

Status and Trends of Waterbirds in High-Intensity Agricultural Areas of the United States

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**Status and Trends of Waterbirds in High-Intensity Agricultural Areas
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Abstract: We used 39-year datasets from the Breeding Bird Survey (BBS) and the Audubon Christmas Bird Count (CBC) to determine continental and regional population trends of 146 species of waterbirds that regularly occur in seven bird conservation regions in which more than 10% of the land area is devoted to row crops. Thirty-nine of the species show long-term continental declines on one or a combination of the surveys; 52 species show large increases. For many of these species, CBC analyses are available for the first time. Current wetlands acreage is a fraction of what occurred 300 years ago as Europeans spread throughout the continent; however, our results show a partial recovery of waterbird populations, especially over the past 20 years. Probable contributors to this partial recovery include: 1) Banning of organochlorine pesticides and the population recovery of fish-eating birds, 2) Success of wetland and farmland conservation programs in restoring waterbird habitat, and 3) Provision of excess food to waterbirds, especially corn and rice. Although there are more increasing species than decreasing, there are nonetheless a significant number of declining species and additional species with inadequate trend information that are known to be of conservation concern. We discuss possible causes of declines and reasons for conservation concern for these species.

There is a strong overlap between high-intensity row-crop agriculture and important regions for waterbirds in the central United States. Seven contiguous Bird Conservation Regions (BCRs) in the central United States are the only seven BCRs with more than 10% of their landcover devoted to row-crop agriculture. These BCRs include the most important breeding region for dabbling ducks (and other waterbirds), the most important wintering region for geese and dabbling ducks (and other waterbirds), most of the Mississippi River, and parts of the Great Lakes, Missouri, Arkansas, Illinois, and Ohio Rivers. As a result, each of these BCRs is critical for waterbirds.

Waterbird conservation has long been a high priority in the United States. Conservation efforts took a great leap forward with the creation of the North American Waterfowl Management Plan in 1986 and passage of the North American Wetlands Conservation Act in 1989. Under that plan, six joint ventures were established to cover the most important breeding and wintering grounds for waterfowl. Among those first six joint ventures were the Prairie Potholes Joint Venture, because it is the most important breeding area in the United States for

dabbling ducks, and the Lower Mississippi Valley Joint Venture, because it is the most important wintering area in the United States for geese and dabbling ducks. Both are included in our focal area. In 1993, the Upper Mississippi River and Great Lakes Region Joint Venture (UMR/GLR JV) was established, at first covering all of Wisconsin, adjacent parts of five other states (including most of Michigan), and the Mississippi River wetlands in Missouri. Expansion of the UMR/GLR JV now has it covering two of the seven most agricultural bird conservation regions (BCRs) in the United States – the Eastern Tallgrass Prairie (BCR 22) and the Prairie Hardwoods Transition (BCR 23). The Central Hardwoods (BCR 24) now has its own joint venture. The Shortgrass Prairie (BCR 18) and the Central Mixed-grass Prairie (BCR 19) are mostly covered by the Playa Lakes Joint Venture, with the eastern Nebraska portion of BCR 19 covered by the Rainwater Basin Joint Venture.

The purpose of this report is to identify the most important waterbirds in these seven BCRs and to determine the status and trends of as many of those species as possible, relying primarily on two large-scale surveys of North American birds, the Breeding Bird Survey (BBS) and the Christmas Bird Count (CBC). We identify the species of primary conservation concern, based on declining trends and on evaluations by a variety of groups.

METHODS

Geographic units of study: Bird conservation regions (BCRs)

Bird Conservation Regions (BCRs) have been adopted as the primary planning units by the North American Bird Conservation Initiative (NABCI; Figure 1; U.S. NABCI Committee 2000; <http://www.nabci-us.org/bcrs.html>); as a result, most relevant statistics on bird populations are aggregated by BCRs, making BCRs by far the most practical geographic template for bird conservation statistics.

High intensity agriculture

We focus on lands used for the production of row crops. We define row crops as areas devoted to the production of corn, cotton, rice, sorghum, soybeans, spring wheat, winter wheat, peanuts, and tobacco.

We gathered county-by-county estimates of row crop acreage (including the crops mentioned above) from the national agricultural production statistics of the USDA's National Agricultural Statistics Service (Figure 2; U.S.D.A. National Agricultural Statistics Service 2003; www.usda.gov/nass/graphics/county03/indexdata.htm). A map of BCR boundaries was overlaid on a national map of counties, and each county was assigned to one BCR based on which BCR included the highest percentage of the county (in cases where a county overlapped BCR boundaries). By summing together the total county acreage in each BCR, it was possible to calculate the percentage of each BCR that was devoted to row crop agriculture in 2003 (Table 1). We determined that a threshold of 10% of a BCR devoted to row crops provided the best definition of high intensity agriculture (Table 1; Figure 1); seven BCRs met this definition.

North American waterbird species

The taxonomic classification of birds follows the American Ornithologist's Union (American Ornithologists' Union 1998, 2000, Banks et al. 2002, 2003, 2004, 2005), with the exception that a recent split of the Canada Goose (*Branta canadensis*) has not been adopted because detailed information on the distribution and relative density of these two new species is not yet available. Trends for Clark's and Western Grebes from the Breeding Bird Survey (BBS) and Christmas Bird Count (CBC), American and Pacific Golden-Plovers (CBC only), and Nelson's and Saltmarsh Sharp-tailed Sparrows (CBC only) are reported in combination because of recent taxonomic splits. We have a BBS trend for Nelson's Sharp-tailed Sparrow because it can be separated during the breeding season by range. Pacific Golden-Plover and Saltmarsh Sharp-tailed Sparrow are not focal species; they are included in this study only because they cannot yet be taxonomically differentiated for CBC-based trends. American Ornithologists' Union (2006, <http://www.aou.org/checklist/index.php3>) includes even more recent changes that will be incorporated into future analyses.

Authorities differ in the use of the term waterbirds (Table 2). Some follow taxonomic lines; others, ecological lines. A wide taxonomic definition of waterbirds (but excluding seabirds) is used under the Ramsar Convention and also by BirdLife International and Wetlands International, as described in Wetlands International (2002; <http://www.wetlands.org/pubs&/WPE.htm>; Table 2). Waterbirds are included in four of the NABCI initiatives, including shorebirds, covered by the U.S. Shorebird Conservation Plan (Brown et al. 2001; <http://shorebirdplan.fws.gov/USShorebird/PlanDocuments.htm>), and waterfowl, covered by the North American Waterfowl Management Plan (USFWS 2003; <http://migratorybirds.fws.gov/reports/status03/statusofwaterfowl03.pdf>; Table 2). The North American Waterbird Conservation Plan (Kushlan et al. 2002; <http://www.nacwcp.org/pubs/ContinentalPlan.cfm>) includes the rest of the Ramsar waterbirds plus the seabirds (Table 2). We added additional waterbirds that are considered landbirds based on their taxonomy (and are thus included in the Partners in Flight initiative), but are waterbirds based on their ecology and/or behavior. This ecological classification is based on an evaluation of existing guild classifications developed by the U.S. Geological Survey (J.R. Sauer, unpublished manuscript), Partners in Flight (P. Blancher, unpublished manuscript), Ehrlich et al (1988), and Butcher and Niven (2004, <http://www.audubon.org/bird/stateofthebirds/index.html>).

Regionally specific lists of waterbirds

The national list of waterbirds is too broad for most of our study. We include species on our regional lists if they exceed a minimum standard of regional importance, based on what Partners in Flight (PIF) calls Relative Density (RD) scores (formerly called Area Importance or AI scores; Panjabi et al. 2005; <http://www.rmbo.org/pif/process/process.html>). Any species with a RD score of 2 or more in at least one of the seven focal BCRs is considered a focal waterbird species for this study (Table 3). Relative Density scores compare the density of a species among BCRs and are independent of the size of the BCR.

The relative density estimate for a species in a BCR (in a season) is calculated by dividing a standardized index of abundance for a species in a BCR by the index of abundance for

the same species in the BCR where it has the highest index of abundance, and then multiplying this figure by 100 to place the relative abundance of all species on a scale of 0 – 100, such that the BCR with highest relative abundance receives a value of 100 (Panjabi et al. 2005). Then relative density (RD) scores are derived by assigning relative density estimates in each BCR (in a particular season) to a 5-rank ordinal scale as follows:

- 1: $0 < RD < 1$
- 2: $1 \leq RD < 10$
- 3: $10 \leq RD < 25$
- 4: $25 \leq RD < 50$
- 5: $50 \leq RD \leq 100$

By using RD scores, we can infer, for example, that a species with a RD score of 2 occurs in a density that is at least 1/100th of its density in the BCR where it has the highest relative density. Relative Density scores therefore provide a convenient and quantitative way to screen out species from the BCR lists that may occasionally occur in the BCR, but whose presence is peripheral and essentially out of their normal range. For this study, we consider any relative density less than 2 (1/100th the maximal density) to be out of the normal range of the species.

For each BCR identified as a high intensity agricultural area, we determined the Relative Density (RD) scores for each waterbird species during the:

- i. Breeding season (using BBS data and PIF assessments)
- ii. Early winter (using CBC data)
- iii. Migration season (primarily using data from the U.S. Shorebird Conservation Plan (Brown et al. 2001), regional shorebird plans (<http://shorebirdplan.fws.gov/RegionalShorebird.htm>), and the North American Waterfowl Management Plan Implementation Framework (USFWS 2004))

Habitat Guild Classification

In Table 4, each waterbird species is assigned to one or more of four habitat guilds during the breeding season and the migration/winter seasons as follows:

Coastal open water – Birds that depend on resources in the near-shore or pelagic regions of coastal open waters of oceans, bays, and/or estuaries.

Coastal wetlands/shore – Birds that depend on the resources of coastal marshes and other coastal wetlands, often where emergent vegetation exists in the littoral region, even though these habitats may have some open water associated with them (e.g., the back side of barrier islands). If open water is present it is generally shallow. Also included are beach/dune habitats. By coasts we are referring to salt water habitat that is contiguous with the larger oceans and seas. The fresh water coasts of the Great Lakes are considered to be inland.

Inland open water – Birds that depend on resources of open fresh water habitats, including larger ponds, lakes, streams and rivers.

Inland wetlands/shore/wet tundra – Birds that depend on a wide variety of wet inland habitats, such as palustrine marshes, sloughs, fens, bogs, swamps, lakeshores, streamside habitats, and any other wet habitats that may qualify as wetlands based on soil moisture content, such as wet tundra in the Arctic.

Species are included in one or more of these categories if they make use of the water-associated component of the habitat – either resources in the water itself or at the surface or interface of the water. For this reason, species such as kingfishers that are feeding directly in streams are included, whereas riparian species that are strictly feeding in the arboreal vegetation in the riparian zone are not included (and were not defined as waterbirds). However, some species that may not feed in or at the surface of the water are included if they are strictly associated with a wetland/aquatic habitat.

Classifications were based on habitat descriptions in the Bird of North America species profiles (Poole and Gill 2002). For the few species not included in this series, habitats were assigned based on habitat information in relevant regional field guides.

Because habitat use often varies between seasons, particularly as birds migrate, species received separate classifications for the breeding season and the migration/winter seasons. In a few cases a particular habitat is only used extensively during migration and in these cases this migratory habitat use is labeled as such (with an “m” in Table 4). Some species (e.g., waterfowl/grebes) migrate quickly through inland sites but winter on the coast. Because in these cases inland sites are only used sparingly and as needed for stopover, they have not received habitat codes for this ephemeral habitat use.

Breeding Bird Survey (BBS)

The BBS, administered by the U.S. Geological Survey (<http://www.pwrc.usgs.gov/BBS/>), is the primary source of status and trend information for North American birds during the breeding season. The BBS is a roadside survey that includes 50 3-minute stops one-half mile apart, at which experienced individuals count all birds seen and heard. Surveys are done between late May and early July beginning 30 minutes before dawn. Surveys have been done on more than 4,000 routes; about 3,000 routes are done each year. Data are aggregated by BCR and by state. The survey began in 1965, so our analyses begin with that year.

