American Birds
The 102nd Christmas Bird Count

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Indicative of the vast amount of unfrozen water on northern Christmas Bird Counts in the 102nd CBC season was this Long-tailed Duck (*Clangula hyemalis*), a winter adult male, at Michigan City Harbor on the Indiana Dunes National Lakeshore, Indiana, CBC. Photo/John K. Cassady

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ON THE COVER: Hummingbirds have become a real phenomenon on Christmas Bird Counts, both in their "expected" area of abundance along the Gulf Coast and in southern areas, and increasingly on far-flung CBCs to the north. This Rufous Hummingbird (*Selasphorus rufus*), an immature male, was attracted not by feeders but by late-blooming flowers, and spent the fall at Lenoir Preserve in Yonkers, New York, to be counted on the Bronx-Westchester, New York, CBC. Photo/Phil Jeffrey

The 102nd Christmas Bird Count

December 14, 2001, to January 5, 2002

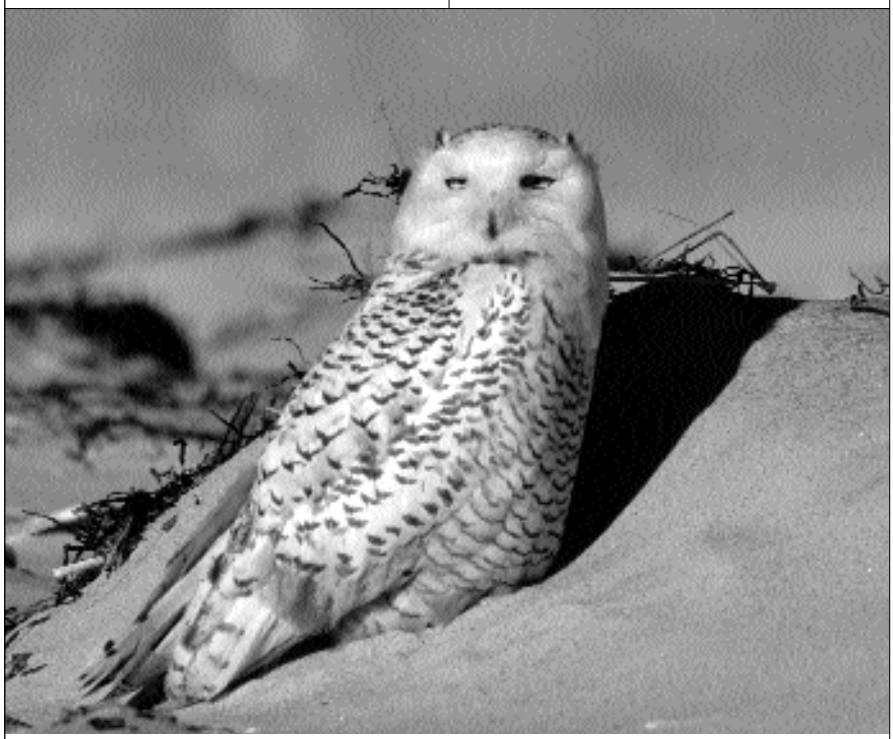
Geoffrey S. LeBaron

What is it that entices otherwise sane human beings—even if they are bird watchers—to spend a significant chunk of their holiday vacation time away from family and friends out in the cold weather counting birds? Is it the lure of the possibility of finding magnificent winter raptors, twittering flocks of irruptive finches, out-of-range vagrant birds, or out-of-season lingering fall migrants? Could it be the hope of breaking a count record from last season (or even better, the record of a neighboring count)? How about the simple prospect of spending a lovely early winter day outdoors?

Or is it actually that the Christmas Bird Count is the only time we may see some of our friends and family?

Any one of these things—and quite probably a litany of other similar possibilities—draws tens of thousands of observers into the field, or to their windows to watch their feeders, each holiday season to participate on the annual Christmas Bird Count (CBC). But the 102nd CBC proved to have an incredible array of these potential observer catalysts. A mild and dry fall season set the stage for the likelihood—and survival—of lingering species and out-of-range wanderers. The enticement of good numbers of western hummingbirds, Ash-throated Flycatchers, and Varied Thrushes in the east, all dutifully reported on rare bird alerts during the fall, whetted CBC observers' appetites.

