the peaks occurring on the graphs (Morrison *et al*. 1994). Counts occurring in each window were then averaged at each site, to determine an annual "index" for the numbers of adult and juvenile birds using the sites. Differences were com-

Table 5. Comparison of numbers of adult shorebirds counted at MSS sites during the 1970s, 1980s and 1990s.

Species	1990s vs 1970s	Sig	1990s vs 1980s	Sig	1980s vs 1970s	Sig
Semipalmated Plover	+		-		-	
Black-bellied Plover	-		-		-	
Ruddy Turnstone	-		-		-	
Red Knot	-	**	-	**	-	
Least Sandpiper	-	***	-		-	(*)
Short-billed Dowitcher	-	***	-	***	-	*
Semipalmated Sandpiper	-	**	-	(*)	-	**
American Golden-Plover	-		+		-	
Willet	+		-		+	
Whimbrel	+		+	**	-	
Dunlin	-	*	-	*	-	
Sanderling	-		-		-	(*)
Spotted Sandpiper	-	***	-	**	-	*
Hudsonian Godwit	-		+		-	
White-rumped Sandpiper	-		-		-	
Pectoral Sandpiper	-		+		-	*
Number of species	16		16		16	
Number of - trends	13		12		15	
Number of + trends	3		4		1	
χ^2 test (1 df) significance	p=0.01		p=0.046		p=0.0005	
No. sig. Negative trends	6		5		6	
No. sig. Positive trends	0		1		0	

"-" = decrease, dark shading indicates significance
"+" = increase, dark shading indicates significance
paired t-test: (*) = 0.1>p>0.05, *=p<0.05, **=p<0.01, and ***=p<0.001
χ^2 test is significant if the proportions of negative and positive trends is not equal

puted for all the sites, and the mean differences compared using a "paired t-test" to determine whether the changes between decades were statistically significant.

Table 5 shows the results of the between-decades comparisons for adults of 16 species of shorebirds using MSS sites. When comparing the 1990s to the 1970s, counts for adults of 6 species of shorebirds (Red Knot, Least Sandpiper, Short-billed Dowitcher, Semipalmated Sandpiper, Dunlin and Spotted Sandpiper) declined significantly. Of the 16 species, 13 showed negative trend values (significant and non-significant) and only 3 showed positive trend values (all non-significant); this proportion is significantly different from the expectation that the number of positive and negative trend values would be equal if no net changes were occurring overall. Similar patterns were noted when comparing 1990s counts to those in the 1980s, and 1980s counts to those in the 1970s. In each case, the number of significant negative trends outnumbered positive ones (5 to 1, and 6 to 0, respectively), and the overall proportions of negative trend values to positive ones (12 of 16, and 15 of 16, respectively) were both statistically significant.

Between-decade comparisons for juveniles are shown in Table 6. Negative trend values again predominated, outnumbering positive trends between periods in all comparisons, and were statistically significantly in two (1990s vs 1970s and 1980s vs 1970s). All statistically significant trends were negative. The somewhat smaller number of statistically significant negative trends may reflect a higher variability in the numbers of juvenile birds passing through migration sites than adults, as a result of factors such as variable breeding success in different seasons, as well as overall changes in population numbers. Nevertheless, generally decreasing numbers of juveniles do appear to reflect the negative trends observed in the adult populations.

The present results from the updated analysis of shorebird counts in eastern Canada appear to be consistent with those showing declines in a variety of other areas, including Ontario (Ross *et al*., p. 24), the eastern USA (Howe *et al*. 1989), the Arctic (Gratto-Trevor

Table 6. Comparison of numbers of juvenile shorebirds counted at MSS sites during the 1970s, 1980s and 1990s.

Species	1990s vs 1970s	Sig	1990s vs 1980s	Sig	1980s vs 1970s	Sig
Semipalmated Plover	+		+		-	
Black-bellied Plover	-	(*)	-	*	-	
Ruddy Turnstone	-		-	(*)	-	
Red Knot	-		-	(*)	-	(*)
Least Sandpiper	-		-		-	
Short-billed Dowitcher	-	**	-	***	-	
Semipalmated Sandpiper	-		-	*	-	
American Golden-Plover	-		-		-	
Willet	+		+		+	
Whimbrel	-		-		+	
Dunlin	-		-		-	
Sanderling	-		-		-	
Spotted Sandpiper	-		-		-	
Hudsonian Godwit	+		+		-	
White-rumped Sandpiper	-		+		-	(*)
Pectoral Sandpiper	-		+		-	
Number of species	16		16		16	
No. of - trends	13		11		14	
No. of + trends	3		5		2	
χ^2 test (1df) significance	p=0.01		p=0.13		p=0.003	
No. sig. Negative trends	2		5		2	
No. sig. Positive trends	0		0		0	

"-" = decrease, dark shading indicates significance

"+" = increase, dark shading indicates significance

paired t-test: (*) = 0.1>p>0.05, *=p<0.05, **=p<0.01, and ***=p<0.001

χ^2 test is significant if the proportions of negative and positive trends is not equal

1994, Gratto-Trevor *et al*. 1998), and more temperate breeding areas of North America (see Morrison, p. 12). They also suggest that declines detected in previous analyses have continued through the 1990s. The pervasive pattern of declines in shorebird populations in North America underlines the urgency of putting into action the conservation measures addressed in the Canadian and US Shorebird Conservation Plans.

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A comparison of roost counts in the 1970s and 1990s in the Bay of Fundy

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In Atlantic Canada, the Bay of Fundy is the primary staging area for the Semipalmated Sandpiper (*Calidris pusilla*), one of the more abundant and widely distributed species of migrant shorebirds in the region during the southward migration. Morrison *et al*. (1994) summarized the results of the Maritimes Shorebird Survey (MSS), conducted between 1974 and 1991 inclusive, for 13 species at 30 – 80 sites. However, major roosts of Semipalmated Sandpipers in the Bay of Fundy were not included in that analysis partly due to the difficulty different observers had in accurately estimating large numbers of roosting sandpipers which, at peak periods, can reach levels exceeding 100 000 birds per flock (Mawhinney *et al*. 1993). This article presents the results of surveys of Semipalmated Sandpipers at major roosting sites in the Bay of Fundy, from 1976 to the present, including aerial surveys over Chignecto Bay and Minas Basin conducted in 1976 and 1997 (Fig. 2).

Since the initial surveys began in 1974 (Elliot 1977), the numbers of birds at beach roost sites in the Bay of Fundy have increased, but this does not necessarily represent larger populations of Semipalmated Sandpipers in the bay. This apparent contradiction is due to other variables that affect populations of staging migratory birds including peak migratory periods, the birds' distribution while in the bay, and their length of stay in the area. These variables have shown considerable change over the past 20 years and may in fact be responsible for the larger numbers of roosting birds seen at high tide in the Bay of Fundy in the late 1990s.

In the 1970s, investigations in the Bay of Fundy indicated that "single roosts containing over 20 000 Semipalmated Sandpipers were found regularly in this area during the peak of migration" and that "the single most important site clearly appears to be Mary's Point, NB, where 65 000 Semipalmated Sandpipers were found on 27 July" (Morrison 1976). The peak numbers of Semipalmated Sandpipers seen in 1976 and 1977 in Chignecto Bay and Minas Basin occurred on 29 July and 2 August, respectively (Hicklin, 1977, 1981 and 1987). From 1997 to 2000, peak numbers in Johnson's Mills, N.B. (in the small bay known as Grande Anse; Fig. 2), occurred on 2, 4, 13 and 20 August, respectively, indicating increasingly

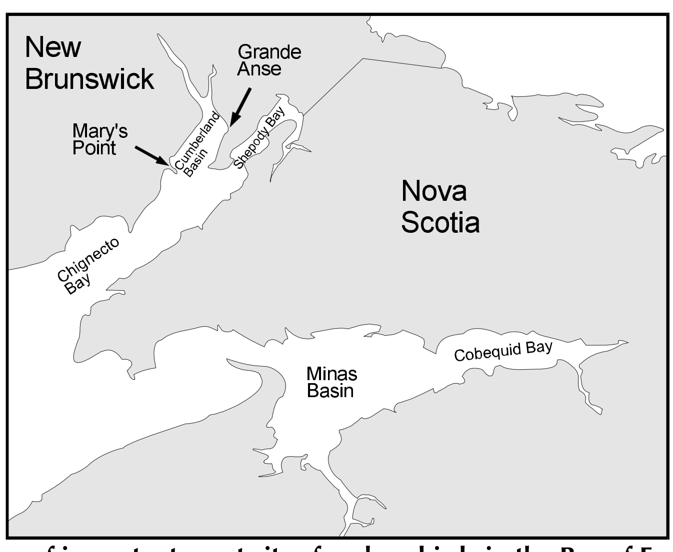

Figure 2. Location of important roost sites for shorebirds in the Bay of Fundy.

later timing of the occurrence of peak numbers (Hicklin, unpublished information; Campbell, 1999). Effectively, by the year 2000, peak numbers of staging Semipalmated Sandpipers in the Bay of Fundy were approximately 20 days later than peak numbers recorded in the mid-70s.

In 1976, aerial surveys showed that Chignecto Bay in the upper Bay of Fundy held 70.7% of sandpipers during fall migration while the Minas Basin/Cobequid Bay portion had only 29.3% (Hicklin 1977). At that time, the numbers of sandpipers peaked at around 100 000 birds but those numbers were reached only at Mary's Point in Shepody Bay (Elliot 1977; Harrington & Morrison 1979; Hicklin 1981,1987). In 1976, 258 850 birds were counted at 10 roost sites, but in 1996, 410 000 birds (an increase of 58.4%) were concentrated at only 4 sites. The distribution of Semipalmated Sandpipers in the two arms of the bay also reversed during that 20 year period with 61.7% of the total number of sandpipers in the upper bay located in Minas Basin and 38.3% in Chignecto Bay. A major predator of shorebirds, the Peregrine Falcon (*Falco peregrinus*), was not present in the Bay of Fundy prior to 1982 when hand-reared birds were introduced; the first breeding record for this species in the bay was in 1989. The peregrines appear to have affected the geographic distribution of the sandpipers, more than their numbers, during their short stay in the Bay of Fundy each year. In Chignecto Bay, the high rocky cliffs that provide peregrine nesting sites are closer to the main shorebird roosting sites at Mary's Point, Hopewell Rocks and Grande Anse than at the roosting sites in Minas Basin. Consequently, higher numbers of predatory attacks on sandpipers were launched by peregrines in Chignecto Bay throughout the 1990s. It appears that sandpipers have been "chased out" of Chignecto Bay to settle in Minas Basin where the risk of predation by peregrines may be lower.

In the 1970s and '80s, colour-marked Semipalmated Sandpipers remained in the area for ten days to fatten prior to the completion of their migration to South America (Hicklin 1987, 1997a). In 1995 and 1996, the sandpipers stayed in the area an average of 15-20 days (Hicklin, unpublished information). This extended stay was believed to be a consequence of declining densities of their favoured prey, the burrowing amphipod *Corophium volutator* (Shepherd et al., 1995), requiring the birds to spend more time foraging to accumulate the necessary resources to complete their migration. In 1997, the numbers of roosting birds in Grande Anse, NB, were estimated at 250 000 to 300 000 birds, three times the maximum numbers recorded in the 1970s, with the peak persisting in Shepody Bay for 22 days (Hicklin, 1997b). That year, the Meteorological Service of Canada reported that wind speeds in the Fundy region were the lowest on record. Without favourable southerly winds, sandpipers were not migrating out of Chignecto Bay as more sandpipers arrived from the north, thus inflating the numbers at the roost sites (Hicklin, 1997b).

These confounding factors mean that, at present, population trends for Semipalmated Sandpipers in the Bay of Fundy cannot be accurately quantified, although the numbers of birds at roost sites during autumn migration remain high. Field studies with colour-marked birds may be helpful in improving our understanding of the population dynamics in this important area.

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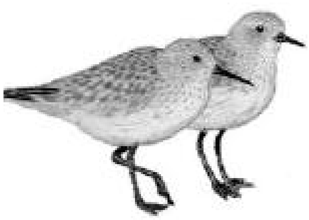

Using trend information to develop the Quebec Shorebird Conservation Plan

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Whether for the challenge of identification or to observe the often spectacular flocks, shorebirds represent a fascinating group for birdwatchers visiting aquatic and riparian habitats. Along the St. Lawrence River, where these habitats are abundant, shorebirds are a favourite group for many birdwatchers in Quebec.

The implementation of a daily checklist program in the 1950s by brother Victor Gaboriault has enabled Quebec birdwatchers to report and submit their observations to local bird clubs. Through the initiative of Jacques Larivée, all checklists have now been entered into a central, computer database known as *Étude des populations d'oiseaux du Québec*, or ÉPOQ. This database, which consists of millions of lines of observation data, is an invaluable source of information on the avifauna of Quebec.

In the past several years, environment and wildlife managers at all levels of government have broadened their interest in birds beyond the traditional focus on gamebirds and endangered species. In Canada, increased attention on shorebirds has resulted in the Canadian Shorebird Conservation Plan (Hyslop et al., in press). In conjunction with this initiative, Quebec is formulating its own shorebird conservation plan, which will be used to identify conservation and research needs for this group of birds throughout the province and to implement the goals of the Canadian Plan in the Quebec Region.

The Quebec Shorebird Conservation Plan depends upon our knowledge of these birds, and could not be prepared without the information contained in ÉPOQ. The first step in the process is to identify which species are found in Quebec, and the distribution, status, population, and provincial trend of each. To compile this information, all shorebird data were extracted from the ÉPOQ databank. Trend analysis was possible for most species during fall migration (25 June–31 December; Table 7), when shorebirds are most abundant in the southern part of the province. Trends were calculated for each species using their annual "occurrence", defined as the proportion of all checklists submitted in a given year (or specific period) in which a particular species was reported. For example, 823 checklists containing at least one shorebird sighting were submitted over the fall migration period in 1978, of which 211 reported Black-bellied Plovers; this species' occurrence for the fall migration in 1978 is 211/823= 0.26, or 26%. Trend analyses of the combined occurrence values for 1976–98 enabled us to determine both the direction of a given trend (i.e., positive [+] or negative [-]) as well as the strength and significance of the trend. For example, a species with a significant ($p<0.05$) negative trend is represented in Tables 7 and 8 by "---", which indicates that, over the period from 1976 and 1998, there was a statistically significant decline in sightings of a particular species reported by birdwatchers. Trend analysis for most species was limited to the St. Lawrence River system (including its principal tributaries), where the majority of checklists reporting at least one shorebird species originated.