Audubon Christmas Bird Count (CBC)

The CBC (<http://www.audubon.org/bird/cbc/>) is the primary source of status and trend information for North American birds in early winter. Each individual CBC occurs within a 15-mile diameter circle on a single day within two weeks of Christmas. Participants join groups that survey subunits of the circle during the course of the day using a variety of transportation methods (mostly on foot, in a car, or watching at a feeder). Just over 2,000 circles are surveyed each year. Like the BBS, data are aggregated by BCR and by state. The first CBC was done in

1900. We begin our analysis of CBC trends with the winter of 1965-66 for comparison with the BBS (which began in 1965) and because earlier CBC data are less comparable to current CBC data due to changes in methods and intensity of effort (Butcher 1990).

Trend analysis methods

BBS trends and annual indices are estimated using the route-regression methods described by Geissler and Sauer (1990). In this analysis, trend is estimated first, and annual indices of abundance are used to assess higher levels of pattern in the context of the trend. CBC trends and annual indices are derived from a hierarchical model that treats CBC counts as overdispersed Poisson random variables, with means described by a loglinear regression with random effects (Link and Sauer 2002, Link et al. 2006). The model includes a stratum-specific effect of effort (party-hours). Route-regression and hierarchical models have been shown to produce similar trend estimates in studies to date (Sauer et al. in press). Thus, comparing BBS trends using route regression with CBC trends using a hierarchical model should not produce any bias. BBS trends using the hierarchical models are expected to be available soon.

Trend categories

We adopted population trend thresholds from Partners in Flight (Panjabi et al. 2005). An average annual change of -2.28% leads to a 50% decline over a 30-year period, so we considered any species with declines of this magnitude or greater to be suffering the most severe declines. For trends from the BBS or CBC alone, the trend had to be statistically significant ($p < 0.05$ for BBS; 95% credible intervals not including zero for CBC) to be placed in this category. An average annual decline of -0.54% produces a 15% decline over a 30-year period. Thus, any decrease between -2.28% and -0.54% is considered moderately declining, but not severely. An average annual increase of $+0.47\%$ leads to a 15% increase over a 30-year period. Thus, any trend between -0.54% and $+0.47\%$ is considered stable, and any trend greater than $+0.47\%$ is considered increasing. An average annual increase of $+1.36\%$ creates a 50% population increase over 30 years, so any trend greater than that is considered to be large and any trend between $+0.47\%$ and $+1.36\%$ per year is considered moderate.

Reliability of population trend data from surveys

The BBS and CBC are omnibus surveys designed to determine status and trends for a large number of species over a large geographic scale. As a result, the reliability of BBS- and CBC-derived trends varies greatly among species. An estimate of reliability is valuable for two major reasons: 1) to determine if the trend data should be considered at all, and 2) if trend information is available from more than one source, to determine which source might be more reliable. In Butcher et al. (in prep.), we estimate trend reliability using four factors:

- i. number of BBS routes or CBC circles that recorded the species at least twice in 39 years,
- ii. average abundance of the species on the routes or circles included in the analysis,
- iii. precision of the trend estimate, and
- iv. proportion of the breeding range covered by the BBS or winter range covered by the CBC.

Combined trend scores

If a species is encountered on both the BBS and CBC, the best estimate of its overall trend may be a combination of the estimated trends from the two databases. To calculate a composite trend estimate, we first weighted each trend estimate by the proportion of the species' range included in the survey (breeding range for BBS, winter range for CBC), then we lowered the weighting for either BBS or CBC if it scored in a lower reliability category for sample size, abundance, or precision relative to the other survey (Butcher et al. in prep.).

For abundance, we reduced the weighting for either BBS or CBC by 10% if its reliability score was one category lower and by 20% if the reliability score was two categories lower.

For sample size, we reduced the weighting for either BBS or CBC only if the sample size category was different. If the category was different, then we reduced the weighting by 10% if the sample size of one survey was 10-20% of sample size of the other, by 20% if one was 5-10% of the other, by 30% if one was 2-5% of the other, and 40% if one was less than 2% of the other.

For precision, we reduced the weighting 10% if one survey had a precision estimate that was 2-4 percentage points higher than the other, 20% if the difference was 4-8%, 30% if the difference was 8-12%, and 40% if the difference was more than 12%.

Value of two trend estimates over one

There are two ways to determine the amount of improvement in a trend estimate by using two sources instead of one. First, we looked at the final weighting of the two trend estimates. The more even the weighting of the two trend sources, the more informative the combined estimate is. Second, we looked at the amount of difference between the estimated trends.

RESULTS

Trend Reliability

We use trend reliability scores to determine how much faith to put in trend estimates for specific species in specific regions. For continental trends, we use four factors, including percentage of range covered by the survey. For regional trends, we use three of the four continental factors: sample size, abundance, and precision. If sample size is below 5 for any species in any region or if abundance is below 0.01 for any species in any region, then we report no trend for that species for that region. If a species in a region has values of 3 for all factors, then we say that the trend is highly reliable and most useful (Table 5). When any species in a region scores 2 or 3 for all factors, then the trend is very reliable and very useful. If at least one of the reliability scores is 0 or 1, we still consider the trend information to be reliable or useful (Butcher et al. in prep.)

Continentially, 94 species are well covered by one or both datasets. These datasets provide useful trend information for 43 additional species, but it is important to qualify the trends for those species, depending on which of the reliability scores falls short.

For the focal waterbirds of this study, useful continental trends are available from either the BBS or the CBC for 137 of the 145 species (Table 5); useful trends are available from both for 95 species; useful trends are available from the CBC only for 30 species; and useful trends are available from the BBS only for 12 species. Useful trends are available from both BBS and CBC for the combination of Western and Clark's Grebes; these species were only recently split into two species, so trends are currently available only for the combination. We have good BBS data for Nelson's Sharp-tailed Sparrow from the BBS and good CBC data for the combination of Nelson's and Saltmarsh Sharp-tailed Sparrows; we combined those trend sources to get the best overall estimate of Nelson's Sharp-tailed Sparrow trends.

The value of the CBC versus the BBS for trend information varies greatly among BCRs (Table 5). BBS data are most valuable for BCR 11, the most northerly of the 7 focal BCRs. For BCR 11, useful trends are available from either BBS or CBC for 68 species, from both for 10 species, from CBC alone for 3 species, and for BBS alone for 55 species. CBC data are most valuable for BCR 26, the most southerly of the 7 focal BCRs. For BCR 26, useful trends are available from either BBS or CBC for 79 species, from both for 22 species, from BBS alone for 6 species, and for CBC alone for 51 species. The other 5 BCRs are intermediate in the extent to which CBC or BBS data are more useful.

Trend Results by Species

We have useful trends for 137 of the 145 focal species (totals are 145 because of the combination of Western and Clark's Grebe). Using combined and weighted trends for the 95 species with both CBC and BBS data available, BBS trends for the 12 species with only BBS trends, and CBC data for the 30 species with only CBC trends, we find that 71 of the 137 species are increasing continentally (52 increasing more than 1.36% per year), 39 are decreasing (13 at more than -2.28% per year), and 27 are stable (Table 6).

Seventeen of the 95 species with useful trends from both BBS and CBC show increasing continental trends on one survey but decreasing trends on the other, whereas 44 species were consistent on both. No species shows a statistically significant increase continentally on one survey and a statistically significant decrease on the other, 20 species show statistically

significant increases on both surveys continentally, and 2 species show statistically significant declines on both surveys continentally.

Trend Results by Groups

Group analysis of CBC data (Table 7) shows that waterbirds as a whole in North America increased significantly from 1966-2004 at 1.42% per year. Moreover, the focal waterbirds also increased significantly from 1966 to 2004 continentally (+1.46%/year).

The CBC data for some of the focal species included in the continental analysis are only available from BCRs outside the focal region (e.g., the species may breed in or migrate through the focal BCRs but winter on the Gulf Coasts). Therefore, to assess how focal waterbirds were faring in the focal BCRs versus across North America, we conducted a group analysis of trends of focal waterbirds for which we had CBC trend data within the seven focal BCRs and found that as a group these waterbirds increased at a rate of 3.78% per year, whereas the same suite of species increased at only 1.54% per year across their North American range in winter.

All six subgroups of waterbirds (shorebirds, divers, gulls/terns/pelicans, waders, dabblers, and others) increased in the 7-focal-BCR region according to CBC data; all the subgroups except for the shorebirds increased continentally. All group comparisons using CBC data show groups doing better in the 7-focal-BCR region than continentally. However, when the analysis includes species that were not found in the 7-focal-BCR region, the landbird group (taxonomic landbirds that use wetlands) did better continentally than in the focal BCRs.

Trends in Agricultural Regions (BCRs) versus Continental Trends

Using CBC data, population trends were more favorable in six of the seven agricultural BCRs than continentally, although the differences are statistically significant only in BCR 22 (Table 8). In BCR 18, trends were essentially the same as the continental trends for the same species. The trends among the individual species in the 7-focal-BCR region were statistically more positive than for those same species at the continental level (Table 8), confirming the results of the group analysis in Table 7.

Using BBS data, results are varied (Table 8): population trends were more positive continentally than they were in three of the agricultural BCRs (none is statistically significant), and population trends were more positive in four of the agricultural BCRs (three out of four differences are statistically significant).

Species of Conservation Concern

Four species of ducks in the focal area are of high continental priority because of their importance as game species (Table 9). All four species are well covered on at least one of the surveys, and three of the four are well covered on both. Additional status and trend information is available for all four species from breeding and wintering waterfowl surveys.

Forty-nine out of the 146 focal waterbirds in this study appear on national or international lists of birds of conservation concern (Table 9). Twenty-five of the 49 are well covered by at least one of the surveys, and seven – Seaside and Le Conte's Sparrows; Mottled Duck; Marbled

Godwit; Bald Eagle; American Bittern; and King Rail – are well covered by both. Useful trend information is available for 21 of the species that aren't well covered (although range coverage for Stilt Sandpiper is minimal), leaving only three – Eskimo Curlew, Buff-breasted Sandpiper, and Hudsonian Godwit – with no useful trend information from these two surveys.

The greatest concern is for the species that have been declared globally threatened (Table 9): Eskimo Curlew (Possibly Extinct), Mountain Plover and Piping Plover (Vulnerable), and Long-billed Curlew, Buff-breasted Sandpiper, and Black Rail (Near Threatened). All of these species are also on Audubon's Red WatchList. Neither BBS nor CBC provides any information for Eskimo Curlew or Buff-breasted Sandpiper. There are no confirmed records of any kind for Eskimo Curlew since 1962, although there are unconfirmed sightings almost every year. Buff-breasted Sandpiper breeds in the Arctic and winters in South America (as the Eskimo Curlew would if it still exists). Buff-breasts pass through the focal BCRs during spring and fall migrations. Trend estimates for the Black Rail and Piping Plover come only from the CBC; these trends suggest that the Black Rail is stable (although data quality is poor, especially for relative abundance) and that the Piping Plover is statistically significantly declining. Trend estimates for Mountain Plover and Long-billed Curlew come primarily from the BBS; the data suggest that both are declining. The best estimate for Mountain Plover is $-2.7\%/year$; for Long-billed Curlew, $-1.4\%/year$.

Three species – Snowy Plover, Nelson's Sharp-tailed Sparrow, and Yellow-billed Loon – are on Audubon's Red WatchList, but are not classified as globally threatened by BirdLife (Table 9). Nelson's Sharp-tailed Sparrow is only recently split from Saltmarsh Sharp-tailed Sparrow (and they are difficult to tell apart in the winter anyway), so CBC data are only available for the two species combined. These data suggest a decline so slight as to be indistinguishable from a stable population. However, BBS data for Nelson's alone suggest a slight increase. Yellow-billed Loon shows a non-significant decline, but is so rare in our focal BCRs that it should not be considered for conservation measures here. Snowy Plover populations are continentally stable according to CBC data.

Two species – Wood Stork and Bald Eagle – are federally listed as threatened or endangered species throughout their range (Table 9). Bald Eagle populations are significantly increasing on both the CBC and BBS; there is currently an effort to de-list the Bald Eagle since it is doing so well throughout its range. Wood Stork trend data come primarily from the CBC and suggest a 3.5% per year increase.

Three other species – Sandhill Crane, Seaside Sparrow, and Least Tern – have populations that are federally listed (as does Snowy Plover, discussed above because it is on the Red WatchList). The listed Seaside Sparrow and Snowy Plover populations are outside of our focal BCRs, but the listed crane population (Mississippi Sandhill Crane) is in or near BCR 26. The Interior Least Tern is listed and is widespread in our focal region. Except for the Mississippi subspecies, Sandhill Cranes are increasing according to both BBS and CBC data. Seaside Sparrow is statistically significantly decreasing on the CBC, but stable on the BBS; the combined trend shows a strong $-3.0\%/year$ decline. Trend data for the Least Tern are from the BBS and show a slight decline of $-1.2\%/year$.