Additionally, it seems that the weather conditions of the summer and fall in the northern regions of North America were unfavorable for seed crops and small mammal crops, so both winter finches (in the form of redpolls and crossbills at least) and irruptive raptors (especially Snowy and Short-eared owls early on) began a southward movement. And generally mild and snow-free weather conditions continentwide kept ponds, lakes, and rivers unfrozen far north of the usual "freeze line," enticing an incredible array of water-associated bird species (loons and grebes, waterfowl, herons, and marsh and shorebirds) to linger in significant numbers far north of their usual CBC ranges. To top it all off, weather conditions, especially on weekends, during the CBC official count period—from December 14 through January 5—tended to be "better than average." By all these measures, it seemed that the 102nd Christmas Bird Count was shaping up to be a grand slam of a CBC.



One of the defining features of the 102nd Christmas Bird Count across many areas in the northern and central latitudes of North America was a good flight of Snowy Owls (*Nyctea scandiaca*). This immature bird was photographed at Jones Beach State Park, New York, in January 2002. Photo/Phil Jeffrey

In the final result, and by many measures (especially of the human component), the 102nd Count results surpassed every preceding season. The record total of 1880 counts set during last season's 101st CBC was shattered this year. With 307 counts in Canada, 1577 counts in the United States, and 52 in the Caribbean, Latin America, and the Pacific Islands, 1936 CBC circles were covered this season, up an amazing 56 from the 101st Count. Not surprisingly, a significant roster of 54 new Christmas Bird Counts is included in this total—19 in Canada (including two new counts in Nunavut), 31 in the United States, one in the Pacific Islands, two in Latin America, and an intriguing new pelagic count done from a research vessel sailing between Antarctica and southern South America. That's quite a different type of count than Mad Island Marsh, Texas, or Monteverde, Costa Rica. The amazing geographic scope of the Christmas Bird Count is documented even in the list of new counts—from the Arctic in Nunavut to the oceans surrounding Antarctica. This varied roster of new CBCs is presented for your perusal in Table 1.

The observer pool attending those counts was equally impressive. The previous record number of participants, from the landmark 100th Christmas Bird

Table 1. New Counts in the 102nd (2001-2002) Christmas Bird Count

Count Name	Count Code
CANADA	
Cold Lake, Alberta	ABCK
Dinosaur Provincial Park, Alberta	ABDI
Nanton, Alberta	ABNA
Rocky Mountain House, Alberta	ABRM
Hat Creek, British Columbia	BCHC
Kingfisher, British Columbia	BCKF
Kaslo, British Columbia	BCKO
McBride, British Columbia	BCMC
Pemberton-Mt. Currie, British Columbia	BCPB
Tofino, British Columbia	BCTO
Clarenville, Newfoundland	NFCL
Lunenburg, Nova Scotia	NSLU
Pictou Harbour, Nova Scotia	NSPI
Arviat, Nunavut	NUAR
Rankin Inlet, Nunavut	NURI
Gameland, Ontario	ONGA
East Point, Prince Edward Island	PEIEP
Qu'Appelle Valley Dam, Saskatchewan	SKQD
Torch Valley, Saskatchewan	SKTV
UNITED STATES	
Cullman, Alabama	ALCU
Crooked Creek Valley, Arkansas	ARCC
Phoenix-Tres Rios, Arizona	AZPT
John Martin Reservoir, Colorado	COJM
Milford, Delaware	DEMF
Floyd County, Georgia	GAFC
Siam-Hopkins, Iowa	IASI
Big Oaks N.W.R., Indiana	INBO
Jetmore, Kansas	KSJM
North Penobscot Bay, Maine	MEBF
Northern Wright County, Minnesota	MNNW
Pine County, Minnesota	MNPC
Two Harbors, Minnesota	MNTH
Liberal, Missouri	MOLI
West Yellowstone, Montana	MTWY
Alligator River N.W.R., North Carolina	NCAR
Lake Ilo N.W.R., North Dakota	NDLI
Angel Fire-Eagle's Nest, New Mexico	NMAE
Pecos, New Mexico	NMPC
Raton, New Mexico	NMRA
New Woodstock, New York	NYNW
Redmond, Oregon	ORRD
Calamity Creek, Texas	TXCE
Orange County, Texas	TXOC
Quanah, Texas	TXQN
Morgan, Utah	UTMG
Leavenworth, Washington	WALW
Hartford, Wisconsin	WIHA
Hustisford, Wisconsin	WIHU
Hayward, Wisconsin	WIHW
Elkins Area, West Virginia	WVEL
PACIFIC ISLANDS, LATIN AMERICA	
Drake Passage, Antarctica	CHDP
Cerro Blanco-Chognon-Puerto Hondo Estuary, Ecuador	ECCB
Ensenada, Baja California, Mexico	MXES
Palmyra Atoll, Pacific Islands	PIPA

