Declines in North American shorebird populations

R. I. Guy Morrison, Yves Aubry, Rob W. Butler, Gerry W. Beyersbergen, Garry M. Donaldson, Cheri L. Gratto-Trevor, Peter W. Hicklin, Vicky H. Johnston, & R. Ken Ross

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Recent updates of trend analyses of shorebird populations in various parts of Canada and the USA indicate that many species are declining. Of 35 species for which analyses are available, 28 (80%) show negative trend values, with 19 showing statistically significant or persistent declines and only one showing a significant increase. Shorebirds face many potential threats during their annual cycles, and these alarming results underline the urgent need for conservation measures for this group of birds, as well as for research to identify the major causes of the declines.

R. I. Guy Morrison, Canadian Wildlife Service (CWS), National Wildlife Research Centre, 100 Gamelin Boulevard, Hull, QC, Canada K1A 0H3, Guy.Morrison@ec.gc.ca (address for correspondence).
Yves Aubry, CWS Quebec Region, Ste.-Foy, QC, Canada G1V 4H5.
Rob W. Butler, CWS Pacific and Yukon Region, Delta, BC, Canada V4K 3N2.
Gerry W. Beyersbergen, CWS Prairie and Northern Region, Edmonton, AB, Canada T6B 2X3.
Garry M. Donaldson, CWS Headquarters, Hull, QC, Canada K1A 0H3.
Cheri L. Gratto-Trevor, Prairie and Northern Region, Saskatoon, SK, Canada S7N 0X4.
Peter W. Hicklin, CWS Atlantic Region, Sackville, NB, Canada E4L 1G6.
Vicky H. Johnston, CWS Prairie and Northern Region, Yellowknife, NU, Canada X1A 1E2.
R. Ken Ross, CWS Ontario Region, Nepean, ON, Canada K1A 0H3.

INTRODUCTION

The Canadian and US Shorebird Conservation Plans have both pointed out that populations of many species of shorebirds in North America appear to be declining (Hyslop *et al.* 2000, Brown *et al.* 2000). Many of the major analyses on which these conclusions are based used data extending only up to the early 1990s (Howe *et al.* 1989, Morrison *et al.* 1994, Harrington 1995). This paper presents the results of recent updates of shorebird trend analyses carried out by members of the Canadian Wildlife Service Shorebird Committee, as well as other selected analyses. Declines in shorebird populations appear to be even more extensive and severe than previously thought, emphasizing the urgent need for conservation measures for this group of birds in the Western Hemisphere.

METHODS AND ANALYSES

Regions of Canada/North America for which updated or new analyses are available, periods of coverage and analyses used are shown in Table 1. Trend analyses of volunteer survey program data from the east coast of Canada (Maritimes Shorebird Surveys) and Ontario (Ontario Shorebird Surveys), as well as Breeding Bird Survey data (Sauer *et al.* 2000) were analyzed using estimating equations/ route regression methods. Checklist data from the Étude des populations d'oiseaux du Québec and count data from the Pacific coast of Canada were analyzed using regression methods. Survey plot data from different periods were used for comparison at the Arctic sites. Analyses from International Shorebird Survey data from the east coast of the USA (Howe *et al.* 1989) are also included.

RESULTS

Analyses of survey data from eastern Canada (Maritime Provinces, Quebec, Ontario) all showed statistically significant disproportionate numbers of species with negative trends compared to a null hypothesis that equal numbers of positive and negative trend values would be found if populations were undergoing random fluctuations (Table 1). Furthermore, all statistically significant trends from this region were negative. A similar situation was found in analyses of Breeding Bird Survey data, where disproportionate numbers of negative trends occurred. In addition, a comparison of numbers of shorebirds on plots on the Rasmussen Lowlands between the mid 1970s and mid 1990s, where trends were all negative and three species had declined significantly

Table 1. Summary of recently updated and other selected trend analyses of shorebird populations in North America. See text for methods and references.