Seventeen focal waterbirds are on Audubon's Yellow WatchList (Table 9). Seaside Sparrow is discussed above. No trend data are available for Hudsonian Godwit. For Wilson's Phalarope and Prothonotary Warbler, only the BBS has trend data, and they suggest a population

increase for Wilson's Phalarope and a slight population decline for Prothonotary Warbler. Eight species have only CBC data. Three of those – American Golden-Plover (data available only in combination with Pacific Golden-Plover), Wilson's Plover and Whimbrel – are declining, while five are increasing – Trumpeter Swan, Yellow Rail (data are marginal due to low relative abundance), American Oystercatcher, Reddish Egret, and Short-billed Dowitcher. Five species have both CBC and BBS data. Both datasets agree that Rusty Blackbird is declining, but disagree about the other four species. The CBC shows a decline for American Woodcock, while the BBS shows an increase; the combined trend shows a decline so slight that it is considered stable. The CBC shows increases for Marbled Godwit, Mottled Duck, and American Black Duck, whereas the BBS shows declines; combined trend estimates show a stable population for Marbled Godwit and slightly increasing populations for Mottled and American Black Ducks.

Twenty focal waterbirds are on the U.S. Fish and Wildlife Service list of Birds of Conservation Concern (Table 9). Twelve of them have been discussed above because they are on other lists as well. Of the remaining eight, Common Tern is statistically significantly decreasing on the BBS and is not included on the CBC. Upland Sandpiper and Louisiana Waterthrush are increasing on the BBS, but have no CBC data. Stilt Sandpiper is increasing on the CBC, although only a tiny percent of the winter range is covered, so the information tells us little about the status of the species as a whole; Stilt Sandpiper is not covered by the BBS. Sedge Wren is increasing according to both the BBS and the CBC, and Le Conte's Sparrow is showing a slight decline on both, although the BBS decline is so slight that it qualifies as stable. Little Blue Heron and Solitary Sandpiper are shown as decreasing on the BBS, but stable on the CBC. Data reliability and range coverage are both higher for the BBS for these two species, and the combined trends show declines for both.

Species with Large Continental Increases

Fifty-two species show large increases in their combined continental trends (Table 10). Four of the trends are derived wholly or partly from the BBS, 12 wholly from the CBC, and 36 from the two surveys combined. Of the 36 species with data from both surveys, only three species – Wood Stork, American Black Duck, and Eared Grebe – show a decline on either survey. Five species – American Wigeon, Common Goldeneye, Glossy Ibis, Black-necked Stilt, and Caspian Tern – have stable populations on one of the surveys. The other 28 species show increases on both surveys.

Only 30 of the 52 species with large increases have at least one survey on which all the reliability scores are 2 or 3 (Table 10). Of the 22 species with low reliability scores, only Yellow Rail and Stilt Sandpiper have low abundance scores. Black-bellied Whistling-Duck and White-faced Ibis have low scores for range coverage and for precision. Six species – Common Loon, Snow Goose, Sandhill Crane, Trumpeter Swan, Long-billed Dowitcher, and Franklin's Gull – had good reliability scores for all criteria except precision. The other 12 have good reliability scores on at least one database for all criteria except range coverage.

DISCUSSION

Two results of this study were particularly surprising: 1) Over the 40-year timeframe of this study, more species of waterbirds increased than decreased (Tables 6 and 7). 2) Many

species had better population trends in the bird conservation regions with high acreages of row crops than in areas with less intensive agriculture (Tables 7 and 8). Here we will consider possible reasons for those results, then we will look at causes for conservation concern for waterbirds on conservation lists and finally look at possible causes for population changes for both increasing and decreasing species.

More waterbirds increasing than decreasing

First, this is a 40-year study, due to the time limitations of the BBS and CBC. Much wetlands loss occurred in the United States prior to 1965; therefore, we believe that the highest populations of wetland birds in the past 40 years are still far below the highest population levels ever on the continent – in most cases, current population levels are lower by one or more orders of magnitude. So, although we are pleased by current trends, it is important to work to maintain population increases far into the future if we are to begin to recoup this continent's potential to support waterbirds.

Second, there are many wetland species that have continued to decline even as a majority has increased. Of a list of 49 species of conservation concern, only a dozen show trend increases sufficient to suggest they could be considered for delisting (Table 9); on the other hand, 16 species showed population declines sufficient to suggest they should be considered for possible addition to national or continental conservation concern lists.

Given these caveats, it was nonetheless surprising and significant that all groups of waterbirds except shorebirds showed significant continental increases on the CBC (Table 7) and that overall continental species trends were positive on both the CBC and the BBS: The average combined trend for all 137 species was +1.2% per year. For species with highly reliable surveys, the average increase on the CBC was +0.81%/year and on the BBS was +0.99%/year. These increased trends of waterbirds contrast with the predominantly declining trends of grassland and shrubland birds (Butcher and Niven 2004; Sauer et al. 2005).

What factors could be contributing to net increases over the past 40 years?

- 1) The Clean Water Act (CWA) was passed in 1972 and strengthened in later years, providing strong incentives for wetland conservation.
- 2) DDT and related organochlorines were banned in 1973. Since then populations of many bird-eating and fish-eating birds have increased.
- 3) The Conservation Reserve Program (CRP) was approved in the 1985 Farm Bill. More than 40 million acres are now included; plus, additional Farm Bill programs (especially the Wetlands Reserve Program [WRP]) have improved farm landscapes for birds.
- 4) The North American Waterfowl Management Plan (NAWMP) was signed in 1986, and six waterfowl joint ventures were launched that year. Additional joint ventures have been added since, and joint ventures are now committed to conservation actions for all birds.
- 5) The North American Wetlands Conservation Act (NAWCA) was passed in 1991, and millions of dollars have been spent on wetlands conservation under the auspices of this act since that time.
- 6) The mid-1990s to the present have been very wet years in the prairie potholes, one of the primary regions for breeding waterbirds in North America.

- 7) The Land and Water Conservation Fund (LWCF) and the Migratory Bird Conservation Fund (that spends the revenues generated by the Migratory Bird Hunting and Conservation Stamp [Duck Stamp]) have added millions of acres to refuges, much of it wetlands acreage.
- 8) Crop residues provide important food resources to waterbirds, especially corn and rice.
- 9) Many farmers flood their fields during the nonbreeding/nonfarming season to attract ducks and duck hunters; these flooded fields also attract many nongame waterbirds.

In evaluating these hypotheses, it should be noted that as many waterbirds increased as decreased in the first decade with long-term population trends (1966-76; Table 11). The proportion of species with increasing population trends increased during 1976-86, then increased again after 1986 and has remained high. That suggests that an accumulation of factors turned the tide for waterbirds, with no signs that increases have stopped as of 2004.

To get a better sense of why some species increased and others decreased, we looked at various attributes of all decreasing species (Table 12) and all species with large increases (Table 13). There were few correlates among the declining species to the characteristics we chose. Shorebirds had more declining species than expected; plus, shorebirds had all the species with unknown trends from both BBS and CBC. The group comprising herons, egrets, and bitterns (all closely related) also had a disproportionate number of declining species.

Patterns among the species with large increases were clearer than patterns among the declining species (Table 13). Fully two-thirds of the dabbling waterfowl showed large increases (including the dabbling ducks, the geese, the swans, and Black-bellied Whistling-Duck). All the geese in our focal region and more than half the dabbling ducks increased; all the species in this group with large increases except Wood Duck feed on rice and/or corn (Elphick and Taft in prep.). Large increases were seen in half of the waders (a group that includes Sandhill Crane, coot, moorhen, rails, ibises, stork, spoonbill, herons, egrets, and bitterns); all the species in this group with large increases feed on rice or fish, except for Sandhill Crane, which feeds extensively on corn. Half of the group that includes American White Pelican, gulls, and terns showed large increases; all the birds in this group eat fish (except for Franklin's Gull), although the gulls have an extremely varied diet. Also, increases were found in more than half of the waterbirds that breed in coastal open waters (6 of 10), including three gulls, Caspian Tern, Osprey, and Bald Eagle.

Waterbirds doing better in regions devoted to row crops

Just as surprising as the fact that more waterbirds are increasing than decreasing is the fact that waterbirds tended to do better in the seven bird conservation regions with the highest proportion of land devoted to row crops than they did overall on the continent (Tables 7 and 8). That was true for six of the seven regions on the CBC and for four of the seven regions on the BBS (Table 8). Perhaps this result is less surprising looking at the possible reasons that waterbirds are doing better overall. Six of the eight possible reasons apply more to farmland than they do to other landscapes. Even NAWMP and NAWCA apply more to these seven BCRs than they do overall because two of the first six joint ventures – Prairie Potholes and Mississippi Alluvial Valley – are in this region, and these two joint ventures have almost certainly attracted more conservation dollars in the last 20 years than any others. Two additional joint ventures –

Upper Mississippi River/Great Lakes Region and Central Hardwoods – have been added in this focal region since.

Possible causes of declines for declining species

Rusty Blackbird.—Rusty Blackbird has the greatest combined continental decline of any species in our study. Causes of the population decline are not well understood. On the wintering grounds (which includes almost all of three focal BCRs and a portion of three more), Rusties have suffered from the loss and fragmentation of bottomland hardwood forests, from competition with other blackbirds and with starlings that do better in human-dominated environments, and from depredation programs aimed at starlings, grackles, cowbirds, and Red-winged Blackbirds (Avery 1995). Rusties eat corn (Elphick and Taft in prep.), but they are probably out-competed by Red-winged Blackbirds and other blackbirds in cornfields, and they may be killed in depredation programs aimed at Red-wings.

Common Tern.—This species breeds primarily on islands in lakes and near the ocean. It spends little time in agricultural habitats, so its population problems are unlikely to be related to agriculture except to the extent that agricultural run-off might affect the water quality of breeding lakes.

King Rail.—King Rail is one of the most rapidly declining waterbirds on the continent. It was formerly much more abundant in the seven-focal-BCR region than it is today (Poole et al. 2005), and it continues to decline in the focal BCRs as it does continentally. King Rails prefer shallow marshes and uneven marshes, so do not benefit from croplands that are flooded for ducks, especially if those fields are relatively flat with deep water. King Rails use rice fields extensively (Elphick and Taft in prep.). Either they are not doing very well in those rice fields, or else the combined acreage of rice fields and natural, shallow wetlands suitable for King Rails continues to decline.

Northern Pintail.—Like the King Rail, Northern Pintail uses very shallow wetlands. However, unlike the rail, pintails will nest in upland grasses and crop stubble (Austin and Miller 1995). Often, nests in crop stubble are destroyed by later cultivation. Like many of the dabbling ducks, pintails are sensitive to drought conditions in the prairie potholes (BCR 11). However, unlike most of the dabbling ducks, pintail numbers have not rebounded with the onset of wetter weather in the potholes in 1994 that continues to the present. Studies through the mid-1990s indicated that pintails were limited by breeding success, not by over-winter survival (Austin and Miller 1995). Pintail harvests were dramatically curtailed in 1985, from more than a million birds a year to about 300,000 birds a year. Since that time, populations have been stable, but have not increased (Wilkins et al. 2006) or have decreased somewhat, but at a lower rate than the earlier decreases (this study).

Piping Plover.—This species winters on beaches on the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea where agricultural practices are not a major issue. A substantial portion of the population breeds on beaches in northeastern United States and southeastern Canada. However, there is another breeding population in the region of this study that breeds along rivers, reservoirs, and alkali wetlands (Haig and Elliott-Smith 2004). This breeding population can interact with agriculture if agricultural activities are intruding into the plover's preferred habitat. Since most work on this species has been done on beaches, there is little literature on the effects of agricultural practices on the breeding success of Piping Plovers.

Seaside Sparrow.—This species lives out its life in coastal saline wetlands. The primary agricultural practice that would directly affect it is haying of saltmeadows.