Count, was just over 52,000 observers (on 1823 counts). During last season's 101st Count, while the number of counts increased, the observer pool was slightly lower—due in large part to generally inclement weather during the CBC period. That trend was again reversed (both the weather and the participation) during the 102nd Count. In Canada, 7190 field observers partnered with 4046 feeder watchers; in the United States, 38,287 were in the field along with 5565 yardbird observers; and in the Caribbean, Latin America, and the Pacific Islands another 1036 field and five feeder observers participated, for a whopping total of 56,129 observers in the 102nd Christmas Bird Count.

On first impression, it seems surprising that no new "countable" species were added to the cumulative roster of birds found during the Christmas Bird Count in North America, and that the total number of birds included is somewhat low. It may be counterintuitive that a new record number of observers in a new record number of census areas did not combine to tally a record number of birds—or any new species in North America. But consider that one major factor generating this record observer effort—mild weather—is beneficial to birds as well as birders. Remember that when environmental conditions are mild, birds are neither concentrated in areas of limited food resources nor hastened southward to warmer climes. Comfort level aside, the harsh winter conditions that can be "good" for observers (those producing impressive tallies of early-winter birds) are actually stressful for many of the birds themselves. While there may have been many more birds than average in North America during the 102nd CBC season, they were dispersed across the continent, and not concentrated in the prime areas covered by CBC circles. And species forming huge flocks during harsh conditions (like blackbirds and starlings) were apparently still dispersed as well, so the 51,908,813 total birds counted (47,241,040 in the United States, 3,720,457 in Canada, and 947,316 in the Pacific Islands, Latin America, and the Caribbean), while impressive, is still an "average" tally. As far as the blackbirds and their effect on total numbers of birds, remember that one count circle (such as Pine Prairie, Louisiana, in the 88th CBC) can more than double the entire number of birds counted during a season's Christmas Bird Counts!

The total taxonomic tally included in the 102nd Christmas Bird Counts in North America and Hawaii was 657 "countable" species, 38 additional forms, and 23 "non-countable" exotic species. There were some exotic species tallied for the first time, including Scarlet-fronted Parakeet, and White-fronted, Yellow-naped, and Yellow-crowned parrots. There is an incredible diversity of free-flying introduced species (especially parrots) from around the world in areas like south Florida and southern California (not to mention Hawaii); and, as discussed in Bill Pranty's feature article "The Use of Christmas Bird Count Data to Monitor Populations of Exotic Birds" in this issue, the CBC is a valuable tool to monitor the status of these introductions. Of course, although the majority of Christmas Bird Counts each season are in North America, the majority of species tallied are included in the 52 counts outside Canada and the United States. This season, a total of 1828 species was tallied on those 52 counts—an impressive number, but not surprising considering the geographic scope of coverage. Note that there is considerable overlap between the 657 species on the North American list and the 1828 outside North America; many are counted in multiple regions.