Table 7. Status and trends of shorebird species occurring in Quebec.

Species	Population Status	Breeding Trend[1]	Migration	Fall Migration
Northern Lapwing	Visitor	nb[2]	Accidental	
Black-bellied Plover	Passage migrant	nb	Common	ns
European Golden-Plover	Visitor	nb	Accidental	
American Golden-Plover	Passage migrant	nb	Uncommon	ns
Common Ringed Plover	Visitor	nb	Accidental	
Semipalmated Plover	Migrant breeder	Common	Common	---
Piping Plover	Migrant breeder	Rare	Rare	
Killdeer	Migrant breeder	Common	Common	---
American Oystercatcher	Visitor	nb	Accidental	
Common Greenshank	Visitor	nb	Accidental	
American Avocet	Visitor	nb	Rare	
Greater Yellowlegs	Migrant breeder	Common	Common	ns
Lesser Yellowlegs	Migrant breeder	Uncommon	Common	ns
Solitary Sandpiper	Migrant breeder	Common	Common	ns
Willet	Migrant breeder	Rare	Rare	
Spotted Sandpiper	Migrant breeder	Common	Common	---
Upland Sandpiper	Migrant breeder	Uncommon	Uncommon	ns
Whimbrel	Passage migrant	nb	Uncommon	ns
Black-tailed Godwit	Visitor	nb	Accidental	
Hudsonian Godwit	Migrant breeder?[3]	?	Rare	ns
Bar-tailed Godwit	Visitor	nb	Accidental	
Marbled Godwit	Migrant breeder?	?	Rare	
Ruddy Turnstone	Passage migrant	nb	Common	---
Red Knot	Passage migrant	nb	Uncommon	---
Sanderling	Passage migrant	nb	Common	-
Semipalmated Sandpiper	Migrant breeder	Common	Common	---
Western Sandpiper	Passage migrant	nb	Rare	
Red-necked Stint	Visitor	nb	Accidental	
Least Sandpiper	Migrant breeder	Common	Common	ns
White-rumped Sandpiper	Passage migrant	nb	Common	ns
Baird's Sandpiper	Passage migrant	nb	Rare	
Pectoral Sandpiper	Passage migrant	nb	Uncommon	ns
Sharp-tailed Sandpiper	Visitor	nb	Accidental	
Purple Sandpiper	Passage migrant	nb	Rare	---
Dunlin	Migrant breeder	Uncommon	Common	ns
Curlew Sandpiper	Visitor	nb	Accidental	
Stilt Sandpiper	Passage migrant	nb	Rare	
Buff-breasted Sandpiper	Passage migrant	nb	Rare	
Ruff	Visitor	nb	Rare	
Short-billed Dowitcher	Migrant breeder	Uncommon	Uncommon	ns
Long-billed Dowitcher	Passage migrant	nb	Rare	
Common Snipe	Migrant breeder	Common	Common	---
American Woodcock	Migrant breeder	Common	Common	ns
Wilson's Phalarope	Migrant breeder	Rare	Rare	ns
Red-necked Phalarope	Migrant breeder	Uncommon	Uncommon	---
Red Phalarope	Migrant breeder?	?	Rare	ns

[1] Trends obtained from annual occurence values caclulated from ÉPOQ (data subset comprised of only checklists with ≥ 1 shorebird observations, 1976-98, submitted from the St. Lawrence River system, except for the Killdeer, Spotted Sandpiper, and Common Snipe whose trends were calculated using checklists from all of Québec, and the American Woodcock, for which trends are based on spring singing ground surveys from 1971-1998 (Canadian Wildlife Service, preliminary data).

(a blank indicates trend analysis was not performed for that species because sample size was too small)

Direction and significance of trends are as follows:

"ns"	population stable, no significant trend: $p > 0.10$
"+++"	positive trend, strong: $p \leq 0.05$
"-"	negative trend, weak: $p > 0.10$
"--"	negative trend, moderate: $0.10 \geq p > 0.05$
"---"	negative trend, strong: $p \leq 0.05$
[2] nb	non-breeder
[3] ?	insufficient data to confirm or determine status

Table 8. Trend analyses for the fall migration period, 1976–98, for four shorebird species at four sites in Quebec.

Site	Black-bellied Plover	Semipalmated Plover	Greater Yellowlegs	Semipalmated Sandpiper
Beauport	---	---	---	---
La Baie[1]	ns	---	ns	---
La Pocatière–Ouelle River	ns	ns	+++	ns
Rimouski-Pointe-au-Père	---	---	---	---

ns non-significant trend: $p > 0.10$

+++ positive trend (significant), strong: $p \leq 0.05$

--- negative trend (significant), strong: $p \leq 0.05$

(also see notes for Table 7)

[1] 1977–97

Interestingly, similar to overall Canadian trends (Hyslop et al. in press), Quebec's fall migration period (1976–98; Table 7) yielded negative trends for 18 out of 22 species for which trend analyses were possible. The four remaining species (Greater Yellowlegs, Whimbrel, White-rumped Sandpiper, and Pectoral Sandpiper) had weak positive trends, not unlike the ambiguous trend obtained for these species for Canada as a whole (i.e., stable?/declining).

While identifying trends is important, understanding the reasons underlying them helps direct species conservation. If the data are analyzed by specific sites we can determine whether the situation at a particular location is influencing the trend or if the trend is occurring province-wide.

Certain sites in Quebec have long been recognized as shorebird hotspots. We calculated occurrence for four sites (either specific locations or grouping of locations; Table 8): Beauport (near Quebec City), La Baie (along the Saguenay River), La Pocatière–Ouelle River (east of Quebec City along the south shore of the St. Lawrence River), and Rimouski–Pointe- au-Père (along the south shore of the St. Lawrence estuary). Analyses were performed for four species observed regularly during fall migration in these areas: Black-bellied Plover, Semipalmated Plover, Greater Yellowlegs, and Semipalmated Sandpiper.

The trends at Beauport are likely influenced by the 1978 legal battle to preserve the flats located there. This fight pitted birdwatchers and environmentalists against supporters of expansion of the Quebec City Port and the construction of a highway on the Beauport flats. For conservation of natural habitats to win over economic development was unheard of at the time, but the victory was short-lived as the principal staging site for shorebirds was assailed by large numbers of windsurfers. The hectic activity that ensued probably created such a degree of disturbance that shorebirds abandoned the site, resulting in a dramatic decline in the number of shorebirds staging there.

No obvious single factor can explain the trends observed at La Baie. The devastating Saguenay floods in the summer of 1996 left in their wake a thick layer of sediment on the flats and shores of the Saguenay River. How shorebirds have been affected by this situation remains to be seen. It will be important to follow the rehabilitation of the riparian habitats over the next few years.

At the Pocatière–Ouelle River site, there was a significant increase in the proportion of checklists reporting Greater Yellowlegs between 1976 and 1998, while the trends for the other three species were not significant (Table 8). This may be an indication that the habitat quality at this site is being maintained over time.

The Rimouski–Pointe-au-Père sector is comprised of a number of sites not easily segregated, but frequently visited by birdwatchers. The large number of shorebirds staging at the Pointe-au-Père marsh was an important factor in the decision to create a National Wildlife Area there. However, the diversion of effluents from the marsh may have altered the productivity of the site, making it less favourable to shorebirds and resulting in increasingly fewer birds staging there each fall.

The second phase in preparing the Quebec Shorebird Conservation Plan will consider species abundance, specifically at sites already recognized for their importance to shorebirds where the ecological integrity of shorebird habitat has been, or could be, altered.

Acknowledgements

Preparation of the Shorebird Conservation Plan for Quebec would not be possible without the collaboration of the thousands of birdwatchers who reliably submit their shorebird observations, and the Association québécoise des groupes d'ornithologues, Ducks Unlimited Canada, and Faune et Parcs Québec.

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Trends in Shorebird Populations Migrating through Southern Ontario

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The Ontario Shorebird Survey (OSS) was established in 1974 with the initial objective of identifying important areas for migrating shorebirds in Ontario. The OSS is part of a group of similar programs that includes the Maritimes Shorebird Survey on Canada's east coast and the International Shorebird Survey in the eastern United States, the Caribbean, and Latin America. Each consists of a network of sites that are surveyed by volunteers at regular intervals during the spring and fall shorebird migrations. Together, they comprise a large number of sites over a wide geographic area and provide valuable information on shorebird stopover areas. With the collection of data over time, these programs can now be used to monitor trends in shorebird populations. Highlights of an analysis of the Ontario data for the period 1974 to 1997 are presented here.

Most published shorebird trends have been from coastal areas, often where shorebirds stage in large numbers for extended periods. In contrast, southern Ontario provides dispersed, small-scale stopover areas for smaller numbers of migrating shorebirds which apparently use them for briefer periods of time. The majority of species in this study are small 'peeps' and plovers (genera *Calidris* and *Charadrius*) that breed in the Arctic. Large proportions of these populations stage in James Bay and then fly over south-eastern Ontario on their way to the east coast of North America. Although it is unclear why, some segments of these populations appear to make the flight in short 'hops' rather than one non-stop flight (Skagen & Knopf 1994); it is these individuals that are detected at monitoring sites in Ontario. Other species, such as the Greater and Lesser Yellowlegs (*Tringa* spp.), breed throughout the boreal forest. These species are thought to migrate in a relatively dispersed manner, so it is reasonable to expect that a representative proportion of the population passes through southern Ontario. A final group of species, including Killdeer (*Charadrius vociferus),* Common Snipe *(Gallinago gallinago*) and Spotted Sandpiper (*Actitis macularia*), are widespread and breed throughout Ontario. For these species, trends reflect both the local breeding populations and individuals passing through from more northern breeding areas.

The OSS has included over 98 sites since 1974 of which only about 20 have been covered for five or more years. Sites are concentrated in southern and eastern Ontario with a small number in the north. Many of these are associated with either the Great Lakes or sewage lagoons.

Shorebird numbers counted at individual sites were usually quite low, often involving considerably less than 100 individuals per visit. Forty shorebird species have been recorded on the surveys to date, of which 14 were present in adequate numbers for trend analyses. The Semipalmated Sandpiper (*Calidris pusilla*) showed a significant decline of nearly 5% per year (Table 9). Large negative trend values were also shown by Common Snipe, Pectoral Sandpiper (*C. melanotos*), Greater Yellowlegs, Lesser Yellowlegs, Short-billed Dowitcher (*Limnodromus griseus*), and Least Sandpiper (*C. minutilla*)

(Table 9). These results were not statistically significant due to high inter-year variation in counts, often a result of small sample size. Although only one species showed a statistically significant trend, the number and magnitude of negative trend values throughout the shorebird community was greater than expected by chance alone, and occurred for species from all breeding zones (Table 9).

The trends determined in the present study are comparable to those found by the Maritimes Shorebird Survey (Morrison *et al.* 1994) and the International Shorebird Survey (Howe *et al.* 1989). The Semipalmated Sandpiper declined in both of those studies, though the trend was significant only in the Maritimes. Local declines for the Semipalmated Sandpiper have also been reported from Delaware Bay, New Jersey (Clark *et al.*, 1993), and on the breeding grounds in Churchill, Manitoba (Hitchcock & Gratto-Trevor 1997). Perhaps the most striking similarity among studies is the disproportionate number of species showing declines. This provides strong evidence that shorebirds as a group warrant concern.

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Table 9. Trends of 14 shorebird species detected during fall surveys of the Ontario Shorebird Survey, 1976-97.

Species	n	Annual Change (%)	P	Breeding Zone
Black-bellied Plover	11	4.33	0.34	Arctic
Common Snipe	10	-15.26	0.10	Widespread
Dunlin	10	1.42	0.58	Arctic
Greater Yellowlegs	16	-7.65	0.26	Boreal
Killdeer	23	-2.23	0.34	Widespread
Least Sandpiper	19	-4.19	0.15	Arctic
Lesser Yellowlegs	22	-7.13	0.13	Boreal
Pectoral Sandpiper	17	-8.34	0.13	Arctic
Sanderling	10	-1.25	0.91	Arctic
Short-billed Dowitcher	10	-6.35	0.32	Boreal
Semipalmated Plover	16	-1.97	0.60	Arctic
Semipalmated Sandpiper	18	**-4.97**	**0.02**	Arctic
Solitary Sandpiper	11	-1.61	0.65	Boreal
Spotted Sandpiper	19	-2.25	0.60	Widespread

A checklist survey of birds in the Northwest Territories and Nunavut

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The NWT/Nunavut Bird Checklist Survey began 6 years ago to fill the need for a basic survey of bird distribution, breeding status, and abundance across Canada's north. Like other checklist programs, the Survey collects bird information from volunteers at various locations and in all seasons. The NWT/ Nunavut Survey also collects weather information which may give some indication of breeding season conditions over broad parts of the Arctic.

The NWT/Nunavut Bird Checklist Survey is of particular importance for shorebirds, because so many of Canada's shorebird species breed at northern locations that are difficult and expensive to survey by traditional methods. The CWS is preparing to do a preliminary analysis and evaluation of the Survey database to determine if the collection of weather information is useful, and to identify gaps in the information contained in the database. This will help focus checklist efforts on species, geographic locales, and time periods for which information is thin or lacking altogether. The breeding season shorebird data that have been collected to date are summarized below.

The Survey database contains 3820 records for 32 species of shorebirds. Over two-thirds (2553 records) are from the breeding season (1 June to 10 July), with nearly 40% of observed birds considered to be breeding. The actual percentage of breeding individuals is likely higher, as many checklists submitted do not indicate the breeding status of birds observed.