Mountain Plover.—The Mountain Plover mostly breeds in short-grass prairie where there is little agriculture, but it now also breeds in recently plowed fields in the eastern parts of its breeding range (in our focal region; Knopf and Wunder 2006). Recently, plovers have been shown to nest in these fields prior to planting, lose their nests during planting, then successfully re-nest after planting (Knopf and Wunder 2006). Declines of this species are due to persecution of prairie dogs in short-grass prairie, planting of tall grasses in the short-grass prairie biome, and the conversion of short-grass prairie to cropland (Knopf and Wunder 2006). The species also winters on agricultural fields in California and Texas. A new management technique is to burn potential Mountain Plover habitat to create short-grass areas suitable for the species (Knopf and Wunder 2006).

Wood Stork.—This species is mostly found as a post-breeding wanderer in our focal region along the Gulf of Mexico coast and in the southern parts of the Mississippi River. It is difficult to track population trends of this species – it is declining on the BBS, but increasing on the CBC. Breeding populations have dropped dramatically in South Florida, but increased from central Florida into South Carolina (Coulter et al. 1999). It is difficult to know how the total U.S. population might have changed during that dramatic shift. The bird is very susceptible to water levels, fish availability, and disturbance, especially at the nesting colonies.

Little Blue Heron.—Little Blue Herons appear limited primarily by habitat and food availability (Rodgers and Smith 1995). They eat a variety of foods. Compared to other herons and egrets, they tend to forage in shaded areas and solitarily. BBS showed declines, while the CBC showed a stable population. The difference may be due to migrants wintering south of the U.S. border doing more poorly than birds wintering in the U.S. and thus picked up on the CBC.

Marbled Godwit.—This species is stable on the Christmas Bird Count and in its U.S. breeding range, but declining in its Canadian breeding range (Sauer et al. 2005). Breeding habitat requirements are very specific (Gratto-Trevor 2000): short, sparse grass near a variety of wetland types. Conversion of grasslands to cropland and loss of wetlands are both detrimental to the species. Marbled Godwits winter in coastal wetlands that are subject to human development and disturbance, especially in Mexico (Gratto-Trevor 2000).

Solitary Sandpiper.—According to Moskoff (1995), this species is little studied, so causes of population decline are unknown. Breeding range overlaps greatly with Rusty Blackbird, suggesting that both species are suffering from habitat degradation of southern boreal forest wetlands. It cannot be assumed that population trends in the rest of the breeding range are consistent with the trend measured by the BBS in the southern portions of the range, nor are CBC trends representative of the wintering population, since CBC covers a small fraction of the wintering range. However, the International Shorebird Survey also shows declines for Solitary Sandpiper, in both the North Atlantic and Midwestern survey regions (Bart et al. 2007).

Whimbrel.—Whimbrels only rarely stop over in agricultural habitats (Skeel and Mallory 1996), so their population trends are unlikely to be linked with agricultural practices.

Wilson's Plover.—This species is confined to coastal habitats (Corbat and Bergstrom 2000), so its population declines are related to human disturbances of coastal habitats, not agricultural practices.

American and Pacific Golden-Plovers.—The CBC trend for the combined species may reflect the trend of the Pacific Golden-Plover more than the American, whereas American is the focal species for this study because it uses agricultural fields in our focal BCRs extensively during spring migration (Butcher et al. 2006). Bart et al. (2007) show declines for American Golden-Plover in the North Atlantic, but increases in the Midwest.

American Bittern.—Like the King Rail, American Bitterns use shallow marshes with a lot of emergent vegetation. Bitterns are found predominantly in protected areas (Gibbs et al. 1992), so the major effect of agriculture would be conversion of marshes to agriculture and effects of agricultural practices on adjacent wetlands.

Mottled Duck.—Mottled Duck shows a slight increase on the CBC, but a strong decline on the BBS, especially in Texas (Sauer et al. 2005). In Texas, the birds use fresh and brackish ponds within emergent marshes; in Louisiana and Texas, large flocks of Mottled Ducks use harvested rice fields after breeding (Moorman and Gray 1994). Mottled Ducks are sensitive to drought conditions that affect water levels in marshes (Moorman and Gray 1994).

Long-billed Curlew.—Although taxonomically a shorebird and thus a waterbird by our definition, ecologically Long-billed Curlews use wetlands only during the nonbreeding season; they breed in grasslands and agricultural fields (Dugger and Dugger 2002). Curlew populations were stable on the CBC, but declining on the BBS, suggesting that declines may be concentrated in the Mexican-wintering population, where habitat use is unknown (Dugger and Dugger 2002), but presumably is frequently dry grassland.

Le Conte's Sparrow.—This sparrow is found in dry grasslands and wet sedge meadows during both breeding and nonbreeding seasons (Lowther 1996). It is secretive, so difficult to census accurately, although good data are available from both the BBS and the CBC. On the BBS, trends were negative in Canada in the western parts of its range (Sauer et al. 2005), areas potentially quite sensitive to drought conditions.

Conservation Concern Species with Poor Trend Information

Eskimo Curlew.—This species went “functionally extinct” very suddenly in the second half of the 19th century (Gill et al. 1998). There have been enough reports since then that it has never officially been declared extinct, but the last specimen was collected in 1963 (and the date of the last photograph is unreported). Loss of the Eskimo Curlew has most often been attributed to unregulated shooting for market, but Gil et al. (1998) also suggest that conversion of tallgrass prairie to agriculture, suppression of prairie fires, efforts to combat locust outbreaks, and the extinction of the Rocky Mountain grasshopper were strong contributing factors.

Buff-breasted Sandpiper.—Like American Golden-Plover and Eskimo Curlew, Buff-breasted Sandpiper primarily uses grassland habitats in its Arctic breeding range, its South American wintering range, and at migration stopovers in-between (Lanctot and Laredo 1994). Population trends are difficult to estimate; this species did not appear frequently enough on migratory shorebird surveys to estimate trends (Bart et al. 2007). Population estimates are very low, and threats along the long migration route (and at both ends) are considered high. All grassland birds are subject to grassland conversion to cropland, especially during winter and on migration; the high Arctic breeding grounds are vulnerable to habitat changes caused by global warming.

Hudsonian Godwit.—This is another species that migrates from its Arctic breeding grounds to South American wintering grounds; but unlike some others covered here, it breeds in wooded wetlands at the northern edge of the boreal forest and winters mostly in coastal areas (Elphick and Klima 2002). Migration surveys suggest population declines (Bart et al. 2007), but population sizes are small. These species is highly congregatory in winter and during migration; spring migration includes rice fields in Texas and Louisiana (Elphick and Klima 2002).

Least Bittern.—Habitat requirements of Least Bittern are most similar to those of King Rail and American Bittern – marshes with emergent vegetation and some open-water patches (Gibbs et al. 1992). Marsh birds in this habitat type would benefit greatly from a proposed marsh bird survey (Conway and Nadeau 2006) since they are quite cryptic and seldom encountered without specific effort.

Black Rail.—Highly secretive nature, very specific habitat requirements, and patchy distribution suggest that this species is a high conservation priority, but preclude our acquiring enough information about it to be sure of status or trends. Black Rails prefer wet meadows and higher portions of salt marshes (Eddleman et al. 1994). Black Rails are seen sporadically in the Eastern Tallgrass Prairie (BCR 22), and it is assumed that historically they bred there routinely, but it can't be proven.

Species doing worse in winter in focal Bird Conservation Regions

Only a handful of species clearly showed lower population trends on the CBC in seven-focal-BCR-region compared with continental trends on the CBC or BBS.

American Black Duck and Wood Duck.—These two ducks forage in agricultural fields much less than other dabblers such as Mallards and geese and prefer wooded habitats much more (Hepp and Bellrose 1995, Longcore et al. 2000). Black Duck populations are declining on the BBS and in the seven-focal-BCR region, but increasing overall on the CBC, suggesting that breeding populations in northeastern Canada are doing much better than those elsewhere. Black Ducks may suffer from competition with Mallards for space, food, and mates (Longcore et al. 2000). Wood Duck populations are increasing continentally on the BBS and CBC, but stable in the seven-focal-BCR region. Restoration of bottomland hardwoods in the seven-focal-BCR region would probably benefit both species.

Sora and Tree Swallow.—These two species don't have much in common, except that both winter in the United States primarily along the coasts and in Florida (Melvin and Gibbs 1996, Robertson et al. 1992), where wintering populations may do better than in the predominantly inland areas of the seven-focal-BCR region.

Lincoln's Sparrow.—Lincoln's Sparrow winters in dense vegetation close to the ground, in both wet and dry habitats (Ammon 1995). The seven-focal-BCR region is in the eastern-most portion of the wintering range.

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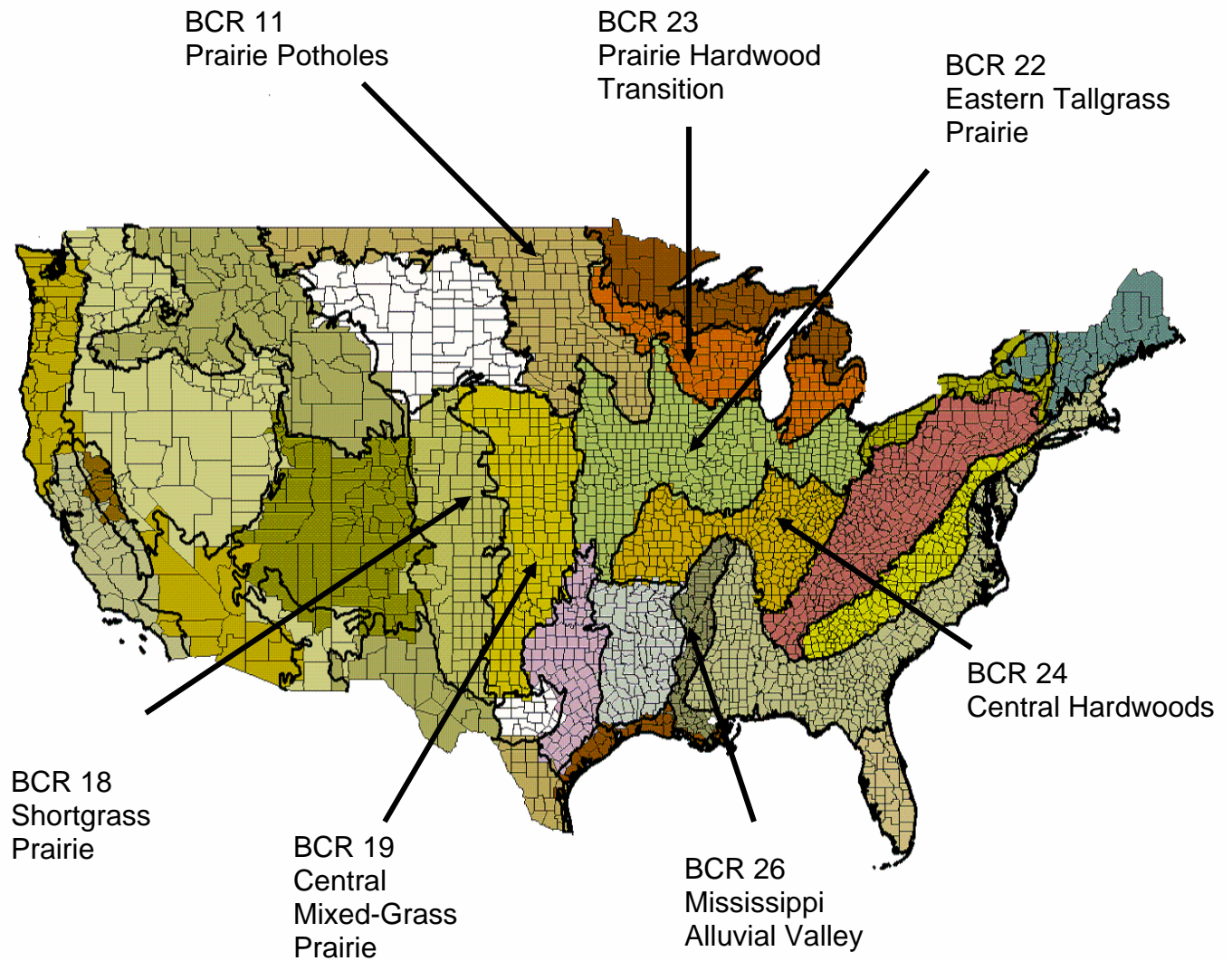


Figure 1. Map of Bird Conservation Regions (BCRs) in the U.S. overlaid on county boundaries. Counties that overlapped BCR boundaries were assigned to the BCR that encompassed the largest percentage of their area. Note that the BCRs bordering Canada and Mexico extend into those countries since the boundaries are defined based on biogeographic characteristics rather than political boundaries. Source: <http://www.nabci-us.org/bcrs.html>.