A look at species totals on counts during the 102nd season provides an education on the effects of mild weather in different portions of the continent. Table 2, as usual, is the list of all counts in the CBC's 102nd year with 150 or more species. In a slight variation of traditional ordering, this year's Table 3 is the list of high counts per region—species totals as reported by compilers and regional editors. Continuing its reign at the top of the species total category in North America is

Table 2.
Counts with 150 or more species recorded on the 102nd (2001-2002) Christmas Bird Count

Table 2a: Counts north of the United States–Mexican border

Count Code	Rank	Count Name	Species Recorded
TXMM	1	Mad Island Marsh, TX	233
CASB	2	Santa Barbara, CA	206
TXFR	2	Freeport, TX	206
CAPR	3	Point Reyes Peninsula, CA	205
CASD	4	San Diego, CA	202
CAMD	5	Moss Landing, CA	197
CAMR	5	Morro Bay, CA	197
CAOC	5	Orange County (coastal), CA	197
CACS	6	Crystal Springs, CA	194
CASC	7	Santa Cruz County, CA	191
TXSB	8	San Bernard N.W.R., TX	190
TXBP	9	Bolivar Peninsula, TX	180
CAOV	10	Oceanside-Vista-Carlsbad, CA	179
CAAR	11	Arcata, CA	177
CAHF	11	Hayward-Fremont, CA	177
TXCC	12	Corpus Christi, TX	175
CAMC	12	Marin County (southern), CA	175
CARS	13	Rancho Santa Fe, CA	173
CAWS	13	Western Sonoma County, CA	173
CAMP	14	Monterey Peninsula, CA	172
CAPP	14	Palos Verdes Peninsula, CA	172
CAOA	15	Oakland, CA	171
CAVE	15	Ventura, CA	171
LASA	15	Sabine N.W.R., LA	171
CACB	16	Centerville Beach to King Salmon, CA	170
CAPA	16	Palo Alto, CA	170
CAON	17	Orange County (northeastern), CA	169
CASF	18	San Francisco, CA	167
NJCM	18	Cape May, NJ	167
NCSB	19	Southport, Bald Head & Oak Islands, NC	166
TXAR	20	Aransas N.W.R., TX	165
FLJA	21	Jacksonville, FL	164
GASV	21	Savannah, GA-SC	164
CASJ	22	San Jose, CA	163
CABE	23	Benicia, CA	162
TXPA	23	Port Aransas, TX	162
CALU	24	La Purisima, CA	161
TXGA	24	Galveston, TX	161
NCWI	25	Wilmington, NC	160
TXHO	25	Houston, TX	160
FLNR	26	West Pasco (New Port Richey), FL	159
CAMU	27	Malibu, CA	158
FLNP	27	North Pinellas, FL	158
LALT	27	Lacassine N.W.R.-Thornwell, LA	158
TXAP	27	Attwater Prairie Chicken N.W.R., TX	158
NCMC	28	Morehead City, NC	156
VACC	28	Cape Charles, VA	156
CALB	29	Long Beach-El Dorado, CA	155
CASS	29	Salton Sea (south), CA	155
CASU	30	San Juan Capistrano, CA	154
FLAB	30	Aripeka-Bayport, FL	154
FLCO	30	Cocoa, FL	154
LACW	30	Crowley, LA	154
ORCB	30	Coos Bay, OR	154
CAAN	31	Año Nuevo, CA	153
CAPC	31	Putah Creek, CA	153
CASM	31	Sacramento, CA	153
FLZE	31	Zellwood-Mount Dora, FL	153
LACR	31	Creole, LA	153
BCLA	32	Ladner, BC	152
CASG	32	Santa Maria-Guadalupe, CA	152
FLAL	32	Alafia Banks, FL	152
FLMI	32	Merritt Island N.W.R., FL	152
SCLP	32	Litchfield-Pawleys Island, SC	152
TXCF	32	Corpus Christi (Flour Bluff), TX	152
TXSA	32	Santa Ana N.W.R., TX	152
SCHH	33	Hilton Head Island, SC	151
CACC	34	Contra Costa County, CA	150
LANO	34	New Orleans, LA	150
MDOC	34	Ocean City, MD	150
MSSH	34	Southern Hancock County, MS	150
TXRO	34	Rockport, TX	150