The most common shorebirds reported are American Golden-Plover (17% of all observations), Baird's Sandpiper (15%), Semipalmated Plover (14%), White-rumped Sandpiper (9%), and Red Phalarope (6%). These five species account for 60% of all shorebird records. The two plover species are likely over-represented in the database as they are loud, conspicuous birds that are easy to locate and identify. It is unusual for a drab, relatively quiet species like the Baird's Sandpiper to be recorded so frequently in a volunteer-based survey, however the Checklist Survey database contains several large contributions from biology field camps where intensive efforts were made to locate and record shorebirds. The inclusion of these datasets skews the Survey results geographically but probably helps to correct the over-representation of conspicuous species.

The Survey database has generated several extensions to the breeding ranges published in *Birds of Canada* (Godfrey 1986) for shorebird species. Breeding ranges for Stilt Sandpiper, Buff-breasted Sandpiper and Black-bellied Plover all extend south into central and southern mainland tundra. Purple Sandpipers are reported breeding at numerous locations on Banks Island, an extension hundreds of kilometres to the west, and breeding was confirmed for Short-billed Dowitchers in the Anderson River/Horton River drainage basin, thousands of kilometres north of its previously described breeding range. The Survey also records other, less dramatic shorebird range extensions. In the past, collecting and interpreting scattered reports and records was not feasible. Because the Survey captures published and unpublished information together in one database, it allows us to get a clearer picture of both past and current bird distributions. As the Checklist Survey database grows, so will its utility for refining breeding ranges and distribution trends for shorebirds.

Further information about the NWT/Nunavut Bird Checklist Survey and instructions for participants can be obtained from the Survey website at: http://www.NWTChecklist.com

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Evidence for declines in Arctic populations of shorebirds

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Very little historical information exists on population numbers of shorebirds breeding in northern North America. Most species of North American shorebirds breed almost entirely in the Arctic (Godfrey 1986), beyond the limit of data from the North American Breeding Bird Survey and its ability to monitor changes in their population numbers. A few studies have used trend analysis to look at population changes in shorebirds staging in eastern North America during migration (Howe *et al.* 1989, Morrison *et al.* 1994), and a very few studies have examined long-term population changes on the breeding grounds, usually in a small study area (e.g. Pattie 1990, Gratto-Trevor 1994, Hitchcock & Gratto-Trevor 1997). This article describes a unique opportunity to examine long-term changes in numbers of shorebirds across a fairly large area (7500 km^2) of the Canadian Arctic. The information presented here is condensed from Gratto-Trevor *et al.* (1998).

In 1975 and 1976, ground surveys for shorebirds and other birds were carried out in the Rasmussen Lowlands, Nunavut, by McLaren *et al.* (1977). These surveys demonstrated that the Rasmussen Lowlands supported a high diversity and density of breeding birds, particularly shorebirds. In 1994 and 1995, almost 20 years later, the area was re-censused to examine changes in the bird population between the mid-1970s and the mid-1990s.

The Rasmussen Lowlands are situated in the central Canadian Arctic on the mainland coast, at the eastern side of the Rasmussen Basin. The nearest settlement is Taloyoak, about 55 km north from the northern edge of the study area. In this isolated region, no major land use changes have occurred since the 1970s. Much of the area is flat and poorly drained with some eskers and rock outcrops, numerous lakes and ponds, and tussocky tundra and sedge marshes. The most common shorebirds breeding in the area (in order of abundance in the 1990s) are Red Phalarope (*Phalaropus fulicaria*), Pectoral Sandpiper, (*Calidris melanotos*), White- rumped Sandpiper (*C. fuscicollis*), Semi- palmated Sandpiper (*C. pusilla*), Dunlin (*C. alpina*), American Golden-Plover (*Pluvialis dominica*), Black-bellied Plover (*Pluvialis squatarola*), and Baird's Sandpiper (*C. bairdii*).

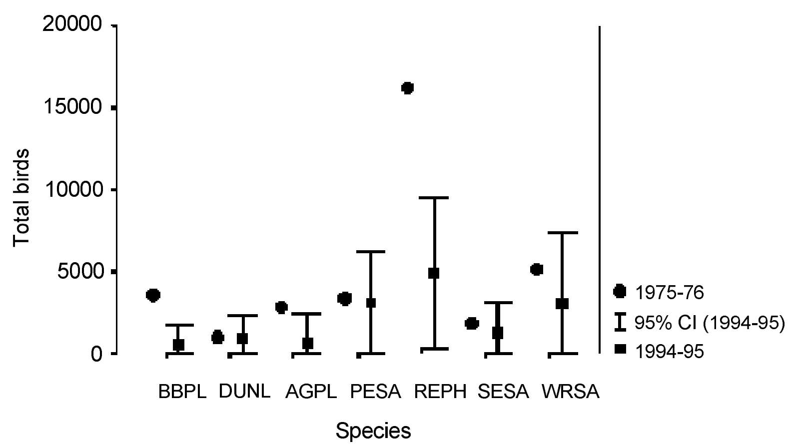

Figure 3. Total estimated bird populations in 7500 km^2 area of Rasmussen Lowlands. Data from 1975-76 were taken from McLaren *et al.* (1977). Bars around 1994-95 data represent 95% confidence limits. Species codes: BBPL=Black-bellied Plover, DUNL=Dunlin, AGPL=American Golden-Plover, PESA=Pectoral Sandpiper, REPH=Red-necked Phalarope, SESA=Semipalmated Sandpiper, WRSA=White-rumped Sandpiper.

The methods used in the two study periods were similar and should not have contributed to significant differences in population estimates. Plot locations in 1994 and 1995 were chosen to achieve a mix of the locations used for 1970s transects and a variety of habitat types throughout the study area. In both studies, large ponds and lakes were excluded from calculations of area searched. The habitats and behaviour of all birds, and their locations within and outside transects were noted in both studies. Only birds seen within the transect or plot areas were included in data analyses. In both studies, birds outside the area or flying overhead were noted but excluded from further analysis, and flocks of five or more birds were excluded as non-breeders. The overall timing of the censuses was similar in both studies: 20 June to 17 July in the '70s versus 18 June to 13 July in the '90s. Arctic weather can have extreme effects on the number of birds breeding in a given year (Evans and Pienkowski 1984, Gratto-Trevor 1991), but weather conditions were also comparable between the study periods. Both had one year with above average temperatures and early snow melt, and one year with below average temperatures and later snow melt (Johnston *et al.* 2000).

Overall population estimates by McLaren *et al.* (1977) were compared to mean estimates and 95% confidence limits from the 1990s for each species (Fig. 3). Numbers above or below the 95% confidence limits were considered significantly different. Numbers of breeding Red Phalaropes, Black-bellied Plovers, and American Golden-Plovers decreased significantly in the Rasmussen Lowlands between 1975-76 and 1994-95, while numbers of Pectoral Sandpipers, White-rumped Sandpipers, Semipalmated Sandpipers, Baird's Sandpipers, and Dunlin apparently did not change significantly overall. In the 1970s, 43% of the shorebirds seen in the area were Red Phalaropes (McLaren *et al.* 1977), but this dropped to 27% in the 1990s. Total population estimates from combined numbers for 1975-76 and 1994-95 showed significant declines for Red Phalaropes (-76%), Black-bellied Plovers (-87%), and American Golden-Plovers (-79%).

There is little information on population changes from other studies for any of these species. Red Phalaropes show no indication of population decline in Alaskan breeding populations (Troy 1996, D. Schamel pers. comm.), but, other than the current study, no information appears to exist for the central or eastern Nearctic. Large numbers of Red Phalaropes have historically staged off Brier Island, Nova Scotia, in the fall (Squires 1952, Brown 1980), and while it is not known whether their numbers have decreased there recently, large declines have been noted in Red-necked Phalaropes staging in the inner Bay of Fundy (Duncan 1995; P. Hicklin, pers. comm.). The wintering areas of Red Phalaropes that breed in the central and eastern Nearctic are unverified, so there is no wintering trend information for this species. Possible reasons for phalarope population declines include changes in abundance or availability of their plankton prey in staging or wintering areas. Global conditions may be affecting upwelling sites, where plankton are forced to the surface during daytime and become available to foraging phalaropes (Brown 1980, Cramp and Simmons 1983).

Analysis of the eastcoast staging areas of Black-bellied Plovers revealed nearly significant decreases in their numbers during migration, with cumulative declines of 46% over 12 years and 33% over 10 years (Howe *et al.* 1989, Morrison *et al.* 1994). Bloodworm harvesting in the Bay of Fundy significantly decreased Black-bellied Plover foraging success (Shepherd 1994), however it began too recently in Nova Scotia to have resulted in population declines, and harvesting in the eastern United States was not concentrated in important Black-bellied Plover foraging habitat (P. Shepherd, pers. comm.). There are no data from wintering areas.

American Golden-Plovers increased during a long-term study on Devon Island, NWT, and no changes were noted in birds staging in eastern Canada (Pattie 1990, Morrison *et al.* 1994). While no data exist from wintering areas, some researchers have noted that considerable portions of the winter range are at risk from agriculture, which may ultimately result in population declines (Johnson and Connors 1996).

Other than the fact that they are both large plovers that migrate south relatively late in the fall, there seems little similarity between Black-bellied Plovers and American Golden-Plovers to explain the large decreases found in their populations at the Rasmussen Lowlands. It seems unlikely that hunting in South and Central America, or illegal hunting in eastern Canada and the United States could explain the decline (Johnson & Connors 1996), but shorebird mortality from hunting is largely undocumented (Senner & Howe 1984).

Reasons for the significant decreases of these three species are unclear, and may differ for each. How consistent these trends are throughout the eastern Nearctic is not known, but the Rasmussen Lowlands are, in themselves, a large area. Because numbers were not censused between 1976 and 1994, the decreases could represent natural population fluctuations as a result of poor breeding in recent years rather than a persistent and continuing decline. To determine whether population numbers again increase, or continue to decline, future researchers should recensus the area more frequently, perhaps two years out of every ten. More information on population trends and factors affecting productivity and survival in this region, and elsewhere in the Nearctic, is needed.

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Increasing numbers of Black-necked Stilts in Canada

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Given the numerous examples of Canadian species declining in numbers, it is a pleasure to report on the increase of a lovely and distinctive shorebird in Canada that harms neither its habitat or native species. Black-necked Stilts (*Himantopus mexicanus*) breed primarily in the southwestern United States, Mexico, and into South America, but their breeding range has expanded northwards in the past 20 years, and they are now established as local breeders in Washington State and perhaps Oregon (Robinson *et al.* 1999).

In Canada, very rare sightings of Black-necked Stilts have been reported from Newfoundland, Nova Scotia, New Brunswick and Ontario, but nesting is unknown in those provinces (Godfrey 1986). The first reported sightings from Manitoba were in 1969, then 1978, with occasional sightings, but no confirmed nesting records, since (Chapman *et al.* 1985). The first verified record of Black-necked Stilt in British Columbia is from1971, with sightings in 1974, 1978, 1981, 1984, 1987 and 1988 (the last year of reporting) (Campbell *et al.* 1990). Again, there are no breeding records.

Alberta and Saskatchewan appear to be the centre of the Canadian distribution of Black-necked Stilt. A possible stilt nest was collected in Saskatchewan in 1894 (Godfrey 1986), but the first verified sighting was not until 1955, and the second in 1971. Since then, birds have been sighted in 1977, 1980, 1987, 1988, 1989, 1990, 1991, and yearly since 1994 (Smith 1996, B. Hepworth pers. comm., A.L. Smith pers. comm.). Nesting in Saskatchewan has been verified four times: at Blackstrap in 1987 (Wedgewood & Taylor 1988), Bradwell in 1989 (Salisbury and Salisbury 1989), Unity in 1996 (Koes & Taylor 1996), and Chaplin Lake in 1999 (J. Bilyk pers. comm.).

The first verified sighting in Alberta was not until 1970 (Weseloh 1972) and the second in 1972, although parts of a specimen were reportedly picked up in the Brooks area in the mid 1950s (Salt & Salt 1976). Subsequent sightings were reported in 1974, 1977, 1980, 1982, 1983, and every year since 1988 (C. Wallis pers. comm.). Nesting was first verified in the province at Beaverhill Lake in 1977 (Dekker *et al.* 1979), and since then in numerous locations in southern Alberta, including New Dayton, Calgary, Stirling Lake, Tyrell Lake, Leduc, Taber, Kininvie Marsh and Kitsim (Chapman *et al.* 1985, Dickson 1989, L. Bennett pers. comm., R. Dickson pers. comm., D. & T. Dolman pers. comm., CLG-T).

Some authors have suggested that increased sightings and breeding attempts north of the species' normal range occur when drought conditions exist in the southern United States (Dekker *et al.* 1979, Rohwer *et al.* 1979, Smith 1996). While drought conditions farther south may have originally led to prospecting Black-necked Stilts, the birds seem to be established local breeders in parts of southern Alberta. For example, at Kitsim, a managed wetland complex just southwest of Brooks, Alberta, six to 18 pairs of Black-necked Stilts have been seen each year from 1995 to 1999, with three or more pairs successfully hatching young, and fledged chicks observed, in each of those years. Given the highly mobile nature of this bird, it will be interesting to monitor the changes in the Canadian distribution of this species over time.

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Status and conservation of Dunlin in Canada

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Dunlin (*Calidris alpina)* have a circumpolar breeding range, and winter on or near coasts north of the equator. Breeding habitat is arctic and subarctic tundra, but they use coastal estuaries, intertidal flats, agricultural lands, and interior seasonal wetlands during the non-breeding season (Butler & Vermeer 1994; Warnock & Gill 1996). As many as nine subspecies of Dunlin have been identified worldwide, two of which, *C. a. pacifica* and *C. a. hudsonia*, occur in Canada. *C. a. pacifica* breeds in Alaska, commonly wintering on the Pacific coast from southern British Columbia to Mexico. *C. a. hudsonia* breeds in Nunavut and along Hudson Bay in Manitoba and Ontario, and is common in winter on the Atlantic and Gulf coasts from New Jersey to Mexico (Warnock & Gill 1996).

