On the decline: Analyses of both the Christmas Bird Count and Breeding Bird Survey show that the American Bittern *(Botaurus lentiginosus)* is significantly in decline. Illustration/John James Audubon

Using Christmas Bird Count Data to Assess Population Dynamics and Trends of Waterbirds

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■ ***The Audubon Christmas Bird Count is the oldest and largest citizen science program in the world.*** It began in 1900 when 27 individuals responded to an editorial in *Bird-Lore* magazine (Chapman 1900) requesting readers to spend an hour or two counting birds in their neighborhood on Christmas afternoon. Since then, the increase in both the number of counts and the number of participants has been dramatic. In 2004–2005, 56,623 individuals counted nearly 70 million birds at more than 2,000 different locations (LeBaron 2005). ■ ***Is it really science?*** The Christmas Bird Count (CBC) counts as a tremendous citizen science event, but the question has always been, is it really science? Scientists have answered that question by publishing dozens of papers in peer-reviewed journals based on CBC analysis. We believe, specifically, that the CBC provides valuable information on population dynamics and trends for hundreds of North American bird species that are frequently encountered on the CBC.

We are especially interested in CBCs done since 1965–66 for two major reasons. First, the U.S. Geological Survey's Breeding Bird Survey (BBS) started in 1965, and we are interested in comparing population trends and annual indices derived from CBC and BBS, especially for permanent resident species with a large portion of their range in the 48 contiguous United States and southern Canada, the areas that are best surveyed by both the BBS and CBC. Second, CBC methodology has been relatively stable since 1965–66, increasing the odds that population changes indicated by CBC data over the past 40 years would be due to actual population changes rather than changes in counting methods.

Our goal is to complete the analysis of population dynamics and trends for all species that have been encountered on 40 or more CBC circles in the past 40 years (and for even rarer species if the statistics suggest the analyses are valid). We want to compare BBS and CBC trends for all species encountered by both surveys for several reasons: 1) to be sure that the surveys are providing similar results when similar results should be expected (especially for resident species with most of their ranges in the contiguous states and southern Canada), 2) to determine which survey is most likely to provide the most useful data on population trends and dynamics, based primarily on percentage of the range and percentage

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John R. Sauer, Ph.D., a wildlife biologist, studies the population dynamics and ecology of birds. In recent years his research has focused on developing and implementing methods for estimation of population change from North American Breeding Bird Survey and Christmas Bird Count data.

On the increase: The Great Blue Heron, far left, *(Ardea herodias)* and the Great Egret *(Ardea alba)* show significant increases on both the Christmas Bird Count and Breeding Bird Survey. Photos courtesy U.S. Fish & Wildlife Service

of the population encountered by each survey, and 3) to seek ways to combine the results of both surveys to improve our estimates of population trends and dynamics. We want to compare population trends and dynamics of different species to look for commonalities that might help us to understand the causes of the trends and dynamics. Finally, we especially want to use the BBS and CBC in combination to identify declining species so that we may undertake conservation actions to reverse declines before species become endangered.

The first results of our studies were published in *American Birds* last year (Niven et al. 2004), and our methods were presented in the same issue (Sauer et al. 2004). The first study focused on 13 species of birds that breed in the boreal forest and winter in the contiguous 48 states and southern Canada. Currently, we are analyzing trends and dynamics of waterbirds. We chose both of these groups because they include many species that are surveyed by both the BBS and the CBC and also many species that are missed by the BBS but well covered by the CBC. Here we compare BBS and CBC results for 35 species of waterbirds that are frequently encountered on both surveys; Dunn and Sauer (1997) provided similar comparisons for a variety of Canadian breeding species.