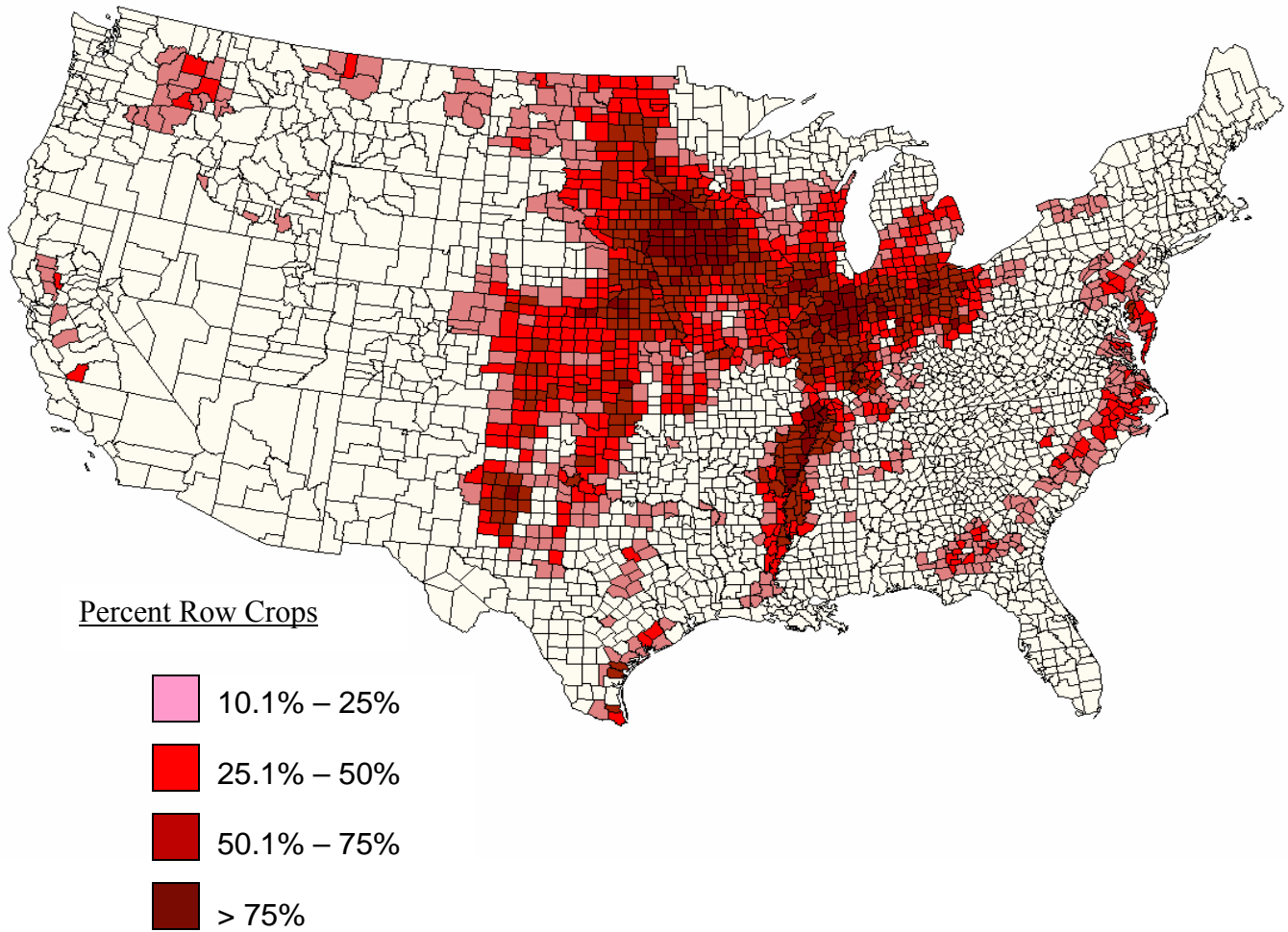


Figure 2. Percentage of each county's land cover that is planted in row crops. Row crops used to determine percent row crops include corn, cotton, peanuts, rice, sorghum, soybeans, spring wheat, tobacco and winter wheat. Source: USDA – NASS 2003 Crop Statistics.

Table 1. Row Crop Acreages in Bird Conservation Regions (BCRs)

BCRs with greater than 10% of their area devoted to row crops are highlighted in bold.

BCR	Name	Number of counties	Area (acres)	Total row crops (acres)	Row crop (percentage)
5	Northern Pacific Rainforest	41	45,158,829	123,800	0.27%
9	Great Basin	84	181,232,282	4,728,200	2.61%
10	Northern Rockies	67	127,872,851	1,097,500	0.86%
11	Prairie Potholes	159	105,541,062	40,759,900	38.62%
12	Boreal Hardwood Transition	76	48,976,538	1,830,100	3.74%
13	Lower Great Lakes St. Lawrence Plain	54	22,831,520	2,166,200	9.49%
14	Atlantic Northern Forest	44	38,465,581	74,100	0.19%
15	Sierra Nevada	7	6,943,206	13,900	0.20%
16	Southern Rockies	75	126,701,587	194,900	0.15%
17	Badlands and Prairies	65	90,119,949	4,314,400	4.79%
18	Shortgrass Prairie	110	95,761,760	19,547,900	20.41%
19	Central Mixed-Grass Prairie	167	96,938,067	28,637,200	29.54%
20	Edwards Plateau	20	12,874,573	120,500	0.94%
21	Oaks and Prairies	94	52,557,901	3,939,700	7.50%
22	Eastern Tallgrass Prairie	376	132,021,408	66,625,899	50.47%
23	Prairie Hardwood Transition	138	62,716,013	14,831,496	23.65%
24	Central Hardwoods	256	75,846,560	10,923,476	14.40%
25	West Gulf Coastal Plain/Ouachitas	101	51,304,179	1,754,200	3.42%
26	Mississippi Alluvial Valley	66	24,667,302	11,252,300	45.62%
27	Southeastern Coastal Plain	362	125,473,933	11,174,184	8.91%
28	Appalachian Mountains	333	99,680,819	2,943,714	2.95%
29	Piedmont	181	47,000,237	2,111,879	4.49%
30	New England/Mid-Atlantic Coast	72	19,997,856	1,439,515	7.20%
31	Peninsular Florida	37	23,226,656	82,420	0.35%
32	Coastal California	38	45,649,222	2,336,600	5.12%
33	Sonoran Mojave Deserts	12	60,340,934	283,000	0.47%
34	Sierra Madre Occidental	8	24,214,925	45,200	0.19%
35	Chihuahuan Desert	20	45,035,725	216,000	0.48%
36	Tamaulipan Brushlands	22	17,939,706	1,547,500	8.63%
37	Gulf Coastal Prairie	27	15,163,174	1,412,400	9.31%

Table 2. Classification of waterbirds by bird families

See Table 3 for the focal species from these families

Family	Ramsar, Wetlands Int., BirdLife Int.	NABCI
Gaviidae	Waterbirds	Waterbirds
Podicipedidae	Waterbirds	Waterbirds
Diomedidae	Seabirds	Waterbirds
Procellariidae	Seabirds	Waterbirds
Hydrobatidae	Seabirds	Waterbirds
Phaethonidae	Seabirds	Waterbirds
Sulidae	Seabirds	Waterbirds
Pelecanidae	Waterbirds	Waterbirds
Phalacrocoracidae	Waterbirds	Waterbirds
Anhingidae	Waterbirds	Waterbirds
Fregatidae	Seabirds	Waterbirds
Ardeidae	Waterbirds	Waterbirds
Ciconiidae	Waterbirds	Waterbirds
Threskiornithidae	Waterbirds	Waterbirds
Phoenicopteridae	Waterbirds	Waterbirds
Anatidae	Waterbirds	Waterfowl
Snail Kite (Accipitridae)		Waterbirds
Gruidae	Waterbirds	Waterbirds
Aramidae	Waterbirds	Waterbirds
Rallidae	Waterbirds	Waterbirds
Jacanidae	Waterbirds	Waterbirds
Haematopodidae	Waterbirds	Shorebirds
Recurvirostridae	Waterbirds	Shorebirds
Charadriidae	Waterbirds	Shorebirds
Scolopacidae	Waterbirds	Shorebirds
Stercoraridae	Seabirds	Waterbirds
Laridae	Waterbirds	Waterbirds
Rhynchopidae	Waterbirds	Waterbirds
Alcidae	Seabirds	Waterbirds
Accipitridae		Landbirds
Alcedinidae		Landbirds
Tyrannidae		Landbirds
Corvidae		Landbirds
Hirundinidae		Landbirds
Troglodytidae		Landbirds
Cinclidae		Landbirds
Parulidae		Landbirds
Emberizidae		Landbirds
Icteridae		Landbirds

Note: We include selected **landbird species** (species not taxonomically considered waterbirds) if they predominantly use wetland habitats.

Table 3. Regional waterbird lists

Includes all species from each Bird Conservation Region (BCR) where the Relative Density (RD) scores are 2 or greater

Species	group	BCRs: 11	18	19	22	23	24	26
<i>ANATIDAE - Dendrocygninae (whistling ducks)</i>								
Black-bellied Whistling-Duck	waterfowl			x				
<i>ANATIDAE - Anserinae (geese & swans)</i>								
Greater White-fronted Goose	waterfowl			x				x
Snow Goose	waterfowl		x	x	x		x	x
Ross's Goose	waterfowl		x	x				
Canada Goose (1)	waterfowl	x	x	x	x	x	x	x
Trumpeter Swan	waterfowl	x		x		x		
Tundra Swan	waterfowl				x	x		
<i>ANATIDAE - Anatinae (ducks)</i>								
Wood Duck	waterfowl	x	x	x	x	x	x	x
Gadwall	waterfowl	x	x	x	x	x	x	x
American Wigeon	waterfowl	x	x	x	x	x	x	x
American Black Duck	waterfowl				x	x	x	x
Mallard	waterfowl	x	x	x	x	x	x	x
Mottled Duck	waterfowl						x	x
Blue-winged Teal	waterfowl	x	x	x	x	x	x	x
Cinnamon Teal	waterfowl	x	x	x				
Northern Shoveler	waterfowl	x	x	x	x	x	x	x
Northern Pintail	waterfowl	x	x	x			x	x
Green-winged Teal	waterfowl	x	x	x	x		x	x
Canvasback	waterfowl	x	x	x	x	x	x	x
Redhead	waterfowl	x	x	x	x	x		x
Ring-necked Duck	waterfowl	x	x	x	x	x	x	x
Greater Scaup	waterfowl			x	x	x	x	x
Lesser Scaup	waterfowl	x	x	x	x	x	x	x
White-winged Scoter	waterfowl	x						
Long-tailed Duck	waterfowl					x		
Bufflehead	waterfowl	x	x	x	x	x	x	x
Common Goldeneye	waterfowl	x	x	x	x	x	x	x
Hooded Merganser	waterfowl	x	x	x	x	x	x	x
Common Merganser	waterfowl	x	x	x	x	x		
Red-breasted Merganser	waterfowl				x	x		
Ruddy Duck	waterfowl	x	x	x	x		x	x
<i>GAVIIDAE (loons)</i>								
Common Loon	waterbird	x		x		x	x	x
Yellow-billed Loon	waterbird	x					x	
<i>PODICIPEDIDAE (grebes)</i>								
Pied-billed Grebe	waterbird	x	x	x	x	x	x	x
Horned Grebe	waterbird	x		x	x		x	x
Red-necked Grebe	waterbird	x						
Eared Grebe	waterbird	x	x	x				
Western Grebe (2)	waterbird	x	x	x				
Clark's Grebe (2)	waterbird	x	x					
<i>PELECANIDAE (pelicans)</i>								
American White Pelican	waterbird	x	x	x		x		x
<i>PHALACROCORACIDAE (cormorants)</i>								
Double-crested Cormorant	waterbird	x	x	x	x	x		x
<i>ANHINGIDAE (anhingas)</i>								
Anhinga	waterbird							x

ARDEIDAE (bitterns, herons & egrets)