Population estimates, trends, and threats to Dunlin populations

The latest population estimates for *C. a. pacifica* and *C. a. hudsonia* are 550 000 (range 500 000 to 600 000) and 225 000 (range 150 000 to 300 000) respectively. Together these two subspecies of Dunlin make up about 24% of the global estimate of 3 260 000+ (Morrison *et al.* 2000). Although these numbers are high, both the Canadian (Hyslop *et al.* in press) and U.S. Shorebird Conservation Plans (Brown *et al.* 2000) list Dunlin as a species of concern due to declining population trends. *C. a. pacifica* appears to be stable in south-western B.C., but is declining elsewhere along the pacific coast (Paulson 1993; Morrison *et al.*, 2000). *C. a. hudsonia* has been declining in both Canada and the U.S., although the decline is not statistically significant in Canada (Morrison *et al.* 1994, 2000).

Data on Dunlin demography and habitat requirements provide insight into the possible reasons for these declines. Shorebirds have relatively low reproductive potential, so their populations are particularly sensitive to factors affecting adult survivorship (Hitchcock & Gratto-Trevor 1997). Most adult mortality takes place during migration or on the wintering grounds (Evans 1991), when Dunlin and other shorebird species typically concentrate in large numbers in coastal wetland habitats, habitats that are also favoured by humans. More than half of the human population of the United States, for example, resides within 80 km of its coasts.

Human activities threaten Dunlin populations through the development of coastal wetlands and nearby agricultural lands for housing, industrial, and recreational use; changes in agricultural practices; greenhouse development, which removes and fragments agricultural habitat; the spread of exotic species of marine plants and invertebrates, affecting feeding conditions and habitat availability; disturbance by people and their pets; industrial, agricultural, and residential run-off/effluent; oil spills; collisions with aircraft and overhead wires; climate change affecting water levels and ocean productivity; as well as oil development on the breeding grounds. Ironically, the recovery of raptor populations following DDT-induced declines may also lead to increased shorebird mortality.

Of these, it is likely that winter habitat loss is the primary factor contributing to the decline of Dunlin populations. Many wetlands along the Pacific coast have been lost or altered due to human impacts (Bildstein *et al.* 1991; Levings & Thom 1994). In fact, Speth (1979) estimated that two-thirds of the intertidal wetlands in California, where approximately half of the *C. a. pacifica* subspecies winters (Page *et al.* 1999), were lost between 1900 and 1975. Warnock and Gill (1996) estimate the loss of *C. a. pacifica* winter habitat to be between 30 and 91%, and the U.S. Shorebird Conservation Plan (Brown *et al.* 2000) attributes the declines in both subspecies to habitat loss along the Pacific, Atlantic, and Gulf coasts.

The population of Dunlin wintering in the Lower Mainland B.C., the primary wintering area in Canada, has not declined over the last 25 years (Fig. 4) possibly due to the availability of agricultural habitat adjacent to the intertidal habitat in that area (Butler & Vermeer 1994; Butler 1999). Dunlin use the agricultural habitats primarily during high tide, and particularly at night when the risk of predation diminishes (Shepherd 1997). These habitats are important alternative feeding sites when the intertidal flats are inundated by the tide, and Dunlin have been recorded feeding in the fields for an average of up to 4 hours a night (Shepherd, unpubl. data). Access to nearby fields may therefore contribute significantly to the ability of wintering Dunlin to meet their daily energy requirements. Knowledge of these patterns is required to incorporate the needs of Dunlin, and potentially other shorebird species, into management plans for agricultural habitats that have traditionally focused on raptors and waterfowl.

Monitoring Dunlin populations

To reach the goals laid out in the Canadian Shorebird Conservation Plan, we must be able to adequately monitor and assess trends in shorebird populations. Although there are important breeding grounds in Canada, many shorebird populations are most efficiently monitored during migration or on the wintering grounds. The Maritime Shorebird Survey, a volunteer-based series of surveys that run from the end of July to the end of October, adequately assesses trends in the numbers of *C. a. hudsonia* in Canada. No comparable survey exists on the west coast, but, as large numbers of *C. a. pacifica* winter as far north as Vancouver, they could be monitored using the Christmas Bird Count. To improve the accuracy of the annual population estimates, carefully trained volunteers should repeat the CBC survey protocol twice more each winter. These counts should ideally be performed shortly before and/or after the CBC to accommodate the considerable month-to-month variation in the numbers of Dunlin using the area, and the fact that December shows the least variation in Dunlin numbers among years (Fig. 5).

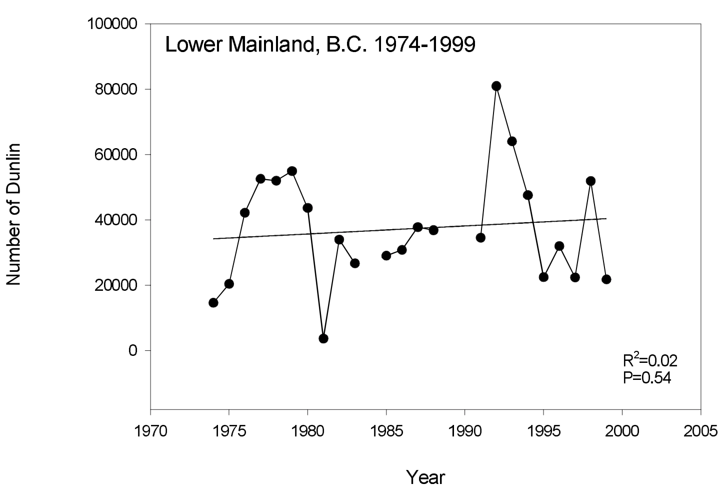

Figure 4. Christmas Bird Count Totals of Dunlin in the Lower Mainland (Vancouver, Ladner, and White Rock), B. C. 1974-1999.

C. a. pacifica are moving south in October and November and early northward movements begin in January (Fig. 5; Warnock & Gill 1996). The U.S. Shorebird Conservation Plan currently proposes an aerial survey of important winter *C. a. pacifica* sites on the Pacific coast, to which Canada could also add survey flights of the Lower Mainland.

Christmas Bird Count data obtained from the National Audubon Society web site at: http://birdsource.cornell.edu/cbc/index.html

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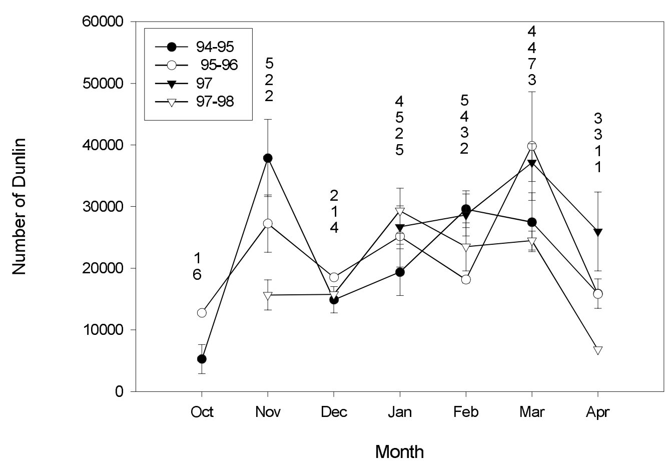

Figure 5. Monthly Dunlin numbers ± SE in Boundary Bay, B.C. 1994-98 (numbers of surveys in order of symbol appearance noted above). In 1994-95 some of the counts were corrected for the fact that they covered only a portion of the total survey area. Data were collected by PS, except in Nov., Dec., Feb., and Mar. 1997-98, when data were collected by volunteers.

Black Oystercatcher population status and trends in British Columbia

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The Black Oystercatcher (*Haematopus bachmani*) is a resident shorebird along the Pacific Coast of North America. Marine shoreline birds, Black Oystercatchers favour rocky intertidal habitats for roosting and breeding. Adults feed their young with marine molluscs, especially mussels and limpets, and also chitons. Nesting habitat ranges from mixed sand and gravel beaches to exposed rocky intertidal areas, however, in B.C. and Alaska, breeding pairs are most abundant on non-forested, low-sloping islands dominated by shell or gravel beaches (Andres & Falxa 1995, Hazlitt 1999). In the Strait of Georgia, pairs occupying breeding territories on these specialized island habitats have higher reproductive success than pairs on steeper rocky islets (Hazlitt 1999).

Black Oystercatchers are a shorebird species of high national and regional concern (Hyslop *et al.* in press, Pacific and Yukon Regional Shorebird Conservation Plan Committee, in prep). The global population estimate is about 11 000 individuals, with greater than 80% of the world's population in Alaska and B.C. (Andres & Falxa 1995, Campbell *et al.* 1990). Black Oystercatchers occur in low relative abundance, presumably limited by the availability of specialized breeding habitat. Significant potential threats exist during the breeding season, ranging from large-scale environmental perturbations, such as oil spills, to local problems like introduced predators that take eggs and chicks, beach debris that covers nesting sites, and human disturbance.

Although population threats exist, current information suggests that the Black Oystercatcher population in B.C. is stable. The Laskeek Bay Conservation Society, with the help of hundreds of volunteers, has monitored the number of breeding pairs in Laskeek Bay, Queen Charlotte Islands for almost a decade. The breeding population has remained stable at about 30 breeding pairs (Gaston & Heise 1993, Gaston *et al.* 1994; Smith 1998; unpublished LBCS reports 1995-1999). Canadian Wildlife Service surveys of Black Oystercatchers in the Southern Gulf Islands, Strait of Georgia, also show a stable number of breeding pairs over the past decade (Vermeer *et al.* 1989, Hazlitt 1999).

Increases in Black Oystercatcher breeding populations have been documented for the two largest colonies of breeding seabirds in the Strait of Georgia–Mitlenatch Island and Mandarte Island. The Mitlenatch population has increased from a single breeding pair in the early 1960s, to 8 breeding pairs in the mid-1990s (unpublished Parks Reports 1963-1973; Verbeek 1998). The first re-

Table 10. Trends in Black Oystercatcher numbers from Christmas Bird Counts in B.C.

Christmas Bird Count	N (years)	Population Trend*	Slope	R2	P*
Sooke	13	No Change	-2.39	0.16	0.16
Victoria	40	**Decline**	-0.68	0.13	**0.02**
Anacortes-Sidney	26	No Change	0.12	0.11	0.1
Pender Islands	33	**Increase**	1.35	0.53	**0.0001**
Duncan	18	No Change	0.12	0.16	0.09
Bamfield	12	No Change	0.69	0.04	0.52
Nanaimo	28	**Increase**	1.72	0.50	**0.0001**
Vancouver	17	**Increase**	0.38	0.33	**0.01**
Deep Bay	23	**Increase**	1.87	0.35	**0.002**
Sunshine Coast	19	**Increase**	1.45	0.33	**0.009**
Skidegate Inlet	16	No Change	0.65	0.01	0.73
Masset	16	**Decline**	-5.60	0.32	**0.02**

***significant trends appear in bold**

National Audubon Society provided Christmas Bird Count data. Only sites with a minimum of 10 years of oystercatcher records were used for trend analyses. The data were not standardized for effort.

cords for Mandarte Island begin in the late 1950s, with 2 breeding pairs of Black Oystercatchers reported each year (1957-1962) (Drent *et al*. 1964). Currently, 7 pairs of Black Oystercatchers occupy breeding territories on Mandarte Island (Hazlitt 1999).

Christmas Bird Count (CBC) data from B.C. support the conclusion that the Black Oystercatcher population is generally stable in most locations and increasing at a few sites (Table 10, Figs. 6 & 7). Although inter-annual variability of Christmas Bird Counts is high for this species at all sites, most areas show a stable population trend. Counts at Victoria (Fig. 8) and Masset, however, demonstrate significant declining trends. The decline at Masset reflects a change in CBC coverage, the later years missing a marine component to the count (Peter Hamel, pers. comm.). The decline at Victoria may be the result of increased urbanization and human disturbance.

Black Oystercatchers appear to be expanding their range into the Lower Mainland (Fig. 9) and other regions (Campbell *et al*. 1990; Campbell *et al*. 1972; Campbell 1968). Between the years 1959 to 1990, not a single sighting was made in almost twenty-five CBC counts at Ladner and Vancouver. However, Black Oystercatchers have been reported regularly through the 1990s in both areas, with a record high number of individuals counted in Vancouver in 1999. The species began to breed in the Lower Mainland on the B.C. Ferry jetty in 1994 (Robin Gutsell, pers. comm.).

Monitoring Black Oystercatcher populations is difficult in many areas due to the remoteness of most rocky intertidal shoreline habitat. Breeding pair surveys are effective at a local scale, but are difficult and expensive at a larger scale. The Christmas Bird Count data, although useful for detecting trends, only provide a single estimate per year at a limited number of sites along the coastline. A new province-wide volunteer survey, the B.C. Coastal Waterbird Survey, launched by Bird Studies Canada and the Canadian Wildlife Service in 1999, will contribute abundance and distribution indices for Black Oystercatchers for the Georgia Basin. This new monitoring program, combined with existing monitoring techniques, will provide more robust population trend data for Black Oystercatchers in B.C.

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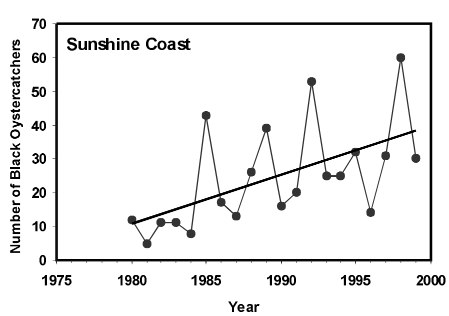

Figure 6. Christmas Bird Count population indices for Black Oystercatchers on the Sunshine Coast, B.C..

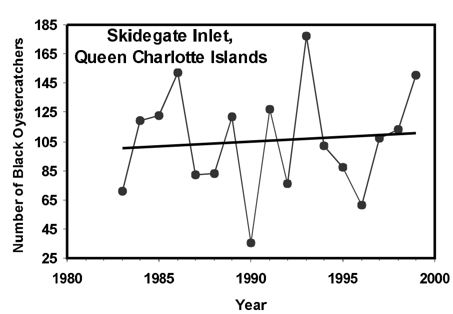

Figure 7. Christmas Bird Count population indices for Black Oystercatchers in Skidegate Inlet, Queen Charlotte Islands.