Preliminary Waterbird Results

Of the 35 species of waterbirds that are very frequently encountered on both the CBC and BBS (Table 1), 12 show very similar trends from both databases (less than 1 percent difference in trend), 15 of the species have somewhat similar trends (between 1 percent and 2.2 percent difference in trend), and eight of the species show divergent trends (more than 2.5 percent difference between the trends). The waterfowl are covered by other very intensive surveys. Comparing BBS and CBC trends with those of the waterfowl surveys is a very important exercise, but beyond the scope of this paper.

Obviously, when a species' trends from two completely different surveys agree with each other, we are more confident about our understanding of the status of that species. However, when the trends disagree, it is not always surprising. The trends disagree most dramatically for American Wigeon (17.6 percent), Redhead (10.6 percent), Eared Grebe (8 percent), Common Loon (4.7 percent), American Black Duck (4.2 percent), Canada Goose (3.6 percent), Blue-winged Teal (3.3 percent), and American Woodcock (2.6 percent).

Table 1. Trends of the 35 waterbirds frequently encountered on the CBC and BBS.

Common Name	CBC Trend: Continental	CBC Trend: Increase/ Decrease/ Stable	#CBC Circles With Species	BBS Trend: Increase/ Decrease/ Stable	BBS Trend 1966–2003	#BBS Routes With Species	Trend Diff. (BBS-CBC)
Redhead	-8.5	d	1480	I	2.1	228	10.6
Northern Pintail	-4.7	D	1821	D	-2.8	404	1.9
American Bittern	-3.4	D	546	D	-1.8	601	1.6
Canvasback	-3.1	D	1540	d	-0.9	131	2.2
Common Loon	-2.4	d	1374	I	2.3	452	4.7
Wilson's Snipe	-1.9	D	1907	d	-0.1	1176	1.8
American Woodcock	-1.8	D	738	i	0.8	158	2.6
American Coot	-1.8	d	1870	d	-0.1	581	1.7
Eared Grebe	-1.2	D	648	I	6.8	130	8
Herring Gull	-1.0	D	1775	D	-3.2	353	-2.2
Lesser Scaup	-0.6	d	1928	d	-0.9	237	-0.3
Green-winged Teal	-0.6	d	1842	I	1.2	327	1.8
Killdeer	-0.4	d	1996	D	-0.5	3383	-0.1
American Wigeon	-0.1	d	1805	i	17.5	301	17.6
Sora	0.0	S	600	d	-0.4	490	-0.4
Green Heron	0.1	i	617	D	-0.9	1654	-1
Ruddy Duck	0.2	i	1533	i	1.3	224	1.1
Spotted Sandpiper	0.5	i	623	d	-0.6	985	-1.1
Pied-billed Grebe	1.5	I	1882	i	1.2	479	-0.3
Common Merganser	1.6	i	1929	I	2	369	0.4
Northern Shoveler	1.8	i	1456	I	1.7	334	-0.1
Great Blue Heron	2.4	I	2233	I	2	2371	-0.4
Blue-winged Teal	2.7	I	975	d	-0.6	637	-3.3
Ring-billed Gull	2.8	i	1997	I	1.8	690	-1
Black-crowned Night-Heron	3.2	I	704	I	4.4	307	1.2
Wood Duck	3.4	I	1746	I	4.6	1180	1.2
American Black Duck	3.4	i	1401	d	-0.8	268	-4.2
Ring-necked Duck	3.5	I	1862	I	3.5	166	0
Great Egret	4.1	I	697	I	1.9	567	-2.2
Gadwall	4.8	I	1756	I	4.7	434	-0.1
Canada Goose (including Cackling)	6.0	I	2295	I	9.6	1512	3.6
Hooded Merganser	6.4	I	1933	I	7.2	108	0.8
Bald Eagle	6.4	I	2097	I	6.1	211	-0.3
Osprey	7.2	I	694	I	6.5	425	-0.7
Double-crested Cormorant	10.0	I	1329	I	8.8	467	-1.2

Note: A small letter indicates trends that cannot be statistically distinguished from zero.