American Bittern	waterbird	x	x	x	x	x		x
Least Bittern	waterbird	x	x	x	x	x	x	x
Great Blue Heron	waterbird	x	x	x	x	x	x	x
Great Egret	waterbird			x	x	x	x	x
Snowy Egret	waterbird		x	x	x			x
Little Blue Heron	waterbird			x			x	x
Tricolored Heron	waterbird							x
Reddish Egret	waterbird							x
Cattle Egret	waterbird		x	x		x	x	x
Green Heron	waterbird		x	x	x	x	x	x
Black-crowned Night-Heron	waterbird	x	x	x	x	x	x	x
Yellow-crowned Night-Heron	waterbird	x		x		x	x	x

THRESKIORNITHIDAE (ibis & spoonbill)

White Ibis	waterbird							x
Glossy Ibis	waterbird							x
White-faced Ibis	waterbird		x	x				
Roseate Spoonbill	waterbird							x

CICONIIDAE (storks)

Wood Stork	waterbird							x
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RALLIDAE (rails, coots & moorhens)

Yellow Rail	waterbird	x						x
Black Rail	waterbird			x	x	x		
King Rail	waterbird	x				x	x	x
Virginia Rail	waterbird	x	x	x	x	x	x	x
Sora	waterbird	x	x	x	x	x		x
Common Moorhen	waterbird	x		x	x		x	x
American Coot	waterbird	x	x	x	x	x	x	x

GRUIDAE (cranes)

Sandhill Crane	waterbird	x	x	x		x		
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LARIDAE (gulls & terns)

Laughing Gull	waterbird							x
Franklin's Gull	waterbird	x		x				
Bonaparte's Gull	waterbird			x	x		x	x
Ring-billed Gull	waterbird	x	x	x	x	x	x	x
California Gull	waterbird	x	x	x				
Herring Gull	waterbird			x	x	x		x
Thayer's Gull	waterbird			x				
Caspian Tern	waterbird					x		x
Royal Tern	waterbird							x
Common Tern	waterbird					x		x
Forster's Tern	waterbird	x	x	x		x		x
Least Tern	waterbird	x	x	x	x		x	x
Black Tern	waterbird	x	x	x		x		

CHARADRIIDAE (plovers)

Black-bellied Plover	shorebird	x	x	x	x	x		x
American Golden Plover	shorebird	x	x	x	x	x		x
Snowy Plover	shorebird		x	x				x
Wilson's Plover	shorebird							x
Semipalmated Plover	shorebird	x	x	x	x	x		x
Piping Plover	shorebird	x	x	x	x	x		x
Killdeer	shorebird	x	x	x	x	x	x	x
Mountain Plover	shorebird	x	x	x				

HAEMATOPODIDAE (oystercatchers)

American Oystercatcher	shorebird							x
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RECURVIROSTRIDAE (stilts & avocets)

Black-necked Stilt	shorebird		x	x				x
American Avocet	shorebird	x	x	x				x

SCOLOPACIDAE (sandpipers)

Greater Yellowlegs	shorebird	x	x	x	x	x	x	x
Lesser Yellowlegs	shorebird	x	x	x	x	x	x	x
Solitary Sandpiper	shorebird	x	x	x	x	x		x
Willet	shorebird	x	x	x				x
Spotted Sandpiper	shorebird	x	x	x	x	x	x	x
Upland Sandpiper	shorebird	x	x	x	x	x	x	x
Eskimo Curlew	shorebird							x
Whimbrel	shorebird							x
Long-billed Curlew	shorebird	x	x	x				x
Hudsonian Godwit	shorebird	x	x	x	x	x		x
Marbled Godwit	shorebird	x			x			x
Ruddy Turnstone	shorebird	x			x	x		x
Sanderling	shorebird				x	x		x
Semipalmated Sandpiper	shorebird	x	x	x	x	x	x	x
Western Sandpiper	shorebird		x	x				x
Least Sandpiper	shorebird	x	x	x	x	x	x	x
White-rumped Sandpiper	shorebird	x	x	x	x	x		x
Baird's Sandpiper	shorebird	x	x	x	x	x		x
Pectoral Sandpiper	shorebird	x	x	x	x	x		x
Dunlin	shorebird	x			x	x		x
Stilt Sandpiper	shorebird	x	x	x	x	x		x
Buff-breasted Sandpiper	shorebird	x	x	x	x	x		x
Short-billed Dowitcher	shorebird	x			x	x		x
Long-billed Dowitcher	shorebird	x	x	x	x	x		x
Wilson's Snipe	shorebird	x	x	x	x	x	x	x
American Woodcock	shorebird	x		x	x	x	x	x
Wilson's Phalarope	shorebird	x	x	x	x	x		x
Red-necked Phalarope	shorebird	x						
<hr/>								
<i>ACCIPITRIDAE (osprey, hawks & eagles)</i>								
Osprey	landbird		x		x	x	x	x
Bald Eagle	landbird	x	x	x	x	x	x	x
<i>ALCEDINIDAE (kingfishers)</i>								
Belted Kingfisher	landbird	x	x	x	x	x	x	x
<i>TYRANNIDAE (flycatchers)</i>								
Alder Flycatcher	landbird	x				x		
Black Phoebe	landbird		x	x				
Eastern Phoebe	landbird	x	x	x	x	x	x	x
<i>CORVIDAE (crows & jays)</i>								
Fish Crow	landbird						x	x
<i>HIRUNDINIDAE (swallows & martins)</i>								
Purple Martin	landbird	x		x	x	x	x	x
Tree Swallow	landbird	x	x	x	x	x	x	x
N. Rough-winged Swallow	landbird	x	x	x	x	x	x	x
Bank Swallow	landbird	x	x	x	x	x	x	x
<i>TROGLODYTIDAE (wrens)</i>								
Sedge Wren	landbird	x			x	x	x	x
Marsh Wren	landbird	x	x	x	x	x	x	x
<i>CINCLIDAE (dippers)</i>								
American Dipper	landbird		x					
<i>PARULIDAE (warblers)</i>								
Prothonotary Warbler	landbird				x		x	x
Northern Waterthrush	landbird	x						x
Louisiana Waterthrush	landbird				x	x	x	x
Common Yellowthroat	landbird	x	x	x	x	x	x	x
<i>EMBERIZIDAE (sparrows)</i>								
Le Conte's Sparrow	landbird	x		x		x	x	x
Nelson's Sharp-tailed Sparrow (3)	landbird	x						
Seaside Sparrow	landbird							x
Lincoln's Sparrow	landbird		x	x				x

Swamp Sparrow	landbird	x	x	x	x	x	x	x
<i>ICTERIDAE (blackbirds & orioles)</i>								
Red-winged Blackbird	landbird	x	x	x	x	x	x	x
Yellow-headed Blackbird	landbird	x	x	x		x		
Rusty Blackbird	landbird	x		x	x		x	x
Boat-tailed Grackle	landbird							x

Summary, by NABCI taxonomic groups:

Total # Waterfowl sp.:	31	21	21	25	22	21	20	22
Total # Waterbird sp.:	49	29	23	33	19	24	19	37
Total # Shorebird sp.:	39	31	28	29	27	26	9	37
Total # Landbird sp.:	27	18	14	16	16	17	18	22
TOTAL # ALL SPECIES:	146	99	86	103	84	66	118	110

(1) Canada Goose includes Cackling Goose. The two species were recently split, but no separate data exist for them yet.

(2) Clark's and Western Grebes are combined. The two species were recently split, but there is not yet enough separate data for them to calculate long-term population trends.

(3) For Christmas Bird Count analyses, Nelson's Sharp-tailed Sparrow is combined with Saltmarsh Sharp-tailed Sparrow. Breeding birds can be separated by range, but winter birds overlap, so there is little separate data for the two species to date.

We include selected **landbird species** (that are not taxonomically considered waterbirds (Table 2) if they predominantly use wetland habitats.

Table 4. Habitat associations of waterbirds

Common name	B - Coastal - open water	B - Coastal - wetland/shore	B - Inland - open water, stream	B - Inland - wetland/shore/wet-tundra	MW - Coastal - open water	MW - Coastal - wetland/shore	MW - Inland - open water, stream	MW - Inland - wetland/shore	Guild
Black-bellied Whistling-Duck				X		s		X	dabbler
Greater White-fronted Goose				X				X	dabbler
Snow Goose		s	X			s	s	X	dabbler
Ross's Goose		s	X			B	s	B	dabbler
Canada Goose (including Cackling)		s	X			B	s	B	dabbler
Trumpeter Swan				X		s	s	X	dabbler
Tundra Swan		s	X		s	B	s	B	dabbler
Wood Duck				X				X	dabbler
Gadwall				X				X	dabbler
American Wigeon				X		B		B	dabbler
American Black Duck				X	s	B	s	B	dabbler
Mallard				X		s		X	dabbler
Mottled Duck		s	X			s		X	dabbler
Blue-winged Teal				X		B		B	dabbler
Cinnamon Teal				X		s		X	dabbler
Northern Shoveler				X		B		B	dabbler
Northern Pintail				X		B		B	dabbler
Green-winged Teal		s	X			B		B	dabbler
Canvasback			B	B	B		B		diver
Redhead				X	s	X	s		diver
Ring-necked Duck				X		s	X	s	diver
Greater Scaup		s	B	B	X		s		diver
Lesser Scaup			X	X	s		X		diver
White-winged Scoter			X		X				diver
Long-tailed Duck			X		X		s		diver
Bufflehead			X		B		B		diver
Common Goldeneye			X		B		B		diver
Hooded Merganser				X	s	s	s	X	diver
Common Merganser			X		s		X		diver
Red-breasted Merganser	s	B	B	B	X		s		diver
Ruddy Duck			B	B	B	B	B	s	diver
Common Loon			X		X		s		diver
Yellow-billed Loon			X		X				diver
Pied-billed Grebe			B	B	s	s	B	B	diver
Horned Grebe			B	B	X		s		diver
Red-necked Grebe			B	B	X				diver
Eared Grebe			B	B	B		B		diver
Western Grebe			B	B	X		s		diver
Clark's Grebe			B	B	X		s		diver
Clark's & Western Grebe's (combined)			B	B	X		s		diver
American White Pelican			B	B	X		s		gulls/terns/pel

Double-crested Cormorant	s	s	X	s	X	s	s	s	diver
Anhinga		s		X		s		X	diver
American Bittern				X		s		X	wader
Least Bittern		s		X		X		s	wader
Great Blue Heron		B		B		B		B	wader
Great Egret		B		B		B		B	wader
Snowy Egret		B		B		B		B	wader
Little Blue Heron		B		B		B		B	wader
Tricolored Heron		X		s		X		s	wader
Reddish Egret		X				X			wader
Cattle Egret		B		B		B		B	wader
Green Heron		B		B		B		B	wader
Black-crowned Night-Heron		B		B		B		B	wader
Yellow-crowned Night-Heron		B		B		X		s	wader
White Ibis		B		B		X		s	wader
Glossy Ibis		B		B		B		B	wader
White-faced Ibis		s		X		B		B	wader
Roseate Spoonbill		X				X			wader
Wood Stork		B		B		B		B	wader
Osprey	B	B	B	B	B	B	B	B	land
Bald Eagle	B		B		B		B		land
Yellow Rail				X		X		s	wader
Black Rail		B		B		B		B	wader
King Rail		s		X		s		X	wader
Virginia Rail				X		B		B	wader
Sora		s		X		B		B	wader
Common Moorhen		s		X		s		X	wader
American Coot			s	X	B	B	B	s	wader
Sandhill Crane				X				X	wader
Black-bellied Plover				X		X		m	shorebird
American Golden-Plover*				s		s		s	shorebird
American* & Pacific* Golden-Plovers				s		s		s	shorebird
Snowy Plover		B		B		X			shorebird
Wilson's Plover		X				X			shorebird
Semipalmated Plover		s		X		B		B	shorebird
Piping Plover		B		B		X			shorebird
Killdeer		s		X		B		B	shorebird
Mountain Plover*									shorebird
American Oystercatcher		X				X			shorebird
Black-necked Stilt		B		B		B		B	shorebird
American Avocet				X		B		B	shorebird
Greater Yellowlegs				X		B		B	shorebird
Lesser Yellowlegs				X		B		B	shorebird
Solitary Sandpiper				X		s		X	shorebird
Willet		B		B		X			shorebird
Spotted Sandpiper				X		B		B	shorebird
Upland Sandpiper*									shorebird
Eskimo Curlew*						s			shorebird
Whimbrel				X		X		s	shorebird
Long-billed Curlew*						B		B	shorebird
Hudsonian Godwit		s		X		B		B	shorebird
Marbled Godwit				X		X		m	shorebird
Ruddy Turnstone		X		s		X		m	shorebird
Sanderling		B		B		X		m	shorebird
Semipalmated Sandpiper				X		B		m	shorebird
Western Sandpiper				X		B		B	shorebird
Western & Semipalmated Sandpipers				X		B		B	shorebird
Least Sandpiper		B		B		B		B	shorebird
White-rumped Sandpiper		B		B		B		B	shorebird