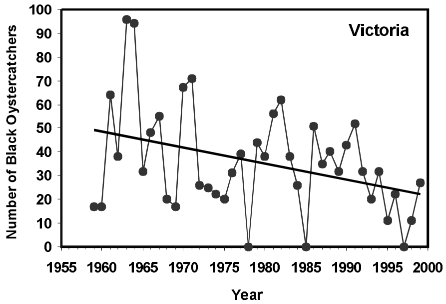

Figure 8. Christmas Bird Count population indices for Black Oystercatchers in Victoria, B.C..

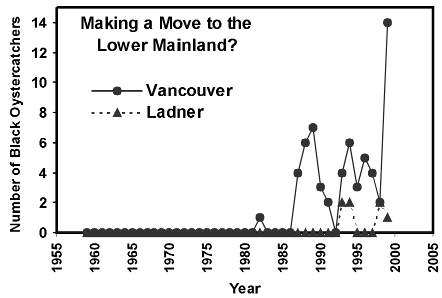

Figure 9. Christmas Bird Count data demonstrate movement of Black Oystercatchers into the Lower Mainland areas of Vancouver, B.C..

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Trends in abundance of Western and Least Sandpipers migrating through southern British Columbia

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The Western Sandpiper (*Calidris mauri)* and Least Sandpiper *(C. minutilla*) are the most numerous shorebird species on the Pacific Coast of North America (Paulson 1993). The Western Sandpiper breeds along the coast of western Alaska and eastern Siberia whereas the Least Sandpiper breeds in the boreal forest of Canada. The Fraser River delta along with San Francisco Bay, Grays Harbor, the Stikine River and the Copper River delta are major migratory stop-over sites for both species (Iverson *et al*. 1995, Butler & Kaiser 1995, Butler *et al*. 1996, Warnock & Bishop 1998). There are about 25 000 ha of mudflat and sandflat habitat on the Fraser River delta used by hundreds of thousands of shorebirds during spring and fall migrations and in winter (Butler 1994), a phenomenon unique to Canada's west coast. Sidney Island is much smaller with only about 100 ha of mud and sandflat enclosed within a lagoon used by a few thousand shorebirds primarily in summer and autumn during fall migration (Butler *et al*. 1987).

Since 1992, the abundance of the Western Sandpiper has been monitored in April and May on the Fraser River delta and in July and August on Sidney Island. Thousands of shorebirds assemble in late April and early May at Brunswick Point on Roberts Bank near the southern edge of the Fraser River delta (Butler 1994). The most numerous species in the flocks are the Western Sandpiper, Dunlin (*C. alpina*) and Least Sandpiper. Three methods were used to count shorebirds at high tide near the peak of migration in late April – early May. Small flocks were estimated by dividing the entire flock into blocks of 100s or 500s along their length and summing the estimates ('blocking method'). From 1992-97, large flocks were estimated by multiplying estimates of the length of the flock along a driveable dike, the breadth of the flock as a proportion against a fixed distance marker, and the density in a selected 10 m^2 patch of mud. From 1998-2000, we counted the number of sandpipers in a 1 m wide strip across the flock at about 100 m intervals ('strip sample method'). The average number counted in the strips was then multiplied by the length of the flock to derive a total. Estimating the number of shorebirds in flocks of many tens of thousands, and occasionally hundreds of thousands, of individuals introduce unknown but likely large estimation errors. On Sidney Island, all shorebirds in the lagoon at mid-tide on most days in July and August were counted. These counts have high precision because Sidney lagoon is sufficiently small to provide a good view of shorebirds, and flocks were generally small enough to enable a count of all individuals. We estimated the number present using the blocking technique described above on days when flocks were too large to count each individual.

Texas first reported declines in censuses of fall migrating Western Sandpipers in the 1980s (Neil 1992). More recently, anecdotal accounts from naturalists and birdwatchers, and our census data, suggest declines have also occurred in Western Sandpiper numbers on the Fraser River delta in British Columbia. The migration of sandpipers across the Fraser River delta increases from a few thousand birds in mid-April to several hundred thousand by month's end, with a rapid decline through early May (Fig. 10). The estimated peak single-day count of Western Sandpipers on the Fraser River delta declined significantly between 1992 and 2000 (Fig. 11), as did the total number of juvenile Western Sandpipers counted on Sidney Island during the southbound migration (Fig. 12). Declines also occurred among adult Western and Least Sandpipers and juvenile Least Sandpipers on Sidney, but none was statistically significant. There are no data from other locations during this time period to determine whether or not these declines are widespread.

There are several possible reasons why shorebirds might have declined in British Columbia. First, the number of predatory falcons on the south coast has increased in spring and summer, possibly resulting in a

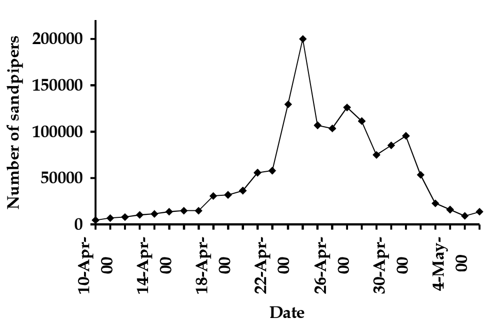

Figure 10. Daily maximum counts of shorebirds at Brunswick Point in April - May 2000.

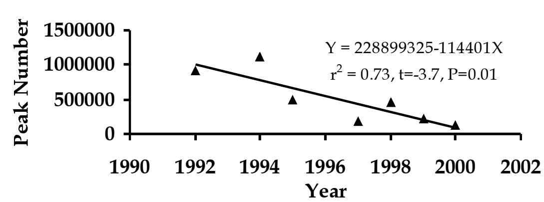

Figure 11. Peak number of Western Sandpipers counted on Roberts Bank.

change in site-use by sandpipers rather than a widespread decline. Clark and Butler (1999) used a computer model of Western Sandpiper migration to hypothesize that predation risk was an important factor in the decision to stay or migrate at stop-over sites. A second hypothesis is that food supplies, and hence shorebird survival, might have declined at winter sites in the strong El Nino years of 1991 and 1997. Preliminary analysis from Panama during the 1997 El Nino shows declines in body masses of some Western Sandpipers, but it is unknown if these declines translate into higher mortality rates (P. O' Hara, pers. comm.). Thirdly, it is possible that the decline is from breeding failure resulting from the El Nino-Southern Oscillation events of the late 1990s. If true, the survival of first year sandpipers may be too low to provide the number of first time breeders needed to maintain population levels. The decline in juveniles seen on Sidney Island lends support to the breeding failure hypothesis as a possible cause for the observed declines. Some other breeding ground studies showed low recruitment of first time breeders to be a cause for population declines in shorebirds (Gratto-Trevor *et al.* 1998). The greatest declines among North American shorebirds in recent years have occurred among high latitude breeding species, such as the Western Sandpiper. Further research throughout the life cycle of the Western Sandpiper, such as mark-recapture techniques developed at Simon Fraser University, should identify where in the annual cycle the apparent problem lies and provide guidance for possible solutions.

Currently, our counts are not robust enough to give us confidence that the declines are real, but the trends on both the Fraser delta in spring and on Sidney Island in summer are sufficient to warrant increased monitoring of populations over a wider area. Methods to test the precision of large flock estimates are needed, and the survey area should be expanded to other parts of the species' range, in particular the major stop-over sites in the USA in spring, and southbound stop-over sites in southern British Columbia and neighbouring beaches in Puget Sound, Washington.

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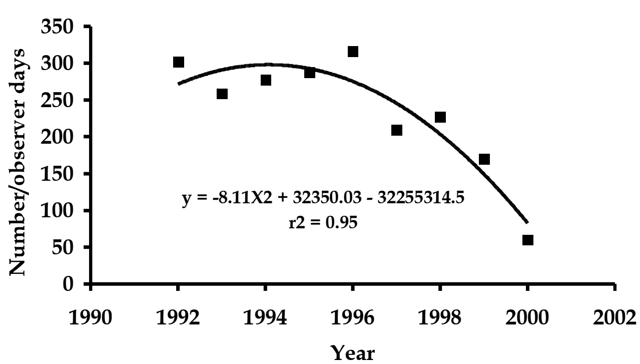

Figure 12. Total number of juvenile Western Sandpipers/observer days on Sidney Island.

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Phalaropes in the Bay of Fundy

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One of the great shorebird mysteries in Canada is the disappearance of the Red-necked Phalarope from its migration staging areas in the western Bay of Fundy. Beginning in 1986, the large flocks of phalaropes normally present in Passamaquoddy Bay began to evaporate. There have also apparently been changes in the numbers of Red Phalaropes at their traditional staging areas on the eastern side of the Bay, but these are less well documented.

Red-necked Phalarope

For over a hundred years, Red-necked Phalaropes (*Phalaropus lobatus*) have been known to stage in large numbers in the Bay of Fundy on their southbound migration. From mid-July to mid- September, their principal staging areas were the Quoddy region of Eastport and Lubec on the coast of Maine, and Deer and Campobello Islands in New Brunswick (Fig. 13; Knight 1987; Palmer 1949; Squires 1976). The tiny crustacean *Calanus finmarchicus* is the birds' major prey during this time, and phalaropes move with the tide to stay in areas of high copepod densities (Mercier & Gaskin 1985). In 1982, the total number of Red-necked Phalaropes passing through the area was estimated at 1 million birds (Mercier & Gaskin 1985), the same order of magnitude as informal estimates by birdwatchers, which ranged from hundreds of thousands to 2 million (Finch 1977, Vickery 1978, Forster 1984). Some believe that this may represent the entire breeding population of Red-necked Phalaropes in eastern Canada, Greenland and perhaps Iceland (R.G.B. Brown *in* Duncan, 1996a).

A major decline in the numbers of birds staging in the Quoddy region was first noted in 1986, with the species becoming essentially absent by 1990. Surveys of plankton showed greatly reduced levels of copepods near the surface between the 1970s and 1990 (Brown 1991), and this is likely to have been the cause of the decline in phalarope

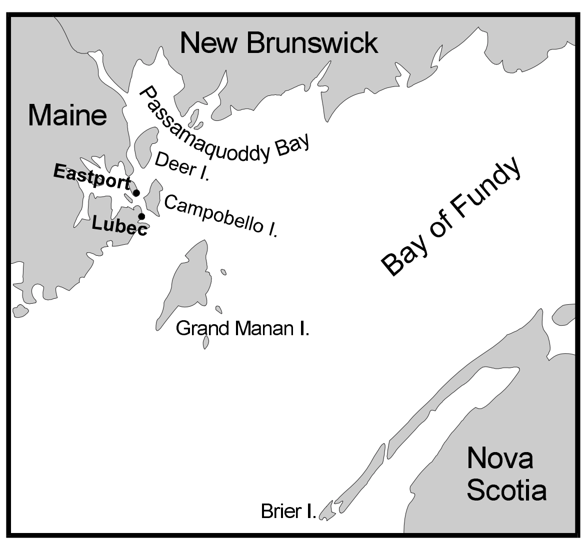

Figure 13. Important migration staging areas for Red-necked and Red Phalaropes in the Bay of Fundy.

numbers. Curiously, however, populations of other species, such as herring, that also depend on the copepods have not collapsed in a similar fashion.

Although the disappearance of staging Red-necked Phalaropes in the Quoddy region sparked concern that the entire population had crashed, very large numbers were seen on northbound passage off Nova Scotia on at least one subsequent occasion (Duncan 1996b). A new staging area has not yet been located, but Brier Island, Nova Scotia, traditionally a minor staging area for this species (Tufts 1986) has had greatlyincreased numbers of phalaropes in some years. This area should be closely monitored. Because Red-necked Phalaropes winter at sea, specific wintering grounds are unknown, preventing population surveys during that portion of their life cycle (Cramp 1983, Duncan 1996b).

Red Phalarope

A similar tale can be told for Red Phalaropes (*Phalaropus fulicaria)*. Until 1986, large flocks were seen regularly during autumn migration near Brier Island, Nova Scotia, accompanied by smaller numbers of Red-necked Phalaropes. Red Phalaropes have always been quite rare in the Quoddy region on the western side of the Bay where Red-necked Phalaropes were once found in large numbers. Since 1986, however, the phalarope flocks at Brier Island have sometimes failed to materialize. Large flocks of phalaropes were again seen at Brier Island in the 1990s, but less regularly than in the past. Although the exact proportion of Red to Red-necked Phalaropes in these recent gatherings has not been determined, there are some indications that there are far more Red-necked Phalaropes among them than previously (Brown 1991, C. Haycock pers. comm.).

The Red Phalaropes at Brier Island are usually found at upwelling "streaks" where plankton is brought to the surface (Brown 1980). Comparison of plankton tows from the 1970s and 1990 showed little change in the zooplankton community (Brown 1991), so this does not explain the differences in the numbers of phalaropes over time. Like the Red-necked Phalarope, the Red Phalaropes seen in Fundy winter at sea, most likely among the large flocks recorded off Senegal, West Africa (Cramp 1983).

Additional research is clearly needed to determine the current status and dynamics of these populations of phalaropes. Perhaps modeling of ocean currents and wind patterns could locate potential staging and wintering sites by identifying plankton upwelling zones. Until we obtain further information, the story of phalaropes in the Bay of Fundy remains unresolved.

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Harvest and population trends of Common Snipe and American Woodcock in Canada

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Two shorebird species are listed for legal harvest as Migratory Game Birds in Canada: the Common Snipe and the American Woodcock. These two widely distributed North American members of the Scolopacidae Family together provide recreation to thousands of Canadians annually.

To conserve these migratory birds of special interest to both hunters and birdwatchers we must assess both population status and harvest levels. The annual harvest of both species is estimated by the National Harvest Survey (NHS) through a random survey of 5–10% of migratory game bird hunters in Canada. The data discussed here are Canada-wide harvest estimates, but more detailed information is also available (Lévesque & Collins 1999). Additional information on age and sex of woodcock harvested is obtained through the Species Composition Survey, supplemented by focused mailings to lists of known woodcock hunters (Bateman 1999; Rodrigue pers. comm.). Snipe population trend index data are obtained through the Breeding Bird Survey (BBS), but the nocturnal habits and breeding displays of the woodcock make the BBS less appropriate for that species. In Canada and the northeastern United States, a singing ground survey is run annually to provide information on woodcock breeding status.

