

Analysis of Shorebird Population Trend Datasets

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Purpose and Methods

In an attempt to provide a more complete picture of trends in North American shorebird populations, I compiled analytical results from two broad surveys: the Christmas Bird Count (Butcher and Niven 2007) and Breeding Bird Survey (Sauer *et al.* 2008). I supplemented this with information on changes in shorebird numbers from more regional sources: International Shorebird Survey (Bart *et al.* 2007), Quebec checklist data (Audrey and Cotter 2001); Ontario Shorebird Survey (Ross *et al.* 2001); Rasmussen Lowlands, Canada (Johnston *et al.* 2000); Devon Island, Canada (Pattie 1990); Churchill, Canada (and Prudhoe Bay, Alaska (Troy 1996)). These sources cover various decades.

Some details on the methods of the surveys, the time frames, and analytical approaches are presented in Table 1. Trend results from these surveys are presented, by species, in Table 2. For temperate breeding species, I used BBS data to determine population trends according to criteria in Table 3, and I used CBC data for those species that primarily wintered in the U.S. and Canada ($\geq 70\%$ of their winter range) and had little other available information. For the remaining datasets, I used a simple sign test to evaluate population trends and assigned a “1” to the dataset if the estimated parameter or statistic was negative and a “0” if the parameter or statistic was zero or positive. These scores were summed and assigned an overall trend using the following decision rules: 1) strong evidence of a decrease ($\geq 70\%$ decreasing), 2) stable (31-69% decreasing); or increasing ($\leq 30\%$ decreasing). Because of intensive management of the species or populations listed under the Endangered Species Act, I did not include them in the assessment. This approach generally follows the assessment in the Canadian Shorebird Plan (Donaldson *et al.* 2000) but includes additional datasets or updated information. Lastly, species-specific information was also consulted to confirm or adjust scores and comparisons to trend assessments in Morrison *et al.* (2006) are provided.

Results and Discussion

As with the assessment provided in the U.S. Shorebird Conservation Plan (Brown *et al.* 2001), many shorebird populations are declining or are unknown (52%). For those species where there was strong evidence for a decline or increase, significantly more species were declining (88%) than were increasing (12%; $P < 0.0001$; $n = 24$). Clearly, we still need to implement programs that determine the status of many shorebird species and reverse the trend of declining species. Information on population trends is best for temperate breeding species and those that migrate through eastern Canada and the U.S. However, many of the datasets consulted here are not contemporary.

Table 1. Description of datasets used in the analysis of shorebird population trends.

	Breeding Bird Survey (BBS)	Christmas Bird Count (CBC)	International/ Maritime Shorebird Survey (ISS)	ÉPOQ	Ontario (ONT)	Rasmussen Lowlands (RAS)	Churchill, Manitoba (CH)	Truelove Lowlands (DEV)	Prudhoe Bay (PB)
Reference	Sauer <i>et al.</i> 2008	Butcher and Niven 2007	Bart <i>et al.</i> 2007	Aubrey and Cotter 2001 <i>in</i> Donaldson <i>et al.</i> 2000	Ross <i>et al.</i> 2001	Gratto- Trevor <i>et al.</i> 1998	Jehl and Lin 2001	Pattie 1990	Troy 1996
Scale	Lower 48 states and southern Canada	mainly southern Canada and lower 48 states	eastern and midwestern US/Canada; analyzed separately	Saint Lawrence River Valley, Quebec	southern and eastern Ontario periodic counts at fixed non- randomly selected wetland sites	low-middle arctic, Northwest Territories	arctic-boreal interface, western Hudson Bay	Devon Island, Canada, mid- high arctic	low arctic, north-central Alaska
Type of survey	roadside point counts along fixed, randomly selected transects	multiple observer area searches at fixed, non- randomly selected sites	periodic counts at fixed non-randomly selected wetland sites	opportunistic checklist submissions	fall migration	area searches of stratified random selection of plots	comparison of historical info and work in 1997	multiple, fixed transects at a single fixed site	area searches of opportunistic plots
Season	breeding	winter	fall migration	fall migration	fall migration	breeding	breeding	breeding	breeding
Time frame	1966–2007	1966–2005	1974–1998	1976–1998	1974– 1997	1975/76– 1994/95	irregular, 1934–1997	1970–1989	1981–1991
Variable measured	total number of birds per route	total number of individuals in an area % change,	total counts of individuals at a site	annual % occurrence	total counts of individuals at a site % change,	density, population estimate for area	qualitative abundance assessment	total number of individuals	density of all individuals
Statistic	% change, route- regression	hierarchical Poisson models	% annual change, mean values	Pearson coefficients	route- regression approach	confidence interval inclusion	three-tier scale of increase or decrease	nonparametric change, Kendall's Tau	nonparametric change, Kendall's Tau