Mad Island Marsh, Texas, this year with a slightly lower species total of 233 than its tally in the 101st Count of 235. An interesting pattern develops when this year's totals are compared with those of other, more wintry seasons. First, at the very northern fringe of Christmas Bird Count coverage, there is little or no change in species totals from year to year. All four Arctic counts—Nome and Prudhoe Bay in Alaska, and Arviat and Rankin Inlet in Nunavut—only had one species (Common Raven) on count day (though Arviat had two others, Willow Ptarmigan and House Sparrow, during count week). This is the norm—in the entire run of the Prudhoe Bay CBC since its inception in the 88th Count, the only species ever tallied is Common Raven, although the two "cw" species this season from Arviat may give observers at Prudhoe Bay hope for doubling—or tripling—their list in some future season. Moving southward mentally as we peruse species totals, in the 102nd Count it is apparent both from Tables 2 and 3 (and from the regional summaries in the pages that follow) that many record species totals were set this season in Alaska, southern Canada, and across much of the northern two-thirds of the Lower 48. Moving farther south, many of the species totals across the southern United States are lower than in some years. As mentioned earlier, factors such as the combination of mild weather allowing survival of vagrants and late migrants to the north, combined with the northward lingering of waterfowl and shorebirds in unfrozen marshes, lakes, and rivers tended to both increase species totals northward and decrease them in the south. Comparing this season's Table 2 (150+ species) with that of other years, there is an indication that species totals in the mid-Atlantic region and even in British Columbia were high, and thus appear in this table, while the totals of some counts farther south in California, Texas, Louisiana, and Florida that may tally 185 species or more are in the 150s to 170s. So it is possible that major changes in global weather patterns, such as pre-"El Niño" seasons and any potential human-induced climate

Table 2b: Counts south of the United States–Mexican border

Count Code	Rank	Count Name	Species Recorded
CRMO	1	Monteverde, Costa Rica	376
CRLS	2	La Selva, Lower Braulio Carillo, N.P., Costa Rica	365
ECNM	3	Mindo-Tandayapa, Ecuador	361
RPAC	4	Atlantic Canal Area, R.P., Panama	334
RPPC	5	Pacific Canal Area, R.P., Panama	312
RPCC	6	Central Canal Area, R.P., Panama	291
BLPG	7	Punta Gorda, Belize	267
BLBE	8	Belmopan, Belize	258
BLBC	9	Belize City, Belize	257
BLGJ	10	Gallon Jug, Belize	248
RPVC	11	Volcan, Chiriqui, Panama	219
MXES	12	Ensenada, Baja California, Mexico	189
TRTR	13	Trinidad, West Indies	172
MXYS	14	Yecora, Sonora, Mexico	152
BRIT	15	Itirapina, Sao Paulo, Brazil	151
ECCB	16	Cerro Blanco-Chognon-Puerto Hondo Estuary, Ecuador	150

Observers returning from a boat trip in Boston Harbor on the Greater Boston, Massachusetts, CBC noticed a large dark shape near the "Black Falcon Terminal" where cruise ships dock. It wasn't one of the city's Peregrines, but instead a returning adult female Gyrfalcon (*Falco rusticolus*) that had been banded by Snowy Owl researcher Norm Smith at Logan airport in Boston some years before. This powerful predator stayed in the city for much of the winter, to the delight of probably thousands of human observers; it was often observed taking gulls on the wing. Photo/Shawn P. Carey

change (a.k.a. "global warming"), if they result in milder fall/winter seasons (and despite the many negative aspects of such events), may tend to reduce the historical species total advantage that counters in southern latitudes have enjoyed.

Farther to the south, in Latin America, this season's effort at Monteverde, Costa Rica, tallied an astonishing 376 species on count day, potentially the highest ever on any Christmas Bird Count. La Selva, also in Costa Rica, and Mindo-Tandayapa, Ecuador, also had species totals over 350. Can the elusive 400-species mark be far off? The diversity of species in the neotropics is mind-boggling, and with increasing participation and coverage on counts in Latin America, a 400-species count day total seems possible.