Common Snipe

Snipe harvest estimates for the period 1974-1999 are summarized in Figure 14. There has been an average annual decrease in the number of snipe harvested of 3500 (R^2 = 90%, F-test significant at <0.001), however this parallels the downward trend of migratory game bird hunting permit sales (524 946 permits sold in 1978 versus 204 101 in 1998). The proportion of permit holders that are successful snipe hunters is also decreasing (3.63% in 1978; 1.83% in 1998) while the proportion of successful duck hunters remains high (61.42% in 1978; 60.60% in 1998). The average harvest per successful snipe hunter has remained relatively steady over time (4.65 birds in 1998).

The most recent Breeding Bird Survey trend analysis (Dunn *et al.* 2000) for Common Snipe indicates no significant trend in Canada as a whole over the 1967-1998 period. Only 2 of the 9 Bird Conservation Regions (BCRs) where snipe were encountered

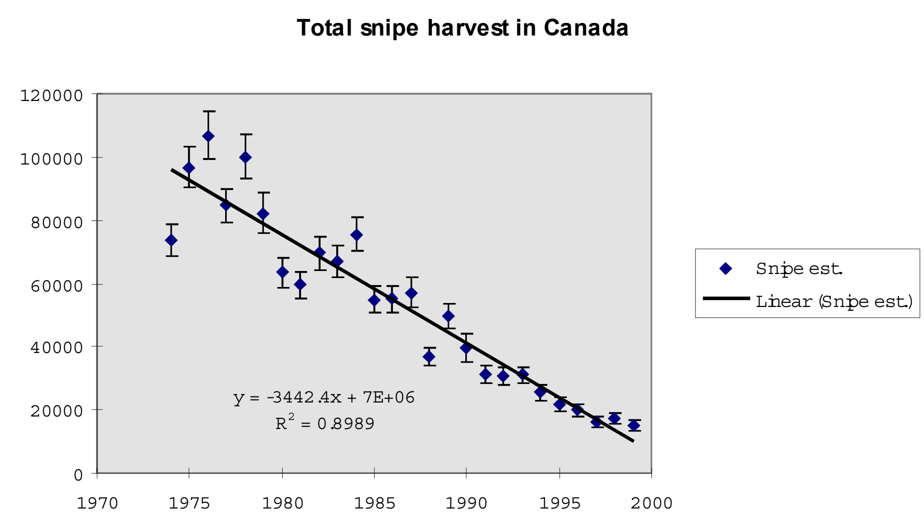

Figure 14. Numbers of Common Snipe harvested in Canada between 1974-1999 from the National Harvest Survey (Lévesque and Collins 1999).

had significant trends ($p<0.05$): positive in the Prairie Potholes and negative in the Boreal Hardwood Transition.

In general, there is no obvious population trend revealed by harvest or BBS data, but rather the diminishing popularity of the snipe harvest.

American Woodcock

The total harvest of American Woodcock peaked at close to 160 000 birds in 1976 (Fig. 15) and steadily declined to 61 699, with its lowest point below 50 000 in 1997. This decline again parallels that of permit sales. However, a closer examination of the harvest data indicates that the average harvest per successful hunter was 6 birds from 1975-1985, 7 birds for the period 1986-1998, and climbed to 8.35 birds per successful hunter in 1999. These figures may indicate that committed woodcock hunters have continued to buy permits and remain active while marginal (and less successful) hunters are no longer involved. There are confounding factors related to changing prey availability and other external factors affecting hunting activity that cannot be defined without further data.

Age ratios from annual samples of the woodcock harvest vary from year-to-year and between regions; this ratio of adult to young birds is an index of regional breeding success that can be dramatically affected by spring weather in any given year. Our still incomplete understanding of the mating system of the American Woodcock provides further difficulty in interpreting these results. Analyses of the longterm results of the singing ground survey indicate declines in the breeding population of New Brunswick and Ontario (Kelley 2000). However, these results may not be a useful index for the whole population as the singing ground survey does not provide good coverage of the cut-over woodland where woodcock are known to breed. More work is needed to quantify the importance of cut-over forest land as breeding habitat and to investigate the relationship between habitat change and the singing ground index.

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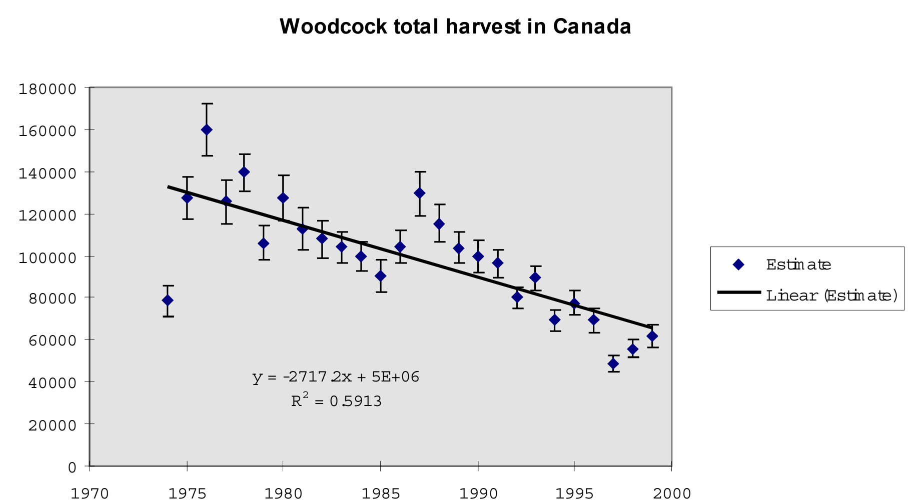

Figure 15. Numbers of American Woodcock harvested in Canada between1974-1999 from the National Harvest Survey (Lévesque and Collins 1999).

To help with snipe and woodcock monitoring efforts, please participate when you are randomly selected for the National Harvest Survey. For more information, contact: Helene.Levesque@ec.gc.ca

For more information on the special collection of woodcock wings, please contact:
Myrtle Bateman (Atlantic provinces and Ontario): Myrtle.Bateman@ec.gc.ca
Jean Rodrigue (Quebec): Jean.Rodrigue@ec.gc.ca

To participate in special woodcock singing ground surveys, please contact your regional coordinator:
Myrtle Bateman (Atlantic): Myrtle.Bateman@ec.gc.ca
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For more information on the Breeding Bird Survey, contact the national coordinator:
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Shorebirds at Risk in Canada

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Four shorebird species have been designated nationally at risk by COSEWIC, the Committee on the Status of Endangered Wildlife in Canada. The status of the Eskimo Curlew (*Numenius borealis*), first designated endangered in 1987, was reconfirmed by COSEWIC in May 2000. The Piping Plover (*Charadrius melodus)* was first designated endangered in 1985, and the Mountain Plover (*C. montanus*), was listed as endangered in 1987 and reconfirmed as such by COSEWIC in November 2000. The fourth shorebird at risk, the Long-billed Curlew (*Numenius americanus*), was designated vulnerable (now called "special concern") in 1992.

An "Endangered" species is one that faces imminent extirpation or extinction, a "Threatened" species is likely to become endangered if limiting factors are not reversed, and a "Special Concern" species has characteristics that make it particularly sensitive to human activities or natural events.

Drafting a recovery plan for the Eskimo Curlew first began in the early 1990s, but this effort was suspended in 1995. Extensive searches of historic breeding areas (and other potential sites) conducted since 1960 have not resulted in any verified sightings of birds with eggs or young. In fact, researchers have made no confirmed sightings of nests or young for well over 100 years (see Gratto-Trevor, p. 44).

Of the 5900 Piping Plovers estimated to be in North America, about 2100 breed in Canada (approximately 25% on the Atlantic coast and the remainder on the Prairies). Piping Plovers also bred in the Canadian Great Lakes area as recently as 1977, but the species has since become extirpated from that region. Degradation and loss of nesting beach habitat, predation, and other causes, have resulted in Piping Plover declines over the past century. Between 1991 and 1996, the Atlantic population estimate decreased from 509 to 422 adults (from 234 to 189 pairs), while the Prairie population estimate increased from 1437 to 1687 adults (from 589 to 679 pairs). In the past two years estimates have increased in all five eastern provinces, with an overall increase of 13% in the Eastern population.

The two Canadian Piping Plover recovery teams (Atlantic and Prairie) have coordinated their activities with U.S. teams for more than a decade. Planning is currently underway for the third International Piping Plover Census, to be conducted in 2001. An updated national recovery plan for Piping Plovers in Canada was submitted for approval by the jurisdictions responsible in May 2000. Recovery efforts in breeding areas include public outreach campaigns, use of nest exclosures and establishment of community guardianship programs. These efforts are beginning to have positive results on Piping Plover reproductive success. New populations have been discovered over the past ten years, and extensive efforts are ongoing at local levels to conserve plover habitat and learn more about the species' requirements.

Despite its English common name and taxonomic classification, the Mountain Plover is neither mountain-dwelling nor found on shores. It appears to reach the northern limit of its breeding range in southeastern Alberta and southwestern Saskatchewan, where remnants of its short-grass prairie breeding habitat are found. At one time, this habitat was kept low by grazing American Bison and fire which enabled the plovers to spot approaching predators. As a result of loss of natural grassland habitat to agricultural development, there has been a long-term population decline of Mountain Plover throughout its North American range. It has become a rare visitor to Canada, although it was probably never very common here. Recovery efforts for this species in Canada are on hold.

The Long-billed Curlew is the largest shorebird in Canada. It is extirpated from southern Manitoba and southeastern Saskatchewan, and populations in southwestern Saskatchewan, southern Alberta and British Columbia are declining. Because Long-billed Curlews are dispersed in small pockets of available grassland habitat over a very large territory, the Canadian population estimate is poor (1000s?, see Morrison, p. 6). Loss of habitat to agricultural development, as with the Mountain Plover, is reducing the availability of breeding habitat for this shorebird. Use of pesticides in the breeding areas may be contributing to the species' low reproduction, since eggshell- thinning and mortality from lethal residues have been detected. Although recovery teams are not formed for special concern species such as the Long-billed Curlew, such species benefit from ecosystem and management plans that lead to habitat improvements.

Information about species at risk in Canada may be found on the CWS species at risk web site at: http://www.speciesatrisk.gc.ca

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Current Status of the Eskimo Curlew in Canada

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The Eskimo Curlew (*Numenius borealis*) is a once-abundant species that became virtually extinct in the 20th century. This species was placed on the U.S. List of Threatened and Endangered Species in 1967 and was listed by COSEWIC as endangered in Canada in 1978. The Canadian Eskimo Curlew Recovery Team was placed on hold in 1995 until the existence of the species is confirmed (preferably on the breeding grounds). No verified nests (or young) have been found for well over 100 years. Occasional sightings of non-breeding birds, some by very experienced birders, still occur (Gollop & Shier 1978, Gollop *et al.* 1986, Gill *et al.* 1998), but, as the species is easily confused with other shorebird species like the Whimbrel (*N. phaoepus*), Little Curlew (*N. minutus*), Long-billed Curlew (*N. americanus* - especially fledged young, since the bills of juveniles continue to grow for months), Upland Sandpiper (*Bartramia longicauda*), Pectoral Sandpiper (*Calidris melanotus*), and Stilt Sandpiper (*C. himan-*

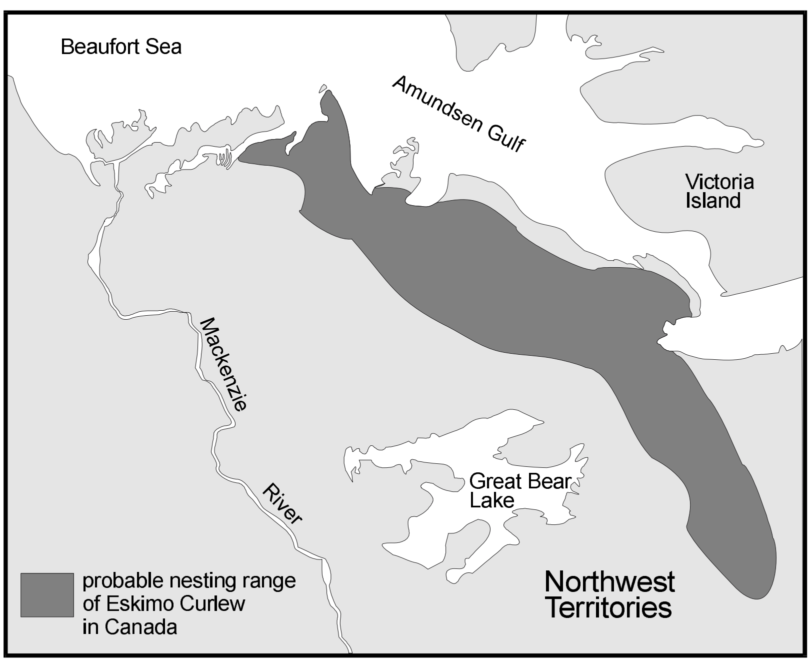

Figure 16. Historically known nesting areas of the Eskimo Curlew in the Northwest Territories.

topus), it is difficult to determine the validity of most sightings. Approximately 18 reports were received from 1975 to 1998 in non-breeding as well as historic breeding areas (Table 1 *in* Gratto-Trevor 1999).

Historically, nests are known only from two areas in the 'barren grounds' of the western Northwest Territories (Fig. 16). During fall migration birds flew eastwards, staging primarily in Labrador and Newfoundland, with sporadic occurrences in northern Ontario, Quebec, the Maritimes, and the New England states. The birds flew non-stop over the Atlantic to South America, presumably wintering primarily in the Pampas of Argentina and farther south. Spring migration was through Texas and the mid-western states, with some birds found in the Canadian Prairies. Populations (originally in the hundreds of thousands or more) were decimated in the 1870s and 1880s primarily by hunting during spring and fall migration, but also possibly by habitat deterioration of mid-west grasslands through conversion of tallgrass prairie to agricultural use and in wintering areas (Gollop & Shier 1978, Gollop *et al.* 1986, Gill *et al.* 1998).