Table 2. Results from datasets on North American shorebird populations trends. Rates of annual change (%) are given for BBS and CBC if the significance of the estimates were $P \leq 0.1$; otherwise, like remaining datasets, “0” indicates a positive sign for the estimate or statistic and “1” indicates a negative sign. Descriptions of datasets and abbreviations are provided in Table 1. Bolded species indicate those that breed in temperate or boreal regions and are reasonably surveyed by the BBS, or those that primarily winter in regions covered by the CBC (>70% of their range). Endangered species or populations are also indicated.

Species	ISS		BBS	CBC	ÉPOQ	ONT	RAS	CH	DEV	PB	Sum	n	Prop. decline	
	Eastern	Midwest												
Black-bellied Plover	1	0		0		1	0	1	1		4	7	0.571	
American Golden-Plover	1	0				1		1	0	0	1	4	7	0.571
Pacific Golden-Plover				1							1	1	1.000	
Snowy Plover (non-ESA)				1							1	1	1.000	
Snowy Plover													ESA	
Wilson's Plover				1							1	1	1.000	
Common Ringed Plover												0		
Semipalmated Plover	0	0		0	1	1		1			3	6	0.500	
Piping Plover													ESA	
Killdeer			-0.6											
Mountain Plover			-2.7											
American Oystercatcher				+1.9										
Black Oystercatcher				+2.9										
Black-necked Stilt			+3.0											
American Avocet			1	0							1	2	0.500	
Hawaiian Stilt													ESA	
Greater Yellowlegs	1	0	0	0	0	1					2	6	0.333	
Lesser Yellowlegs			-9.5											
Solitary Sandpiper	1	1	1	0	1	1					5	6	0.833	
Willet			-0.9											
Wandering Tattler												0		
Spotted Sandpiper	1	0	1	0	1	1					4	6	0.667	
Upland Sandpiper	1	0	0		1						2	4	0.500	
Eskimo Curlew													ESA	

Species	ISS		BBS	CBC	ÉPOQ	ONT	RAS	CH	DEV	PB	Sum	n	Prop. decline
	Eastern	Midwest											
Whimbrel	1			1	0			1			3	4	0.750
Bristle-thighed Curlew												0	
Long-billed Curlew			1	1							2	2	1.000
Hudsonian Godwit	1	1			1			0			3	4	0.750
Bar-tailed Godwit												0	
Marbled Godwit			-0.9										
Ruddy Turnstone	0	1		0	1				0		2	5	0.400
Black Turnstone				1								0	
Surfbird												0	
Red Knot	1	0		1	1						3	4	0.750
Sanderling	1	0		1	1	1					4	5	0.800
Semipalmated Sandpiper	1	1			1	1	1	1		1	7	7	1.000
Western Sandpiper	0	1		1							2	3	0.667
Least Sandpiper	1	0			1	1		1			4	5	0.800
White-rumped Sandpiper	0	1			0		1		1		3	5	0.600
Baird's Sandpiper	0	1							0		1	3	0.333
Pectoral Sandpiper	1	0			0	1				0	2	5	0.400
Purple Sandpiper				1	1						2	2	1.000
Rock Sandpiper				1									
Dunlin	1	0		1	1	0	1	1		1	6	8	0.750
Stilt Sandpiper	1	0		0				1		0	2	5	0.400
Buff-breasted Sandpiper							1			1	2	2	1.000
Short-billed Dowitcher	0	0		0	1	1		0			2	6	0.333
Long-billed Dowitcher	1	0									1	2	0.500
Wilson's Snipe	1	0	1	1	1	1					5	6	0.833
Wilson's Phalarope	0	0	0		1						1	4	0.250
Red-necked Phalarope	0	1			0			1		0	2	5	0.400
Red Phalarope					1		1		1	0	3	4	0.750