Baird's Sandpiper*			s		s	X		shorebird
Pectoral Sandpiper			X		s	X		shorebird
Dunlin	B		B		B	B		shorebird
Stilt Sandpiper*			s		s	X		shorebird
Buff-breasted Sandpiper*							s	shorebird
Short-billed Dowitcher			X		X		m	shorebird
Long-billed Dowitcher			X		B		B	shorebird
Wilson's Snipe			X				X	shorebird
American Woodcock			X				X	shorebird
Wilson's Phalarope			X				B B	shorebird
Red-necked Phalarope			X	X	m	s	m	shorebird
Laughing Gull	B	B	s	s	B	B	s s	gulls/terns/pel
Franklin's Gull				X		B		gulls/terns/pel
Bonaparte's Gull			B	B	B	B	B B	gulls/terns/pel
Ring-billed Gull	B	B	B	B	B	B	B B	gulls/terns/pel
California Gull			B	B	B	B	s s	gulls/terns/pel
Herring Gull	B	B	B	B	B	B	B B	gulls/terns/pel
Thayer's Gull	X				X		s	gulls/terns/pel
Thayer's & Iceland Gull's	X				X		s	gulls/terns/pel
Caspian Tern	B	B	B	B	B	B	B B	gulls/terns/pel
Royal Tern	B	B			B	B		gulls/terns/pel
Common Tern	B	B	B	B	B	B	s s	gulls/terns/pel
Forster's Tern	s	s	B	B	B	B	B B	gulls/terns/pel
Forsters & Common Terns (combined)	B	B	B	B	B	B	B B	gulls/terns/pel
Least Tern	B	B	s	s	B	B		gulls/terns/pel
Black Tern				X	X		m m	gulls/terns/pel
Belted Kingfisher		s	X			s	X	land
Alder Flycatcher				X			X	land
Black Phoebe				X			X	land
Eastern Phoebe				X			X	land
Fish Crow	B			B		B	B	land
Purple Martin				X		s	s	land
Tree Swallow		s		X		B	B	land
Northern Rough-winged Swallow				X			X	land
Bank Swallow				X			X	land
Sedge Wren				X			X	land
Marsh Wren	B			B		B	B	land
American Dipper			X				X	land
Prothonotary Warbler				X		X		land
Northern Waterthrush				X			X	land
Louisiana Waterthrush				X			X	land
Common Yellowthroat				X			X	land
Le Conte's Sparrow				X			X	land
Nelson's Sharp-tailed Sparrow	B			B		X		land
Sharp-tailed Sparrows (2 sp. Lumped)	B			B		X		land
Seaside Sparrow	X					X		land
Lincoln's Sparrow				X		s	s	land
Swamp Sparrow	B			B		B	B	land
Red-winged Blackbird		s		X		s	X	land
Yellow-headed Blackbird				X			X	land
Rusty Blackbird				X			X	land
Boat-tailed Grackle	X			s		X	s	land

*Although these species are taxonomically defined as shorebirds, ecologically they are primarily landbirds, especially in the season(s) where the wetland habitat choices are left blank or marked only with a lower-case "s". An "X" is used to signify a primary habitat used during a particular season. If two or more water-associated habitats are used during a particular season with approximately equal preference, a "B" is used for "both". If a species occurs equally in an upland and wetland habitat, an "X" is nonetheless recorded in the table.

("B" is used if two water/wetland habitats are used.)

A habitat that is used less frequently and is of "secondary" importance receives an "s".

For some species that use a distinct habitat during migration but not winter, an "m" is recorded for migration use.

Table 5. Numbers of Focal Waterbirds with Reliable CBC and BBS Surveys 1966-2004

Continental

Breeding Bird Survey

	3	2	1	0	No Data	All Species	% 2+
Waterfowl	2	16	2	3	8	31	58%
Waterbirds	2	21	18	1	6	48	48%
Shorebirds	5	5	5	0	24	39	26%
Landbirds	7	17	2	1	0	27	89%
All focal species	16	59	27	5	40	145	52%

Christmas Bird Count

	3	2	1	0	No Data	All Species	% 2+
Waterfowl	7	13	4	7	0	31	65%
Waterbirds	2	12	26	4	4	48	29%
Shorebirds	2	6	19	2	10	39	21%
Landbirds	4	8	6	3	6	27	44%
All focal species	15	39	55	20	20	145	37%

CBC or BBS

	3	2	1	0	No Data	All Species	% 2+
Waterfowl	8	18	2	3	0	31	84%
Waterbirds	4	25	19	0	0	48	60%
Shorebirds	7	7	16	1	8	39	36%
Landbirds	9	16	2	0	0	27	93%
All focal species	28	66	39	4	8	145	65%

Regional

Breeding Bird Survey

	3	2	1	0	No Data	All Species	% 2+
BCR 26	0	10	8	10	82	110	9%
BCR 24	7	6	8	0	97	118	11%
BCR 23	11	19	6	8	22	66	45%
BCR 22	8	6	10	6	54	84	17%
BCR 19	4	11	17	8	63	103	15%
BCR 18	2	7	14	6	57	86	10%
BCR 11	15	27	15	7	35	99	42%
Continental	16	59	27	5	40	145	52%

Christmas Bird Count

	3	2	1	0	No Data	All Species	% 2+
BCR 26	0	32	26	3	49	110	29%
BCR 24	1	12	19	0	86	118	11%
BCR 23	1	5	7	0	53	66	9%
BCR 22	1	16	16	0	51	84	20%
BCR 19	0	20	18	4	59	103	19%
BCR 18	0	18	17	0	51	86	21%
BCR 11	0	4	5	1	89	99	4%
7 focal BCRs	15	31	28	3	68	145	32%
Continental	15	39	55	16	20	145	37%

CBC or BBS

	3	2	1	0	No Data	All Species	% 2+
BCR 26	0	35	26	7	42	110	32%
BCR 24	8	13	23	0	74	118	18%
BCR 23	11	23	8	5	19	66	52%
BCR 22	9	17	22	2	34	84	31%
BCR 19	4	25	26	8	40	103	28%
BCR 18	2	22	22	3	37	86	28%
BCR 11	15	29	17	6	31	99	44%
Continental	28	66	39	4	8	145	65%

CBC = Audubon Christmas Bird Count

BBS = Breeding Bird Survey

3 = highest reliability rank, definitions are in the Methods

Reliability is based on sample size, average abundance,
precision of trend estimate, and (for continental trends only)
proportion of seasonal range covered by the survey

2 = second highest reliability rank, earned if any of the 3 (or 4)

factors scores a 2 out of a possible 3

1 = third highest reliability rank, earned if any of the 3 (or 4)

factors scores a 1 out of a possible 3

0 = lowest reliability rank, earned if the precision or coverage score

is 0. If the sample size or average abundance score is zero,
then the trend is not used.

No Data = species for which trend data are not available, are too few,

or average abundance is too low

Table 6. Trends of focal waterbird species in North America 1966 to the present

	<u># of species</u>	<u>% of species</u>
Species with large increases	52	36%
Species with small increases	19	13%
Species with stable populations	27	19%
Species with small declines	26	18%
Species with large declines	13	9%
Species with no trend information	8	6%
TOTAL	145	

These are the focal species for the study because they occur regularly during at least one season of the year in at least one of the seven focal bird conservation regions that has 10% or more of its land base devoted to row-crop agriculture.

Table 7. Summary of group analyses of CBC trend data 1966-2004

Except for landbirds, groups of focal species in focal BCRs did better than the same groups did continentally.

	# species	# species w/ CBC trend data	Group trend % per year
All waterbirds continentally	265	212	1.42*
Focal species continentally	145	137	1.46*
Focal CBC species continentally	145	108	1.54*
Focal species in focal BCRs	145	108	3.78*
All shorebirds continentally	50	42	0.02
Focal shorebirds continentally		31	0.15
Focal CBC shorebirds continentally		18	0.56
Focal shorebirds in focal BCRs		18	1.83
All landbirds continentally	37	34	1.26*
Focal landbirds continentally		27	0.62
Focal CBC landbirds continentally		22	0.67
Focal landbirds in focal BCRs		22	0.96
All divers continentally	38	37	1.32*
Focal divers continentally		27	0.62
Focal CBC divers continentally		21	1.29
Focal divers in focal BCRs		21	3.78*
All gulls/terns/pelicans continentally	34	26	1.59*
Focal g/t/p continentally		14	2.52*
Focal CBC g/t/p continentally		11	2.70*
Focal g/t/p in focal BCRs		11	9.81*
All waders continentally	29	29	2.27*
Focal waders continentally		25	2.37*
Focal CBC waders continentally		19	2.10*
Focal waders in focal BCRs		19	3.66*
All dabblers continentally	21	21	3.98*
Focal dabblers continentally		18	4.41*
Focal CBC dabblers continentally		17	3.14*
Focal dabblers in focal BCRs		17	6.46*

* = statistically significantly different from zero trend

Group trend = percent change per year for the group as a whole

(all group trends are positive in this study)

All species = all waterbirds that normally occur in the United States
Focal species = all waterbirds that normally occur in the 7 bird conservation regions
with 10% or more of the land base devoted to row-crop agriculture
Focal species continentally = in each of the second lines above,
CBC trends for all focal waterbirds in each group
Focal CBC species continentally = in each of the third lines above,
CBC trends for all focal waterbirds that have CBC trends
in the 7-focal-BCR region
Focal BCRs = 7 bird conservation regions
with 10% or more of the land base devoted to row-crop agriculture
Focal species in focal BCRs = CBC trends were calculated for all focal waterbirds
in the 7-focal-BCR region

Table 8. Trend differences: continental versus focal BCRs.

a. Christmas Bird Count:

Except in BCR 19, species had better population trends in the high-ag BCRs than they did continentally.

	n	Mean score	p
7 focal BCRs	77	85.87	0.020
Continental	77	69.13	
BCR 11	10	12.65	0.112
Continental	10	8.35	
BCR 18	35	40.00	0.065
Continental	35	31.00	
BCR 19	42	42.05	0.869
Continental	42	42.95	
BCR 22	33	39.53	0.011
Continental	33	27.47	
BCR 23	13	14.35	0.590
Continental	13	12.65	
BCR 24	32	35.7	0.171
Continental	32	29.3	
BCR 26	61	64.17	0.405
Continental	61	58.83	

b. Breeding Bird Survey:

In four of the seven BCRs, species had better population trends in the BCRs than they did continentally.

	n	Mean score	p
BCR 11	65	72.52	0.034
Continental	65	58.48	
BCR 18	29	25.24	0.056
Continental	29	33.76	
BCR 19	40	36.72	0.148
Continental	40	44.28	
BCR 22	30	33.95	0.128
Continental	30	27.05	
BCR 23	44	40.94	0.193
Continental	44	48.06	
BCR 24	21	25.33	0.044
Continental	21	17.67	
BCR 26	28	34.59	0.005
Continental	28	22.41	

Tests are Wilcoxon Matched Pair Signed Rank tests, where n = the number species in the analysis, mean scores are the rank sums, and the probabilities are two-sided.