Since 1975, there have been seven possible sightings reported from historic and putative breeding areas. Only two of these involved breeding birds: a nest in the southern district of Keewatin (7 July 1992), and a bird with one young in the Arctic National Wildlife Refuge, Alaska (1 August 1983). The Keewatin nest area was searched in the summer of 1994, but only Whimbrel were found, and analysis of the nest photograph concluded it was a Whimbrel nest (Obst & Spaulding 1994). The area of the Alaskan sighting was surveyed the following summer, and no Eskimo Curlew was found. The searchers suggested that the birds seen the previous year were Upland Sandpipers, which were common breeders in that area and very curlew-like (Gill & Amaral 1984). In neither instance was the original observer very familiar with North American shorebirds. No confirmed Eskimo Curlew nests, nor birds behaving as if they had nests or young, have been found since 1866, even though searches were carried out in historic breeding areas from 1972 to 1986, and for a number of years in the 1990s (Gollop *et al.* 1986, Obst *in* Uriarte 1995, Obst *in* Gill *et al.* 1998). No Eskimo Curlews were found during extensive searches in historic wintering areas of Argentina and Uruguay in 1992-1993 (Blanco *et al.* 1993). The last specimen obtained was shot in Barbados in 1963 (Bond 1965), however, 23 birds were reported from Texas in 1981 (Blankenship & King 1984), and recent possible sightings in the Canadian Prairies during spring migration are intriguing (Pollock 1996, Walden 1996, Gollop 1997). Current population estimates are based on guesswork, and vary from 23 to 100 birds (Gollop & Shier 1978, Gollop 1988, Morrison *et al.* 1994). Eskimo Curlews may persist in very small numbers, but populations have not recovered measurably from the large population declines of the 1870s to 1890s.

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Reporting banded shorebirds through the Pan American Shorebird Program

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Each year, many bands are recovered from waterfowl during the hunting season. But since few species of shorebirds are hunted in North America, shorebirds are marked with more than metal bands. This allows for visual reports of Canadian birds from other areas which can help trace their migration routes. Some birds are given a dye pattern during specific studies, but that lasts only until those feathers are moulted. Shorebirds are usually marked with colour bands and/or 'flags' – colour bands with tabs that stick out from the leg. There are two types of colour banding schemes: cohort and individual.

In cohort schemes, large numbers of birds are marked with the same pattern and colours. This scheme is usually used during migration studies to identify the location and year of banding, and perhaps the age of the bird. For example, all shorebirds banded at Little Quill Lake, Saskatchewan in 1990 were marked with a white flag over a metal band on the upper left leg. In addition, spring migrants received a white flag over a red colour band on the upper right leg, while fall migrants were marked on the lower right leg: a red colour band for adults, and dark green for juveniles.

Birds are given individual combinations when it is important to identify a specific bird without recapturing it. This scheme is common for breeding and behavioural studies. Individuals of a species are given a unique combination of bands and colours. This allows identification of individuals and their mates as soon as they return to the breeding area before there has been an opportunity to recapture the bird.

Obviously, tracking the birds marked by individual banders requires a considerable amount of coordination. To achieve this, the Pan American Shorebird Program (PASP) was created in the mid-1980s to define distinctive flag colours for each country in the Americas. This makes it easier to identify who banded a marked shorebird, and to connect banders with sightings (and observers) of their colour marked shorebirds. For the last six years, PASP has been coordinated from the Canadian Wildlife Service office in Saskatoon using a database created by G. Alaie of all known shorebird marking schemes in the Americas. In cooperation with the U.S. and Canadian banding offices, I coordinate the marking schemes of individual banders in Canada and the United States. Other countries coordinate their own marking schemes, and provide a contact for sightings of shorebirds marked in their country.

Not all banders use flags, but, when they are used, the flag indicates the country in which the bird was banded. The country of banding may be indicated by one flag colour (although two flags of the same colour may be used), or two (rarely, a single bi-coloured flag)[see sidebar].

If you see a colour-banded shorebird (with or without flags), describe it as accurately as possibly noting the following information:

- the species, location of sighting, date and other information (e.g., behaviour, other birds present);
- band type: metal, colour band, flag;
- colours: as exactly as possible - light green, dark blue; bi-coloured light green over dark blue;

Country flags:

Canada	White
United States	Dark Green
Venezuela	Black
Suriname	Light Green
Peru	Yellow
Brazil	Blue
Argentina	Orange
Chile	Red
Central America	Red over ...
Mexico	Red over Yellow
Honduras	Red over Grey
Costa Rica	Red over Black
Guatemala	Red over Orange
Nicaragua	Red over Dark Green
Belize	Red over Light Green
El Salvador	Red over Blue
Panama	Red over White
Caribbean Islands	Yellow over ...
Haiti	Yellow over Red
Puerto Rico	Yellow over Dark Green
Dominican Republic	Yellow over White
Northern South America	Light Green over ...
Colombia	Lt. Green over yellow
Ecuador	Lt. Green over Red
Guyana	Lt. Green over Dark Green
French Guiana	Lt. Green over Blue
Central South America	Orange over …
Bolivia	Orange over Red
Paraguay	Orange over Yellow
Uruguay	Orange over Blue

- band location on bird (bird's left or right leg, upper or lower leg, above or below other bands).

For example, red colour band upper left, dark green flag over orange colour band upper right, metal lower left. Please note if you are unsure of any bands or if you did not see all parts of both legs clearly.

Using our database, we will try to match your sighting to a bander and forward the information to them with instructions to provide you with more information about their project and the bird. Often this system works very well: reports of nesting Marbled Godwits banded in southern Alberta since 1995 have been received from Baja California, Mexico, and Humboldt Bay, San Francisco Bay, and Bodega Bay, all in California. Some of these reports have been from researchers studying other birds, but many others were sent in by birdwatchers. This has provided very valuable information on differences in migration routes and wintering areas between the sexes, consistency of site use by individuals from year to year, and separation of pairs during migration and winter. Semipalmated Sandpipers banded during the Quill Lakes shorebird migration study were reported (primarily by birdwatchers) in French Guyana, Guyana, Aruba, Cuba, Puerto Rico, Suriname, British Columbia, Alaska, North Dakota, New York, Tennessee, Maryland, South Carolina, North Carolina, Virginia, Saskatchewan, Ontario, New Brunswick, and Nova Scotia. These reports revealed that most Semipalmated Sandpipers migrating through Saskatchewan in spring breed in the central arctic and migrate south through the Bay of Fundy. The same species captured during fall migration in Saskatchewan breed in the western arctic and migrate south through the interior of North America. These migration patterns would not have been discovered without sightings from birders.

Not all observations, however, can be traced to the bander. Possible reasons include: lost, or discoloured, colour bands (even small Semipalmated Sandpipers can live until 15 years of age and Marbled Godwits to 30 years - beyond the life of colour bands); incomplete or incorrect band combination reported (wrong colour, wrong leg, missed bands, did not note upper or lower leg, did not differentiate colour bands from flags); reported combination attributable to several different banders (most common for non-flagged small birds, or birds banded many years ago). So be as complete as possible, and be patient — some of those observations you send in will provide information useful for the conservation of shorebirds!

Send information on banded shorebirds by email, fax or mail to:

Dr. C.L. Gratto-Trevor, PASP, Canadian Wildlife Service,115 Perimeter Road, Saskatoon, SK S7N 0X4 Canada, fax (306) 975-4089, email: cheri.gratto-trevor@ec.gc.ca

Shorebird Conservation in Canada

Garry Donaldson, CWS National Office, Hull, QC K1A 0H3, Garry.Donaldson@ec.gc.ca

Thanks to the recent efforts of a number of individuals from government and non-government organizations, Canada's shorebirds now have an organized effort to ensure their continued conservation.

Work on protecting Canada's shorebirds began in September 1998 when the Canadian Shorebird Conservation Plan (CSCP) was initiated with the establishment of multi-stakeholder steering and technical working groups. Their initial task was to create a framework document to outline issues facing Canada's shorebirds and recommended actions to conserve them.

Several areas of concern were motivating factors in establishing the plan. Canada's responsibility for the shorebirds of the Western Hemisphere is notable. Many species have more than half of their breeding range in Canada, and 15 arctic-nesting species have over 80% of their breeding range within our borders. Canadian wetlands and coastlines also provide critical migration stopover areas as well as winter habitat that both require protection. Declining numbers are additional cause for concern. Of 45 shorebird species for which trend estimates are available in Canada, two-thirds are thought to be in decline in at least some part of their range. Other concerns stem from human-based impacts such as wetland drainage for agriculture and development, exposure to pollution, and disturbance on nesting grounds. Unless we address these concerns, shorebirds will continue to be at risk.

The CSCP addresses issues on a hemispheric scale in recognition of the highly migratory nature of shorebirds. This follows the early lead of the Western Hemisphere Shorebird Reserve Network (WHSRN), established in 1985. WHSRN has resulted in a network of key shorebird sites but also provides a network of the people, policies, and programs supporting shorebird conservation. The CSCP will use WHSRN's framework for collaboration and communication among shorebird conservationists throughout the hemisphere.

Its international focus will be strengthened through it's role as a component of the North American Bird Conservation Initiative (NABCI). This venture to integrate bird conservation planning and action is being developed by government and non-government partners from Canada, the USA, and Mexico. While remaining autonomous, CSCP conservation priorities will be integrated with those for waterfowl, landbirds, seabirds and colonial waterbirds under NABCI. This will provide a forum to achieve greater efficiency in bird conservation.

The vision of the CSCP is that *healthy populations of shorebirds are distributed across their range and diversity of habitats in Canada and throughout their global range.* The Plan has five goals that are designed to fulfill needs for research, monitoring, and evaluation as well as habitat conservation, communication, and international linkages. Those goals are:

1. Sustain the diversity and abundance of shorebird populations within Canada and restore populations of declining and threatened species.

2. Secure and enhance sufficient high quality habitat to support healthy populations of shorebirds throughout their ranges in Canada.

3. Ensure that information on shorebird conservation needs and practices is widely available to decision makers, land managers and the public.

4. Ensure that coordinated conservation efforts are in place, on the ground, throughout the range of Canadian shorebird species.

5. Ensure that shorebird conservation efforts are guided by common principals throughout the Western Hemisphere.

Implementation of strategies aimed at achieving these goals will be overseen by a CSCP Management Board to be made up of members from a variety of interest groups. A Technical Advisory Committee, made up of experts drawn from government, conservation organizations, universities and museums, is in place and will ensure that all shorebird conservation actions are based on a foundation of sound science.

By June 1999, the CSCP steering committee had approved the text in the plan framework document. As a national plan, the CSCP identifies shorebird conservation concerns in a nationwide context but recognizes that the most effective way to carry out conservation efforts is at a regional or local scale. Thus, the next step is to prepare and implement regional plans that outline, in greater detail, the work to be done to meet the goals of the national plan. To date, there has been considerable progress in the development of these regional plans.

Atlantic Canada serves as one of the most important fall migration routes and stop-over areas for shorebirds in North America, with about 5 million southbound adult and juvenile birds pausing there to refuel during migration. A major theme for the conservation of both migrating and breeding shorebirds in this region will be an emphasis on the preservation of adequate high-quality and undisturbed habitat at a diversity of sites. The Atlantic Canada Shorebird Conservation Plan, also recognizes the importance of population monitoring, research into biological unknowns, and communication of important information with a variety of audiences.

CSCP
Canadian
Shorebird Conservation
Plan

Conservation actions are already underway such as major initiatives to conserve important habitats in the Upper Bay of Fundy with the cooperation of the North American Waterfowl Management Plan's (NAWMP) Eastern Habitat Joint Venture partners.

Of the 47 shorebird species that are included in the CSCP, 34 are regularly found in Quebec. A thorough analysis of available survey data from *Étude des populations d'oiseaux du Québec* checklists was the first step towards setting conservation priorities in a draft Quebec Shorebird Conservation Plan. Priority issues for Quebec shorebirds include an assessment of important staging sites, and a review of threats to shorebirds that occur in Quebec. Degradation of habitats at important shorebird sites is also a concern, such as the Sainte-Anne-de-Portneuf sandbar that may be affected by hydroelectric development on the Portneuf River, and the Havre-aux-Basques lagoon that may be opened to tidal water.

The Great Lakes, James Bay, and many interior habitats are used by a number of shorebird species in Ontario. Information is lacking on many of these birds and will be addressed by the Ontario Shorebird Conservation Plan. A committee made up of representatives from the Canadian Wildlife Service, Ontario Field Ornithologists, Bird Studies Canada, Ducks Unlimited Canada and the Ontario Ministry of Natural Resources is currently developing this plan.

The prairie provinces make up a very important area for shorebirds in Canada. More than half of the species that breed in Canada are found here, including eight whose breeding range in Canada is primarily or entirely in the prairies. The Prairie Canada Shorebird Conservation Plan identifies three key focal areas: population monitoring, research needs, and habitat management. In each of these areas, priorities have been assigned to breeding and migrant birds in three major habitat types: prairie, boreal forest and coastal regions along Hudson Bay. Among the high priority actions identified for population monitoring is an assessment of the accuracy of monitoring schemes for prairie shorebirds. Implementation will occur through existing projects and through new projects established in cooperation with NAWMP's Prairie Habitat Joint Venture partners and the CSCP Management Board.

Habitat in western Canada is important for a wide variety of breeding and migrating shorebirds. Partners from NAWMP's Pacific Coast Joint Venture are working with others to draft the Pacific and Yukon Shorebird Management Plan that will address the needs of shorebirds in British Columbia and the Yukon. Because political boundaries are irrelevant to the movements of shorebirds, this plan will be linked to the North Pacific Planning Unit of the U.S. Shorebird Conservation Plan. Conservation in the Pacific and Yukon Region will encompass a wide variety of habitats including open ocean, coastal lowlands, rocky shorelines, interior freshwater wetlands, grasslands, montane wetlands, alpine tundra and arctic tundra.

Shorebird conservation in the Northwest Territories and Nunavut will be combined with landbirds into one conservation plan. In anticipation of coherence with conservation systems promoted through NABCI, priorities have been identified by Bird Conservation Region. Bird conservation action will be integrated in each of the major habitat types found in the two territories through this approach.

As regional plans are further implemented, the effectiveness of the CSCP will need to be assessed. Achievements will be measured against the plan's goals to ensure that effective conservation is occurring, and, if needed, better direct conservation resources and actions towards meeting those goals.