	Maritime Provinces Canada 1974-1998 Annual % e change	Quebec 1976-1998 Pearson coefficient	Ontario 1976-1997 Annual % change	Breeding Bird Survey 1966-1999 Annual % change	Arctic Rasmussen Lowlands` 1970s - 1990s	Arctic Churchill 1983-1993	Pacific coast Canada 1991-1998	East coast USA 1974-1982 Annual % change	Overall assessment
Black-bellied Plover *Pluvialis squatarola*	+0.366	-0.228	+4.33		↓↓ - *			**-5.4 ***	↓↓
American Golden-Plover *Pl. dominicus*	-50.4	-0.143			↓↓ - *				↓↓
Semipalmated Plover *Charadrius semipalmatus*	-1.55	**-0.504 ***	-1.97					-9.5	↓↓
Killdeer *Ch. vociferus*		**-0.777 ***	-2.23	**-0.3 ***					↓↓
Mountain Plover *Ch. montanus*				-0.9					(-)
Black-necked Stilt *Himantopus mexicanus*				+0.6					(+)
American Avocet *Recurvirostra americana*				-0.2					(-)
Greater Yellowlegs *Tringa melanoleuca*		+0.017	-7.65	+12.8				-3.1	↔
Lesser Yellowlegs *T flavipes*		-0.091	*-7.13*	**-8.2 ***				+3.5	↓↓
Solitary Sandpiper *T solitaria*		-0.177	-1.61	*-10.2*					↓
Willet *Catoptrophorus semipalmatus*	-0.099			-0.6				+0.2	↔
Spotted Sandpiper *Actitis macularia*	-3.06	**-0.480 ***	-2.25	-0.5					↓↓
Upland Sandpiper *Bartramia longicauda*		-0.090		**+1.0 ****					↑
Whimbrel *Numenius phaeopus*	+4.37	+0.311						**-8.3 ****	↔
Long-billed Curlew *N. americana*				*-1.5*					(-)
Hudsonian Godwit *Limosa haemastica*	-4.83	-0.087							↓
Marbled Godwit *L. fedoa*				-0.5					↓
Ruddy Turnstone *Arenaria interpres*	**-3.28 ***	**-0.648 ***						-8.5	↓↓
Red Knot *Calidris canutus*	**-17.6 ***	**-0.543 ***						-11.7	↓↓
Sanderling *C.alba*	**-7.78 (*)**	**-0.399 (*)**	-1.25					**-13.7 ****	↓↓
Semipalmated Sandpiper *C pusilla*	**-7.66 ***	**-0.667 ***	**-4.97 ***		-	↓	↓↓	-6.7	↓↓
Western Sandpiper *C. mauri*							↓↓		↓↓
Least Sandpiper *Calidris minutilla*	**-15.8 ****	-0.007	*-4.19*					+2.9	↓↓
White-rumped Sandpiper *Calidris fuscicollis*	-10.9	+0.031			↓ -				↔
Baird's Sandpiper *C. bairdii*					-				↓
Pectoral Sandpiper *C. melanotos*	+2.54	+0.043	*-8.34*		-				↔
Purple Sandpiper *C maritima*		**-0.531 ***							↓↓
Dunlin *Calidris alpina*	**-7.17 (*)**	-0.335	+1.42		-				↓↓
Buff-breasted Sandpiper *Tryngites subruficollis*					-				↓
Short-billed Dowitcher *Limnodromus griseus*	**-9.26 ***	-0.065	-6.35					**-5.5 ***	↓↓
Common Snipe *Gallinago gallinago*		**-0.602 ***	**-15.3 (*)**	0.00					↓↓
American Woodcock *Scolopax minor*				-2.3					↓
Wilson's Phalarope *Phalaropus tricolor*		-0.040		**-2.2 ***					↓↓
Red-necked Phalarope		**-0.566 ***				↓			↓↓

Table 1 continued See text for methods and references.

	Maritime Provinces Canada 1974-1998 Annual % e change	Quebec 1976-1998 Pearson coefficient	Ontario 1976-1997 Annual % change	Breeding Bird Survey 1966-1999 Annual % change	Arctic Rasmussen Lowlands` 1970s - 1990s	Arctic Churchill 1983-1993	Pacific coast Canada 1991-1998	East coast USA 1974-1982 Annual % change	Overall assessment
Phalaropus lobatus									
Red Phalarope		-0.337			↓↓ - *				↓↓
Phalaropus fulicaria									
Total species	16	25	14	15	9			12	31 (35)
No species negative	13	21	12	11	9			9	25 (28)
No species positive	3	4	2	3	0			3	6 (7)
c^2 test, significance (p=0 0004)	p=0.01	p=0.0006	p=0.008	p=0.03	p=0.003			p=0.08	p=0.0006
No. sig, negative trends	7	10	1	3	3		2	4	19
No. sig, positive trends	0	0	0	1	0			0	1

Statistically significant trends or changes are indicated in **bold**, with **=p<0.01, *=p<0.05, (*)=p<0.10; numbers in italics indicate p<=0.15. In columns where no numerical estimate is shown, "-" indicates a negative change, ↓ indicates a large but not statistically significant (or not statistically tested) negative change, and ↓↓ indicates a statistically significant (p<0.05) negative change. For the "Overall assessment" column, ↓↓ indicates predominantly negative trends or changes across analyses with at least one significantly negative trend or change, ↓ indicates predominantly negative trends or changes or only estimate available is negative, ↔ indicates analyses include both positive and negative trends, ↑ indicates best estimate involves significant positive trend. Trends for species occurring predominantly in the USA derived from BBS data only are shown in brackets; summary totals including these species are also shown in brackets. "No. species positive" includes both positive ↑ and mixed ↔ trend estimates.