Table 9. Focal waterbirds of conservation priority

<u>Listing Category</u>	<u>Species</u>	<u>Continental Trend</u>
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Listed species of continued concern because of confirmed declines

YWL	Rusty Blackbird	-6.6%/yr
BCC	Common Tern	-6.3
HC	King Rail	-4.6
HCP	Northern Pintail	-3.6
VU, RWL	Piping Plover	-3.2
(E), YWL	Seaside Sparrow	-3.0
VU, RWL	Mountain Plover	-2.7

Listed species of continued concern because of BBS declines in U.S. range

E	Wood Stork	-3.2 (BBS)
BCC	Little Blue Heron	-2.5 (BBS)
YWL, BCC	Marbled Godwit	-1.0 (BBS)

Listed species of continued concern because of suggested declines

BCC	Solitary Sandpiper	-5.9
YWL, BCC	Whimbrel	-4.6
YWL, BCC	Wilson's Plover	-4.0
YWL, BCC	American Golden-Plover	-3.8*
HC	American Bittern	-2.2
YWL	Mottled Duck	-1.9
YWL, BCC	Prothonotary Warbler	-1.5
NT, RWL	Long-billed Curlew	-1.4
GHC	Western Sandpiper	-1.4
HC	Horned Grebe	-1.2
(E), BCC	Least Tern	-1.2
BCC	Le Conte's Sparrow	-0.9
RWL	Yellow-billed Loon	-0.9
HCP	Lesser Scaup	-0.7
YWL	American Woodcock	-0.5
HC	Sora	-0.3
CHC	Sanderling	-0.3
RWL, (T)	Snowy Plover	-0.2

Listed species with trend data insufficient to evaluate status

PE, RWL	Eskimo Curlew	--
NT, RWL	Buff-breasted Sandpiper	--
YWL, BCC	Hudsonian Godwit	--
HC	Least Bittern	-0.5
NT, RWL	Black Rail	0.4
CHC	Ruddy Turnstone	0.8
YWL, BCC	Short-billed Dowitcher	1.8
YWL, BCC	Yellow Rail	3.3
BCC	Stilt Sandpiper	7.4

Continued management priority despite increasing trend

HCP	Mallard	1.7
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Listed species of lower conservation concern because of confirmed population increases

T	Bald Eagle	5.6
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Listed species possibly of lower conservation concern because of suggested population increases

YWL	Trumpeter Swan	9.5
HCP, YWL	American Black Duck	1.4
HC	Pied-billed Grebe	1.3
RWL	Nelson's Sharp-tailed Sparrow	0.9
BCC	Louisiana Waterthrush	0.8
YWL, BCC	Wilson's Phalarope	0.8
BCC	Upland Sandpiper	0.7

Listed species possibly of lower conservation concern in U.S. due to population increase/stability in U.S.

HC	Snowy Egret	4.8
YWL, BCC	American Oystercatcher	1.9
YWL, BCC	Reddish Egret	1.8
BCC	Sedge Wren	1.6
HC	Tricolored Heron	0.3

Unlisted species possibly of conservation concern in the U.S. because of suggested population declines

	Lesser Yellowlegs	-7.2
	Greater Scaup	-3.4
	Canvasback	-2.2
	Long-tailed Duck	-1.9
	Herring Gull	-1.6**
	Black Tern	-1.5
	Tundra Swan	-1.2
	Wilson's Snipe	-1.0
	Yellow-crowned Night-Heron	-1.0
	Yellow-billed Loon	-0.9
	Cattle Egret	-0.8
	Clark's & Western Grebes (combined)	-0.7
	American Coot	-0.7
	Green Heron	-0.7
	Spotted Sandpiper	-0.7
	Bank Swallow	-0.6
	Red-winged Blackbird	-0.6**
	Cinnamon Teal	-0.6

*American Golden-Plover trend is for American and Pacific Golden-Plovers combined, because they were only recently split into separate species, so there are few years with separate data for the species.

**Herring Gull and Red-winged Blackbirds are poor candidates for listing because many people consider them to be above desired population levels. Herring Gull declines may be the result of better management of landfills; Red-winged Blackbird population declines may result from depredation efforts in crops and especially at winter roosts.

BBS = Breeding Bird Survey

BCC = Birds of Conservation Concern (U.S. FWS)

CHC = Continental High Concern (U.S. Shorebird Conservation Plan)

E = Endangered (U.S. Endangered Species List)

(E) = portion of the species is Endangered (U.S. Endangered Species List)

GHC = Global High Concern (U.S. Shorebird Conservation Plan)

HC = High Concern (Waterbird Conservation for the Americas)

HCP = High Continental Priority (North American Waterfowl Management Plan)

NT = Near-Threatened (BirdLife, IUCN)

PE = Possibly extinct

RWL = Red WatchList (Audubon)

T = Threatened (U.S. Endangered Species List)

(T) = portion of the species is Threatened (U.S. Endangered Species List)

VU = Vulnerable (BirdLife, IUCN)

YWL = Yellow WatchList (Audubon)

Table 10. Continental trends: Large increases

Common name	Combined trend category -- continental		CBC trend category -- continental		BBS trend category -- continental	
	Combined trend -- continental	CBC	CBC trend -- continental	Reliability rank	BBS trend -- continental	Reliability rank
Ross's Goose	I*	11.9	I*	11.9 2	?	X
Greater White-fronted Goose	I*	10.6	I*	10.6 2	?	X
Double-crested Cormorant	I*	8.2	I*	9.7 2	I*	6.7 2
Thayer's & Iceland Gulls	I*	8.1	I*	8.1 2	?	X
Franklin's Gull	i	7.4	?	x	i	7.4 1
Canada Goose (including Cackling)	I*	7.2	I*	6.3 2	I*	9 2
Osprey	I*	6.4	I*	7.3 1	I*	6.3 2
Hooded Merganser	I*	6.2	I*	6.4 3	I*	6 1
Bald Eagle	I*	5.6	I*	5.4 3	I*	6.1 2
Glossy Ibis	I	4.8	I*	9.6 2	S	-0.4 1
Snowy Egret	I	4.8	I*	4.1 1	I*	4.9 2
American Wigeon	I	4.7	S	-0.1 2	i	15.9 0
Gadwall	I	4.6	I*	4.9 3	I*	4.4 3
American White Pelican	I	4.4	I*	8.0 2	I*	2.6 2
Laughing Gull	I	4.2	I*	6.3 1	I*	3.8 2
Wood Duck	I	3.8	I*	3.2 0	I*	4.1 2
Ring-necked Duck	I	3.2	I*	3.7 2	I*	2.5 2
Eared Grebe	I	3.2	d	-1.2 2	I*	5.3 2
Caspian Tern	I	2.5	S	-0.1 1	I*	3.3 2
Bufflehead	I	2.4	I*	2.1 3	i	3.3 2
Marsh Wren	I	2.3	i	0.9 2	I*	3.3 2
Virginia Rail	I	2.3	I*	1.6 2	I*	2.7 1
Ring-billed Gull	I	2.2	i	3.3 1	i	1.6 3
Great Blue Heron	I	2.1	I*	2.4 3	I*	1.9 2
Northern Shoveler	I	1.9	i	2.5 2	I*	1.5 2
Common Goldeneye	I	1.8	S	0.0 0	i	4.7 2
Mallard	I	1.7	I*	2.2 3	i	1.1 2
Eastern Phoebe	I	1.6	I*	2.5 2	i	0.9 3
Boat-tailed Grackle (30-year trend)	I	1.5	i	1.1 3	I*	1.9 3
Bonaparte's Gull	i	1.5	i	1.5 2	?	X
American Black Duck	I	1.4	i	2.8 1	d	-1.2 2
Black-bellied Whistling-Duck	I*	12.8	I*	22.9 0	I*	6.3 0
Greater Yellowlegs	I*	10.0	I*	2.7 1	I*	13.2 1
Snow Goose	I*	10.0	I*	10.0 0	?	X
White-faced Ibis	I*	9.9	I*	15.5 1	I*	8.5 1
Trumpeter Swan	i	9.5	i	9.5 1	?	X
Roseate Spoonbill	I*	8.2	I*	6.6 1	I*	10.3 1
Stilt Sandpiper	I*	7.4	I*	7.4 0	?	X
White Ibis	I*	4.9	I*	6.2 1	I*	3.9 1
Sandhill Crane	I	4.5	i	2.6 0	I*	6.8 1
Black-crowned Night-Heron	I	3.5	I*	3.2 1	i	3.6 1

Wood Stork	I	3.5	I*	5.3	1	d	-3.2	0
Yellow Rail	i	3.3	i	3.3	1	?		X
Black Phoebe	I	2.8	I*	3.7	1	I*	2	1
Long-billed Dowitcher	i	2.7	i	2.7	1	?		X
Great Egret	I	2.6	I*	4.1	1	I*	2	1
Black-necked Stilt	I	2.5	I*	10.3	1	S	0.4	1
American Oystercatcher	I*	1.9	I*	1.9	1	?		X
Reddish Egret	I*	1.8	I*	1.8	1	?		X
Short-billed Dowitcher	i	1.8	i	1.8	1	?		X
Sedge Wren	I	1.6	i	1.0	1	I*	1.9	1
Common Loon	I	1.6	i	1.1	0	I*	2.4	1

CBC = Audubon Christmas Bird Count

BBS = Breeding Bird Survey

I* = statistically significantly increasing population with trend > 1.36%/year.

Such a trend would double the population in 30 years.

All these thresholds were set by the Partners in Flight Science Committee.

i = increasing population > 0.47/year, but either not statistically significant
or not > 1.36%/year

S = stable population. Trend is between -0.54/year and +0.47/year

d = decreasing population < -0.54/year, but either not statistically significant
or not < -2.28%/year

D* = statistically significant decreasing population with trend < -2.28%/year.

Such a trend would cut the population in half in 30 years.

3 = highest reliability rank, definitions are in the Methods

Reliability is based on sample size, average abundance,
precision of trend estimate, and (for continental trends only)
proportion of seasonal range covered by the survey

2 = second highest reliability rank, earned if any of the 3 (or 4)

factors scores a 2 out of a possible 3

1 = third highest reliability rank, earned if any of the 3 (or 4)

factors scores a 1 out of a possible 3

0 = lowest reliability rank, earned if the precision or coverage score

is 0. If the sample size or average abundance score is zero,
then the trend is not used.

Table 11. Continental Christmas Bird Count trends by time period

	<u>1966-76</u>	<u>1976-86</u>	<u>1986-96</u>	<u>1996-2001</u>	<u>2001-2004</u>
Increasing species	44	57	74	70	69
Stable species	32	32	33	31	45
Decreasing species	48	36	18	24	11

Table 12. Attributes of declining species (including all species with both large and small declines)

	# species <u>w/known trends</u>	# species <u>w/unknown trends</u>	<u># declining</u>	<u>% declining*</u>
TOTAL	137	8	39	28%*
Waterfowl	31	0	8	26%
Dabblers	18	0	4	22%
Divers	13	0	4	31%
Waterbirds	48	0	14	33%
Divers	9	0	3	33%
Waders	25	0	7	28%
<i>Herons/egrets/bitterns</i>	12	0	5	42%
Pelican/gulls/terns	14	0	4	29%
Shorebirds	31	8	11	35%*
Landbirds	27	0	6	22%
*Percentage of the species with known trends				
Breeds				
Coastal open water	10	0	3	30%
Coastal wetland/shore	41	1	10	25%*
Inland open water	29	0	8	28%
Inland wetland/shore	113	5	31	29%*
Migrates/winters				
Coastal open water	32	1	11	35%*
Coastal wetland/shore	78	3	19	25%*
Inland open water	20	0	4	20%*
Inland wetland/shore	83	4	21	27%*
*Percentage of the species with known trends				
Birds on conservation lists	49	3	22	45%*
Birds not on conservation lists	88	5	17	19%*
*Percentage of the species with known trends				

Table 13. Attributes of increasing species (including only species with large increases)

	# species w/known trends	# species w/unknown trends	# increasing	% increasing*
TOTAL	137	8	52	38%*
Waterfowl	31	0	16	52%
Dabblers	18	0	12	67%
Divers	13	0	4	31%
Waterbirds	48	0	23	48%
Divers	9	0	3	33%
Waders	25	0	13	52%
Pelican/gulls/terns	14	0	7	50%
Shorebirds	31	8	6	19%*
Landbirds	27	0	7	26%
*Percentage of the species with known trends				
Breeds				
Coastal open water	13	0	6	60%
Coastal wetland/shore	60	2	17	42%*
Inland open water	32	0	10	34%
Inland wetland/shore	116	6	34	31%*
Migrates/winters				
Coastal open water	38	1	12	39%*
Coastal wetland/shore	96	7	25	33%*
Inland open water	41	1	8	40%*
Inland wetland/shore	102	7	31	39%*
*Percentage of the species with known trends				
Birds on conservation lists	49	3	10	20%*
Birds not on conservation lists	88	5	42	48%*
*Percentage of the species with known trends				



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