Menu of volunteer-based ornithological programs in Canada

This list includes only projects that document species abundance and population trends. For a more complete listing of programs that monitor landbirds, you may obtain a copy of the *Canadian Landbird Monitoring Strategy* from: Connie Downes, Migratory Bird Populations Division, National Wildlife Research Centre, Environment Canada, Ottawa K1A 0H3; 819-953-1425 tel; 819-953-6612 fax; Connie.Downes@ec.gc.ca.

Distributional Studies

Bird banding

Bird Banding Office,
National Wildlife Research Centre,
Canadian Wildlife Service,
Ottawa, ON K1A 0H3
tel (819) 997-4213, fax (819) 953-6612
email: Lucie.Metras@ec.gc.ca
http://www.cws-scf.ec.gc.ca/nwrc/bbo/index.html

Studies of Abundance and Population Trends

Breeding Bird Survey (BBS)

Migratory Bird Populations Division,
Canadian Wildlife Service,
National Wildlife Research Centre,
Hull, PQ K1A 0H3
tel (819) 953-1425, fax (819) 953-6612
email: Connie.Downes@ec.gc.ca
http://www.cws-scf.ec.gc.ca/nwrc/bbs.htm

Canadian Lakes Loon Survey (CLLS)

Kathy Jones
Bird Studies Canada
P.O. Box 160
Port Rowan, ON N0E 1M0
tel (519) 586-3531, fax (519) 586-3532
email: aqsurvey@bsc-eoc.org
http://www.bsc-eoc.org/cllsmain.html

Checklist programs

Alberta Bird Survey Checklist
Federation of Alberta Naturalists
Box 1472
Edmonton, AB T5J 2N5
tel (780) 453-8629
info@fanweb.ca
http://www.fanweb.ca/

NWT/Nunavut Bird Checklist Survey
Craig Machtans, CWS
Suite 301, 5204-50th Ave.
Yellowknife, NT X1A 1E2
tel (867) 669-4771, fax (867) 873-8185
email: Craig.Machtans@ec.gc.ca
http://www.NWTChecklist.com

Étude des Populations d'Oiseaux du Québec (ÉPOQ)
Jacques Larivée
ÉPOQ
194 Ouellet
Rimouski, PQ G5L 4R5
tel (418) 723-1880
email: jacques.larive@cgocable.ca
http://www.oiseauxqc.org/epoq.html
(French only)

Christmas Bird Counts (CBC)

Contact your local naturalist club for the name of the CBC coordinator in your area, or write:

Geoff LeBaron
National Audubon Society
700 Broadway
New York, NY 10003
tel (212) 979-3000
email: glebaron@audubon.org
http://birdsource.cornell.edu/cbc/

Forest Bird Monitoring Program (FBMP)

Canadian Wildlife Service
49 Camelot Drive
Nepean, ON K1A 0H3
tel (613) 941-5913, fax (613) 952-9027
email: FBMP@ec.gc.ca
http://www.on.ec.gc.ca/wild-life/wild-watchers/watchers99-e.html#fbmp

BC Coastal Waterbird Surveys

Stephanie Hazlitt, Bird Studies Canada
5421 Robertson Road, R.R. # 1
Delta, BC V4K 3N2
tel 604-940-4696 fax 604-946-7022
1-877-349-2473 (toll free)
email: waterbirds@ec.gc.ca

Hawk counts

Hawk Migration Association of North America
Mark Blauer (Membership)
164 1/2 Washington St.
Carbondale, PA 18407-24
email: 6595@email.msn.com, *or*

William Barnard (Chair)
Norwich University Biology Department
Northfield, VT 05663
barnard@norwich.edu
http://www.hmana.org

Hawkwatches

(i) Ontario**:**

Bruce Peninsula
Mark Wiercinski
Box 9
Heathcote, ON N0H 1N0
tel (519) 599-3322

Greater Toronto Raptor Watch (Sept.1-Dec.)
(Cranberry Marsh / High Park)
John Barker
27 Horizon Crescent,
Scarborough, ON M1T 2G2
tel (416) 291-1598

Hawk Cliff (Sept.1 - Nov.30)
Su Ross
483 George Street
Port Stanley, ON N5L 1H1
tel (519) 782-4152

Holiday Beach (Sept.1 - Nov.30).
Bob Pettit, President
23393 Meadows Avenue
Flat Rock, MI 48134, USA
tel (313) 379-4558

or Hank Hunt, Canadian Vice-President
tel (519) 948-7015

Niagara Peninsula (March 1 - May 15).
Mike Street
73 Hatton Drive
Ancaster, ON L9G 2H5
tel (905) 648-3737 (evenings)

(ii) Alberta**:**

Calgary Hawkwatch
Wayne Smith
8220 Elbow Drive
Calgary, AB T2V 1K4
tel (403) 255-0052

Alberta Hawkwatch
Peter Sherrington
Eagle Monitoring
R.R. 2
Cochrane, AB T0L 0W0
tel (403) 932-5183

Manitoba Breeding Bird Atlas

Manitoba Naturalists' Society
401-63 Albert Street,
Winnipeg, MB R3B 1G4
tel (204) 943-9029
email: mns@escape.ca
http://www.mbnet.mb.ca/mns/

Maritimes Shorebird Survey

Peter Hicklin
Canadian Wildlife Service, Atlantic Region
P.O. Box 6227
Sackville, NB E4L 1G6
tel (506) 364-5042, fax (506) 364-5062,
email: Peter.Hicklin@ec.gc.ca

Marsh Monitoring Program

Bird Studies Canada
P.O. Box 160
Port Rowan, ON N0E 1M0
tel (519) 586-3531, fax (519) 586-3532
email: aqsurvey@bsc-eoc.org
http://www.bsc-eoc.org/mmpmain.html

Migration Monitoring Program (MMP)

Bird Studies Canada
P.O. Box 160
Port Rowan, ON N0E 1M0
tel (519) 586-3531, fax (519) 586-3532
email: generalinfo@bsc-eoc.org
http://www.bsc-eoc.org/national/cmmn.html

Migration Monitoring/Banding Stations:

Rocky Point
David Allinson
3472 Sunheights Drive,
Victoria, BC V9C 3P7
(250) 480_9433 (W); 250-478-0493 (H)
email: goshawk@pacificcoast.net
http://www.islandnet.com/~rpbo/

Vaseux Lake
Wendy Easton, CWS
R.R. 1 Delta, 5421 Robertson Rd.
Vancouver, BC V4K 3N2
tel (604) 940-4673, fax (604) 946-7022
email: Wendy.Easton@ec.gc.ca

Mackenzie Nature Observatory
Vi Lambie or Cheryl Freeman
c/o MacKenzie Nature Observatory
P.O. Box 1598
Mackenzie, BC V0J 2C0
tel Vi (250) 997-6876(H)
email: lambie@uniserve.com *or*
tel Cheryl (250) 997-6927 (H)
email:peeka@uniserve.com

Lesser Slave Lake Bird Observatory
P.O. Box 1076
Slave Lake, AB T0G 2A0
tel (780) 849-7117, cell: (780)805-1355
fax (780) 849-7122
email: birds@lslbo.org
http://www.lslbo.org

Beaverhill Bird Observatory
Jason Duxbury
Beaverhill Bird Observatory
P.O. Box 1418
Edmonton, AB T5J 2N5
tel (780) 430-1694 (H)
email: jduxbury@gpu.srv.ualberta.ca
http://www.ualberta.ca/~jduxbury/BBO/bbopage.htm

Inglewood Bird Sanctuary
Doug Collister
3426 Lane Cr. SW
Calgary, AB T3E 5X2
tel (403) 240-1635 (H); (403) 246-2697 (W)
fax (403) 246-2697, email: collis@telusplanet.net

Last Mountain Bird Observatory
Al Smith, Canadian Wildlife Service
Prairie & Northern Region
115 Perimeter Rd.
Saskatoon, SK S7N 0X4
tel (306) 975-4091 (W); fax (306) 975-4089
email: Alan.Smith@ec.gc.ca
http://www.unibase.com/~naturesk/lmbo.htm

Delta Marsh Bird Observatory
Heidi den Haan
R.R. 1, Box 1
Portage la Prairie, MB R1N 3A1
tel (204) 239-4287; fax (204) 239-5950
email: hdenhaan@dmbo.org
http://www.dmbo.org

Thunder Cape Bird Observatory
Nick Escott
133 South Hill St..
Thunder Bay, ON P7B 3T9
tel (807) 345-7122 (H)
email: escott@norlink.net
http://tbfn.baynet.net/TCBOtbfn.htm

Whitefish Point Bird Observatory
Jeanette Morss, WPBO
16914 N. Whitefish Point Rd.
Paradise, MI 49768
tel (906) 492-3596; fax (906) 492-3954
email: warbler@jamadots.com
http://www.wpbo.org

Long Point Bird Observatory
Kathryn Warner, Landbird Programs Coordinator
Bird Studies Canada
P.O. Box 160
Port Rowan, ON N0E 1M0
tel (519) 586-3531, fax (519) 586-3532
email: lpbo@bsc-eoc.org
www.bsc-eoc.org/lpbovol.html

Haldimand Bird Observatory
John Miles
tel (519) 587-5223 (H), email: miles@kwic.com
http://www.geocities.com/haldimandbirdobservatory

Toronto Bird Observatory
Lori Nichols
Box 439, 253 College St.,
Toronto, ON M5T 1R5
tel 416-604-8843 (H)
email: nkhsin@netrover.com.

Prince Edward Point Bird Observatory
Eric Machell
P.O. Box 2
Delhi, ON N4B 2W8
tel (519) 582-4738 (H)
email: elmachell@iname.com
http://home.interhop.net/~peptbo

Innis Point Bird Observatory
Bill Petrie (chair) *or* Bill Murphy
P.O. Box 72137, North Kanata Station
Ottawa, ON K2K 2P4.
tel (613) 820-8434 (H); (613) 996-6783 (H)
email:wfpetrie@magi.com *or* murphy.bill@fin.gc.ca
http://www.magi.com/~wfpetrie/IPBO.html

Tadoussac
Jacques Ibarzabal
1824 Sainte-Famille
Jonquiere, QC G7X 4Y3
tel (418) 542-2560 (H)
email: jhawk.ibarzabal@sympatico.ca

Fundy Bird Observatory
Brian Dalzell
62 Bancroft Point
Castalia, NB E5G 3C9
tel (506) 662-8650 (H), fax (506) 662-9804
email: dalzell@nbnet.nb.ca
http://personal.nbnet.nb.ca/gmwhale/seabirds.htm

Point Lepreau
Jim Wilson
Saint John Naturalists' Club
2 Neck Rd.
Quispamsis, NB E2G 1L3
tel (506) 847-4506 (H); fax 506) 849-0234
email: jgw@nbnet.nb.ca

Brier Island
Lance Laviolette
R.R. 1
Glen Robertson, ON K0B 1H0
tel (613) 874-2449 (H)
(514) 340-8310 ext. 7642 (W)
email: lance.laviolette@lmco.com

Atlantic Bird Observatory
Phil Taylor or Trina Fitzgerald
Dept.of Biology, Acadia University
Wolfville, NS B0P 1X0
tel (902) 585-1313 (W); fax (902) 585-1059
email: ABO@acadiau.ca
http://landscape.acadiau.ca/acwern/field/FIELD-AU.html

Gros Morne National Park Migration Monitoring Station
Stephen Flemming, Gros Morne National Park
P.O. Box 130
Rocky Harbour, NF A0K 4N0
tel (709) 458-2417; fax (709) 458-2059
email: stephen_flemming@pch.gc.ca

Monitoring Avian Productivity and Survivorship (MAPS)

Standardized constant-effort bird-banding to estimate population size and productivity. Banding permit required. Continent-wide, but limited coverage. Contact your local banding group, or:

Lucie Métras
Bird Banding Office
National Wildlife Research Centre
Canadian Wildlife Service
Ottawa, ON K1A 0H3
tel (819) 997-4213, fax (819) 953-6612
email: Lucie.Metras@ec.gc.ca

Institute for Bird Populations
P.O. Box 1346
Point Reyes Station, CA 94956
tel (415) 663-1436; fax (415) 663-9482
email: ddesante@birdpop.org
http://www.birdpop.org/maps.htm

Project FeederWatch

Project FeederWatch
Coordinator Bird Studies Canada
P.O. Box 160
Port Rowan, ON N0E 1M0
tel (519) 586-3531, fax (519) 586-3532
email: pfw@bsc-eoc.org

Nest Record Schemes

Compilation of records from individual nests (habitat, clutch size, success, etc.).

British Columbia

Wayne Campbell
Ministry of Environment, Lands and Parks
P.O. Box 9374 Stn. Prov Govt
Victoria, BC V8T 5J9
tel (250) 356-1376
email: wcampbell@fwhdept.env.gov.bc.ca

Prairies

Manitoba Museum of Man and Nature
190 Rupert Avenue
Winnipeg, MB R3B 0N2
tel (204) 956-2830, fax (204) 942-3679
email: info@museummannature.mb.ca

Ontario

Centre for Biodiversity and Conservation Biology,
Northern Biodiversity, Royal Ontario Museum
100 Queen's Park Crescent
Toronto, ON M5S 2C6
tel (416) 586-8059; fax (416) 586-5863
email: cathy@rom.on.ca
http://www.rom.on.ca/biodiversity/cbcb/cbnorth.html

Quebec

Michel Gosselin
Vertebrate Collection
Canadin Museum of Nature
P.O. Box 3443, Station D
Ottawa, ON K1P 6P4
tel (613) 566-4291; fax (613) 364-4027
mgosselin@mus-nature.ca

Maritimes

A.J. (Tony) Erskine
CWS Atlantic Region
P.O. Box 6227
Sackville, NB E4L 1G6
tel (506) 364-5035
fax (506) 364-5062
email: Tony.Erskine@ec.gc.ca

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- feedback to volunteers of ornithological surveys;
- information on trends in Canadian bird populations;
- a menu of volunteer-based ornithological projects in Canada.

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Canadian Wildlife Service, Ottawa, Ontario K1A 0H3, tel (819) 953-4390, fax (819) 994-4445, email: Judith.Kennedy@ec.gc.ca

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Canada

Environment Canada | Environnement Canada
Canadian Wildlife Service | Service canadien de la faune

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