(Gratto-Trevor *et al.* 1998, Johnston *et al.* 2000). Gratto-Trevor (1994) noted strong decreases in two species of shorebirds at Churchill, results confirmed by the observations of Lin and Jehl (W. Lin and J. Jehl; pers. comm.). Analyses of counts of the on estuaries in British Columbia showed a statistically significant negative trend (R. W. Butler unpubl data) .

Overall, of the 35 species of shorebirds covered by the analyses in Table 1, 28 (80%) were negative: this included 19 species with statistically significant or persistent negative trends and only one with a positive trend.

DISCUSSION

The updated analyses indicate that declines in shorebird populations may be much more widespread and pervasive than previously thought. The pattern of declines, both in terms of statistically significant results and in terms of disproportionate numbers of negative values, appears consistent across data collected in all parts of the continent. The shorebird populations concerned involve birds from many different breeding areas. Analyses of shorebird counts from eastern Canada, for instance, involve mostly breeders from eastern and central Arctic and boreal regions, while species covered by the Breeding Bird Surveys involve temperate and boreal breeders from many parts of the USA and Canada, including interior regions. To these may now be added species occurring on the west coast of Canada, whose breeding origins are from western Alaska and western Canada. Declines have also been detected on Arctic breeding grounds.

Many declines appear to be ongoing and consistent. Species such as the Semipalmated Sandpiper have shown significant declines in almost all major analyses that have been conducted. The Short-billed Dowitcher, a boreal breeding species, has shown consistent declines in eastern North America. Other species for which negative trends were previously high but not statistically significant, such as the Red Knot, have now become statistically significant. Arctic breeding species such as the Sanderling and Ruddy Turnstone and west coast Least Sandpiper also show consistent declines. A major conservation concern exists for the Red-necked Phalarope, which has essentially disappeared from areas where it was once extremely numerous in the Bay of Fundy (Morrison *et al.* 1995; Duncan, 1997).

While the suitability of the different survey methods may be debated in terms of applicability for different species (particularly Breeding Bird Survey analyses), the consistency of the results over wide geographical areas involving a variety of data-collection methods and different analytical methods all point to widespread declines and are highly unlikely to occur at random. Inconsistent results for some species will require more investigation: for instance, the declines observed for American Golden-Plovers on the Rasmussen Lowlands in the Arctic and in eastern Canada appear to contrast with results showing increases at Churchill (W. Lin and J. Jehl, pers. commun.) and a positive trend in long-term counts conducted on the Truelove Lowlands in the High Arctic (Pattie 1990).

No single obvious explanation appears to emerge for the widespread declines in shorebird populations, and it is likely that multiple factors may be involved in causing decreases in particular species or groups of species. Shorebirds are especially vulnerable to environmental degradation or change, in view of the life history characteristics of many species, which involve long migrations, concentration of major portions of the population at a restricted number of sites, and/or occupation of habitats that are often targets of industrial or recreational development (Myers *et al.* 1987, Piersma *et al.* 2000). Climate change, including effects on Arctic breeding sites and potential alterations in coastal areas as a result of sea-level changes, has the potential for causing major effects on shorebird populations. Global climate change may also lead to alterations in patterns of prevailing winds, which could affect patterns of upwelling and oceanic productivity, which appear to be highly influential in determining patterns of shorebird abundance and distribution (Butler *et al.* 2000). A severe series of cold summers was suggested as a possible correlate of widespread declines of shorebird populations in the 1970s (Morrison *et al.* 1994) and the effects of hydroelectric developments on boreal breeding grounds was suggested as a factor contributing to the decline of Short-billed Dowitchers (Maisonneuve 1990). Toxic chemicals and other contaminants are potential threats in some areas. The increasing abundance of predators such as the Peregrine Falcon *Falco peregrinus* to levels more approaching those of the past as a result of species recovery programs may also be affecting the distribution of shorebirds during migration and/or on the wintering grounds. Red Knots and several other species are thought to be potentially at risk during their northward migration from the effects of over-fishing of Horseshoe Crabs in Delaware Bay (Tsipoura and Burger 1999).