Table 3. Decision rules used to assign scores to population trends from various shorebird datasets.

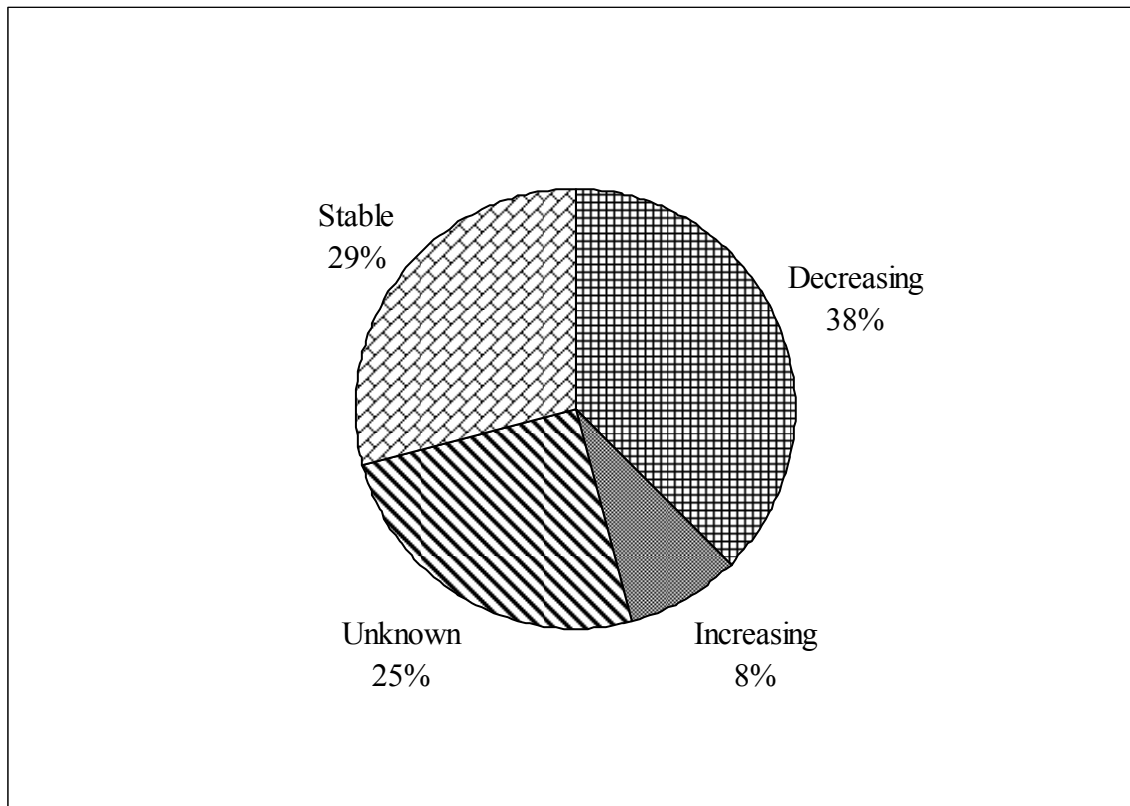
Description of evidence	BBS or CBC (% annual change)	% all datasets decreasing
Strong evidence of a decline (DEC)	more than a -0.54 decrease, $P \leq 0.1$	≥ 70
Apparently stable (STA)	-0.54 to +0.47, $P \leq 0.1$	31-69
Strong evidence of an increase (INC)	more than a +0.47 increase, $P \leq 0.1$	≤ 30
Unknown (UNK)	insignificant trend, $P > 0.1$	no information