Compilers and regional editors may be thought of as the heart and soul of the Christmas Bird Count, but its lifeblood is the pool of participants. Of course, it shouldn't be forgotten that most compilers and regional editors are included in the "observer" category as well. The Christmas Bird Count is somewhat unique in that there are two different types of census data included: field observers and feeder watchers, with efforts for each kept separately. There is no "good" or "bad" between the two, they are simply different types of census methods. Each is valuable in its own right, and the combination serves to produce an even better picture of the diversity and number of birds present in CBC circles during the official count period of December 14 through January 5 each season. Table 4 this season is the list of all Christmas Bird Counts with 100 or more total observers reported. North Bay, Ontario, maintains its grip on the top spot in this category, a title belonging to those dedicated observers since the 99th CBC.

At this point in each of my summaries for the past 14 years, it has been my tradition to analyze four or five species' presence (or absence) in the given season's Christmas Bird Count results. We've always taken an early-winter snapshot of Bohemian Waxwing and Grasshopper Sparrow, often Evening Grosbeak and some other "winter finch" or two, and occasionally other species of note for the given year. This season I break with that tradition, and instead invite you to do *your own* analysis. We have been working very hard over the past five years to bring the Christmas Bird Count into the 21st century; the transition is now nearly complete. The data from each count every season are now entered on-line by compilers or their designated lieutenant, vastly improving the accuracy of data entry over the old method of paper form submittal followed with data entry by contractors. The CBC historical database is available on-line as well, and although it has been since the 99th count, this year we've developed a new, interactive "output tool" that allows anyone to ask nearly any question of their own design of the CBC database. Are you interested in the results of your count over its entire history? That's available at the click of a mouse. Do you have an interest in a particular species on your count, in your region, or on the Christmas Bird Count as a whole? Just use that mouse again. Have you always wanted to download the data from your count (or any other) into your own computer and do your own analyses? Go ahead, visit the CBC home page,

Table 3. Regional high counts for the 102nd (2001-2002) Christmas Bird Count

Region	# of CBCs	Highest Count (species total)
St. Pierre & Miquelon	2	Ile St. Pierre (49)
Newfoundland	13	St. John's (62)
Nova Scotia	18	Halifax-Dartmouth (116)
Prince Edward Island	3	Prince Edward Island N.P. (62)
New Brunswick	5	Sackville (60)
Quebec	27	Quebec (85)
Ontario	102	Long Point (119)
Manitoba	17	Winnipeg (57)
Saskatchewan	12	Fort Walsh, Cypress Hills (51)
Alberta	36	Calgary (69)
British Columbia	64	Ladner (152)
Nunavut	2	Arviat (1)
		Rankin Inlet (1)
Northwest Territories	3	Norman Wells (16)
Yukon Territory	5	Whitehorse (24)
Alaska	34	Juneau (75)
Maine	25	Greater Portland (103)
New Hampshire	16	Coastal New Hampshire (114)
Vermont	16	Ferrisburg (85)
Massachusetts	33	Cape Cod (133)
Rhode Island	3	Newport County-Westport (124)
		South Kingstown (124)
Connecticut	16	New Haven (126)
New York	72	L.I.: Sagaponack (137)
New Jersey	27	Cape May (167)
Pennsylvania	66	Southern Lancaster County (105)
Delaware	7	Bombay Hook N.W.R. (135)
		Rehoboth (135)
Maryland	23	Ocean City (150)
District of Columbia	1	Washington (115)
Virginia	40	Cape Charles (156)
North Carolina	44	Southport, Bald Head, & Oak Islands (166)
South Carolina	18	Litchfield-Pawleys Island (152)
Georgia	21	Savannah (164)
Florida	61	Jacksonville (164)
Ohio	54	Cincinnati (88)
		Toledo (88)
West Virginia	16	Charles Town (80)
Kentucky	10	Land Between the Lakes (91)
Tennessee	25	Reelfoot Lake (114)
Alabama	12	Gulf Shores (144)
Mississippi	15	Southern Hancock County (150)
Michigan	53	Anchor Bay (86)
Indiana	38	Lake Monroe (106)
Wisconsin	42	Madison (89)
Illinois	54	Rend Lake (104)
Minnesota	47	Duluth (74)
Iowa	28	Keokuk (87)
Missouri	25	Mingo (105)
Arkansas	21	Holla Bend N.W.R. (112)
Louisiana	22	Sabine N.W.R. (171)
North Dakota	19	Garrison Dam (57)
South Dakota	16	Pierre (69)
Nebraska	9	Lake McConaughy (103)
Kansas	24	Linn County (94)
Oklahoma	20	Oklahoma City (108)
Texas	95	Mad Island Marsh (233)
Montana	33	Bigfork (82)
		Stevensville (82)
Wyoming	18	Casper (64)
Colorado	37	Pueblo Reservoir (110)
New Mexico	30	Caballo (131)
Idaho	22	Hagerman Valley (92)
Utah	16	Provo (101)
Nevada	11	Truckee Meadows (110)
Arizona	33	Green Valley-Madera Canyon (147)
Washington	42	Sequim-Dungeness (140)
Oregon	41	Coos Bay (154)
California	114	Santa Barbara (206)
Hawaii	11	Honolulu, O'ahu (52)
Palmyra Atoll	1	Palmyra Atoll (14)
Guam	2	Dededo (29)
Saipan	2	Saipan (41)
Mexico	12	Ensenada, Baja California (189)
Belize	4	Punta Gorda (267)
Costa Rica	2	Monteverde (376)
Panama	4	Pacific Canal Area (334)
Colombia	3	Sabana de Bogota (140)
Ecuador	2	Mindo-Tandayapa (361)
Peru	1	Rio Orosa, Loreto (129)
South Atlantic Ocean	1	Drake Passage (23)
Brazil	2	Itirapina, Sao Paulo (151)
Paraguay	1	Asuncion Bay, Asuncion (102)
Trinidad	1	Trinidad (172)
Bahamas	2	New Providence Island (114)
Dominican Republic	2	Santo Domingo (50)
Puerto Rico	3	Cabo Rojo (111)
Virgin Islands	3	St. Croix (65)
		Tortola (65)
Bermuda	1	Bermuda (89)