It is clear that a considerable amount of research will be needed to identify the causes of observed declines in shorebird numbers, and that a variety of factors will be involved. Shorebirds, along with grassland species and sea-ducks, appear to stand out as groups that are currently particularly at risk in North America and which are showing steady declines. The recently updated shorebird trend analyses underline the importance of taking action on conservation issues addressed in the Canadian and US Shorebird Conservation plans.

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REFERENCES

Brown, S., Hickey, C., & Harrington, B., eds. 2000. *The U.S. Shorebird Conservation Plan.* Manomet Center for Conservation Sciences, Manomet, MA.

Butler, R.W., Davidson, N.C. & Morrison, R.I.G. 2000. Global-scale shorebird distribution related to productivity of near-shore ocean waters. Submitted to *Waterbirds.*

Duncan, C. D. 1997. Phalaropes in the Bay of Fundy. *In:* Percy, J.A., P.G. Wells, & A.J. Evans (eds) (1997). *Bay of Fundy Issues: a Scientific Overview.* Workshop Proceedings, Wolfville, N.S., January 29 to February 1, 1996. Environment Canada. Atlantic Region Occasional Report No. 8, Environment Canada, Sackville, N.B., 191 pp.

Gratto-Trevor, C.L., V.H. Johnston, & S.T. Pepper. 1998. Changes in shorebird and eider abundance in the Rasmussen Lowlands, NWT. *Wilson Bull.* 110: 316-325.

Johnston, V.H., Gratto-Trevor, C.L. & Pepper, S.T. 2000. *Assessment of bird populations in the Rasmussen Lowlands.* Canadian Wildlife Service Occasional Paper No. 101. Canadian Wildlife Service, Ottawa.

Harrington, B. 1995. *Shorebirds: east of the 105th meridian.* Pp. 57-60, in Our Living Resources. U.S. Department of the Interior, National Biological Service, Washington, D.C.

Howe, M. A., Geissler, H., & Harrington, B. A. 1989. Population trends of North American shorebirds based on the International Shorebird Survey. *Biological Conservation* 49: 185-199.

Hyslop, C., Morrison, R. I. G., Donaldson, G., & Davidson, I. 2000. *The Canadian Shorebird Conservation Plan.* Canadian Wildlife Service Special Publication. Canadian Wildlife Service, Ottawa.

Maisonneuve, C. 1993. Is population decline in Short-billed Dowitchers, *Limnodromus griseus*, related to hydroelectric projects? *Canadian Field-Naturalist* 107: 253-255.

Morrison, R. I. G., Butler, R. W., Beyersbergen, G. W., Dickson, H. L., Bourget, A., Hicklin, P. W., Goosen, J. P., Ross, R. K., & Trevor-Gratto, C. L. 1995. *Potential Western Hemisphere Shorebird Reserve Network sites for shorebirds in Canada: Second Edition 1995.* Canadian Wildlife Service Technical Report Series. Canadian Wildlife Service, Headquarters, Ottawa.

Morrison, R. I. G., Downes, C., and Collins, B. 1994. Population trends of shorebirds on fall migration in eastern Canada 1974-1991. *Wilson Bull.* 106: 431-447.

Myers, J.P., Morrison, R.I.G., Antas, P.Z., Harrington, B.A., Lovejoy, T.E., Sallaberry, M., Senner, S.E and Tarak,

A. 1987. Conservation strategy for migratory species. *American Scientist* 75: 12-26.

Pattie, D. L. 1990. A 16-year record of summer birds on Truelove Lowland, Devon Island, Northwest Territories, Canada. *Arctic* 43: 275-283.

Piersma, T. & A. J. Baker. 2000. Life history characteristics and the conservation of migratory shorebirds. Pp. 105-124 IN: L. M. Gosling and W. J. Sutherland (eds). *Behaviour and Conservation.* Cambridge Univ. Press, Cambridge, UK.

Sauer, J. R., Hines, J. E., Thomas, I., Fallon, J., and Gough, G. 2000. *The North American Breeding Bird Survey, Results and Analysis 1966-1999.* Version 98.1. USGS Patuxent Wildlife Research Center, Laurel, MD. Internet address: http://www.mbr.nbs.gov/bbs/bbs.html.

Tsipoura, N. and Burger, J. 1999. Shorebird diet during spring migration stopover on Delaware Bay. *Condor* 101: 635-644.