Table 4. Assignment of shorebird population trends following rules in Table 3 and comparison to assessment in Morrison *et al.* 2006. Comments on information and assessment are also provided.

Species	This assessment	Morrison <i>et al.</i> (2006)	Comments/adjustments	
Black-bellied Plover	DEC	DEC	3 of 7 datasets had significant declines; no significant increases	
American Golden-Plover	STA	DEC		
Pacific Golden-Plover	UNK	DEC		
Snowy Plover	UNK	DEC		
Snowy Plover	ESA			
Wilson's Plover	UNK	STA		strong decline in CBC
Common Ringed Plover	UNK	STA?		
Semipalmated Plover	STA	STA?		
Piping Plover	ESA	STA	managed population segments	
Killdeer	DEC	DEC	increasing; slight decline in prairies	
Mountain Plover	DEC	DEC	also decline in CBC	
American Oystercatcher	INC	STA	strong increase in CBC	
Black Oystercatcher	INC	STA	strong increase in CBC	
Black-necked Stilt	INC	STA?	strong increases in CBC/BBS	
American Avocet	STA	STA	ns in BBS, significant trend in CBC	
Hawaiian Stilt	ESA			
Greater Yellowlegs	STA	STA?		
Lesser Yellowlegs	DEC	DEC	5 of 6 other datasets support decline ns in BBS	
Solitary Sandpiper	DEC	DEC		
Willet	DEC	STA?		
Wandering Tattler	UNK	STA	other datasets stable	
Spotted Sandpiper	STA	STA?	strong decline in CBC but small proportion of winter range	
Upland Sandpiper	STA	DEC	ns in BBS	
Eskimo Curlew	ESA	EXT?		
Whimbrel	DEC	DEC?		

Species	This assessment	Morrison <i>et al.</i> (2006)	Comments/adjustments
Bristle-thighed Curlew	UNK	STA?	
Long-billed Curlew	UNK	DEC	ns in BBS and CBC
Hudsonian Godwit	DEC	STA	
Bar-tailed Godwit	UNK	DEC	
Marbled Godwit	DEC	DEC	negative in ISS, ns in CBC
Ruddy Turnstone	STA	STA?	
Black Turnstone	UNK	STA?	
Surfbird	UNK	DEC	
Red Knot	DEC	DEC	other surveys - dramatic decline
Sanderling	DEC	DEC	
Semipalmated Sandpiper	DEC	DEC	
Western Sandpiper	STA	DEC?	
Least Sandpiper	DEC	DEC	
White-rumped Sandpiper	STA	DEC	
Baird's Sandpiper	STA	STA?	
Pectoral Sandpiper	STA	DEC	
Purple Sandpiper	DEC	STA?	strong decline in Quebec
Rock Sandpiper	UNK	STA?	negative in CBC but imprecise
Dunlin	DEC	DEC	
Stilt Sandpiper	STA	STA?	
Buff-breasted Sandpiper	DEC	DEC	decline also on Somerset Island
Short-billed Dowitcher	STA	STA?	
Long-billed Dowitcher	UNK	STA?	
Wilson's Snipe	DEC	DEC	
Wilson's Phalarope	INC	DEC	
Red-necked Phalarope	STA	DEC	
Red Phalarope	DEC	DEC	

Figure 1. Distribution of shorebird species with increasing, stable, decreasing, or unknown population trends.



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