www.audubon.org/bird/cbc, and you'll be able to do that, and many other things, as well. And the current tool we have on the Christmas Bird Count home page is only the first generation of what we're planning as a suite of tools that will allow anyone, with any need or interest, to make inquiries of the entire CBC database.

You've undoubtedly noticed that this 102nd Christmas Bird Count issue of *American Birds* is slimmed down from any CBC volume that has been sent out in the past 50 years or so. What are not included in print this season are the complete results—every single bird and observer—reported from every individual Christmas Bird Count. Those data are completely, and even more interactively, available on-line through the CBC home page.

In recent years the Christmas Bird Count issue has only been sent to compilers, regional editors, and a very few subscribers. This year we have decided to expand readership, and have sent the bird count issue of *American Birds* to nearly all CBC participants. This volume includes five feature articles, all highlighting the value of the data that each and every Christmas Bird Count observer, compiler, and regional editor has collected and reviewed over the past 102 years. Two features are reprints of peer-reviewed scientific papers, one is a discussion of the methods of analyses of the CBC database, another documents the value of the Christmas Bird Count for monitoring exotic and introduced species, and the fifth highlights Audubon WatchList bird species as reflected in the CBC historical database. These last two features include graphs that were generated using the on-line output tool—the exact same tool that is now available for your personal inquiries. At long last, the majority of participants on the Christmas Bird Count are able to see the value of their work—the great importance of the CBC database to both pure ornithology and to conservation science. All of us are making a difference with our efforts on the count.

The future is very bright for the Christmas Bird Count on several different fronts. Based upon the highly successful model of Audubon's partnership with Bird Studies Canada as the Canadian partner in the count, we hope to engage other organizations in Latin America and the Caribbean to facilitate the growth of the count in areas outside the United States and Canada. A "scientific review" of the count will be undertaken (as with the Breeding Bird Survey) to discuss the pros and cons of current CBC methodology and to determine ways of enhancing the value of the Christmas Bird Count data to researchers interested in studying early winter (that's winter in North America) bird populations across the Western Hemisphere. And finally, in addition to developing new output tools for the historical CBC database, we've begun the process of revamping the compiler's data entry pages. This process will result in an easier, faster, and generally more "user friendly" data entry experience for Christmas Bird Count compilers.