A significant proportion of the populations of American Wigeon, Redhead, Common Loon, American Black Duck, Canada Goose, and Blue-winged Teal breed north of the area covered by the BBS, so BBS results are representative only of the southern parts of the breeding range for those species. In addition, significant numbers of American Wigeon, Redhead, and Common Loon winter in Mexico, and Blue-winged Teal winter even farther south, so the CBC does not fully represent winter population trends for those species. American Black Duck and Canada Goose winter primarily in the range of the CBC, so we would expect CBC trends to represent full species trends for those two species.

American Woodcock breeds primarily in the area well covered by the BBS and winters primarily in the area well covered by the CBC, so initially we were surprised that the trends from the two surveys were so different for this species. However, the woodcock is actually very poorly surveyed by the BBS, even though it appears on more than 150 routes. Woodcock are most active at dawn and dusk and rarely encountered when the sun is up. Although they were encountered on more than 150 routes, they were quite rare and inconsistent on almost all those routes. There is a specially designed woodcock survey, which provides more reliable trend information from the breeding season.

A surprising number of species show significant increases on both the CBC and the BBS: Canada Goose, Great Blue Heron, Bald Eagle, Hooded Merganser, Ring-necked Duck, Gadwall, Wood Duck, Double-crested Cormorant, Black-crowned Night-Heron, Great Egret, and Osprey. The 1990s were very wet years in many important waterbird breeding areas, bringing up the 40-year population trends for a variety of waterbirds. In addition, many wetland conservation programs have been very active in the past 10 to 20 years, such as the North American Wetlands Conservation Act (NAWCA). As well, Great Blue Heron, Black-crowned Night-Heron, Osprey, Bald Eagle, and Double-crested Cormorant—all fish-eating birds—benefited greatly from the ban of DDT in the early 1970s. However, we need to remember that a good decade or two for waterbirds has still not made up for several centuries of wetland loss and abuse. We can cheer good conservation outcomes of recent times, but need to maintain these efforts into the future to maintain current waterbird populations or, perhaps, continue to bring them closer to the higher levels that were reached in previous centuries.

The BBS and the CBC agree that the Northern Pintail, Herring Gull, and American Bittern are declining significantly. Both the CBC and the BBS show negative trends for Killdeer, Lesser Scaup, Wilson's Snipe, American Coot, and Canvasback; but either the surveys disagree in the significance of the declines, or both surveys show that the declines are not statistically significant. Given that so many waterbirds showed increases during this time period, we are concerned about the declines of each of these species, and they deserve close watch in future years.

Analyzing and Comparing Surveys

Conservation activities require sources of information that can be used to develop population and habitat management strategies on both wintering and breeding grounds. CBC data from the early winter season provide a unique view of the winter distribution and population dynamics of many species, and complement and enhance the information from surveys such as the BBS that are conducted during the early summer. Comparing results from these surveys is the first step in the development of procedures that jointly use the information from the surveys in conservation.

Results presented here show that often direct comparison of results are complicated by differing coverage of the breeding and wintering ranges of the species, as well as by differences in the quality of information from both surveys. Future analyses will attempt to provide more quantitative comparisons of CBC and BBS results, and directly test hypotheses about reasons for differences in survey results. We also note that the hierarchical modeling approach used in CBC and BBS analyses can be extended to accommodate comparisons of CBC data with other survey results. These analyses should provide additional insights into the consistency of the surveys and provide composite results that include information from several surveys.

State of the Birds

Last year we wrote a "State of the Birds" report that provided habitat-specific status information using BBS data and conservation status (presence on Audubon's Red or Yellow WatchList; Butcher 2004). Future State of the Birds reports will include both BBS and CBC trend information; our next report will focus on the waterbirds, including the species included in this report.

We believe that up-to-date information on bird population trends is vital for understanding which species are undergoing population declines so that we can take conservation action before species become endangered. In addition, some species are increasing in population so greatly that many regard them as pests; understanding their population dynamics is quite helpful as well.

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