Since the horrific events of September 11, 2001, the perception of the world has changed for many people in North America. The effect of drastically restricted access to U.S. military and government facilities was directly felt by many compilers during the 102nd Christmas Bird Count, as heightened security precautions negatively affected the organization of many CBCs that are conducted in such locations across the continent. Many areas were "off limits" to the public, or only available for CBC census to a limited observer pool, or under official escort. A few counts had to be cancelled completely. But the vast majority of existing Christmas Bird Counts were conducted, many new counts were started, and a record number of observers turned out to be part of the 102nd Count. Humans strive to find solace during difficult times, and "getting back to nature" can provide a soothing effect for people who appreciate the natural world. The Christmas Bird Count has a great lore and tradition that is part and parcel of the program, and it has been conducted without interruption through five prior wars. From time to time there has been a diminution in the number of observers and counts due to such tragedies, just as there has been during seasons of difficult treatment from Mother Nature.

Finding solace in nature during the winter solstice may be a part of the tradition for many people involved with the Christmas Bird Count, no matter what the catalyst that feeds their need. It's been this way for over a century, and is likely to continue for many decades to come. Perhaps the most amazing fact is that the data that are obtained by all the dedicated CBC observers serve to help ensure the survival of the very creatures that drive the passions of Christmas Bird Count participants. My own association with the Christmas Bird Count began during graduate school about a quarter of a century ago, when I first began participating on counts; I could never have imagined the twists of fate that would lead to my being in charge of the entire program. Some of the most wonderful birders, ornithologists, conservationists, and human beings I've ever encountered have been involved with the Christmas Bird Count. We salute the dedicated multitudes of CBC observers each season, and anticipate meeting you in the field (or at feeders) during future Christmas Bird Count seasons.

Table 4.
Counts with 100 or more participants on the 102nd (2001-2002) Christmas Bird Count

(fw = feederwatchers)

Count Code	Count Name	# Participants
ONNB	North Bay, ON	889 (44 + 845 fw)
ABED	Edmonton, AB	561 (196 + 365 fw)
CAWB	Wallace-Bellota, CA	527 (37 + 490 fw)
MACO	Concord, MA	269 (87 + 82 fw)
OHTO	Toledo, OH	267 (31 + 236 fw)
BCVI	Victoria, BC	197 (193 + 4 fw)
CAPR	Point Reyes Peninsula, CA	184 (184 + 0 fw)
CAOA	Oakland, CA	177 (163 + 14 fw)
CASB	Santa Barbara, CA	176 (172 + 4 fw)
VAFB	Fort Belvoir, VA	172 (170 + 2 fw)
ABCA	Calgary, AB	171 (70 + 101 fw)
CTHA	Hartford, CT	170 (120 + 50 fw)
ABSA	St. Albert, Alberta	164 (74 + 90 fw)
BCVA	Vancouver, BC	150 (116 + 34 fw)
SCHH	Hilton Head Island, SC	149 (149 + 0 fw)
MBWI	Winnipeg, MB	147 (80 + 67 fw)
OHCF	Cuyahoga Falls, OH	144 (88 + 56 fw)
ABSR	Strathcona, AB	140 (49 + 91 fw)
BCNN	Nanaimo, BC	139 (108 + 31 fw)
NSWO	Wolfeville, NS	139 (48 + 91 fw)
LABR	Baton Rouge, LA	136 (59 + 77 fw)
AKFA	Fairbanks, AK	135 (100 + 35 fw)
SKSA	Saskatoon, SK	131 (77 + 54 fw)
MIPO	Pontiac, MI	129 (73 + 56 fw)
NSHD	Halifax-Dartmouth, NS	129 (77 + 52 fw)
AKAN	Anchorage, AK	127 (80 + 47 fw)
RIBI	Block Island, RI	127 (127 + 0 fw)
CAMC	Marin County (southern), CA	126 (120 + 6 fw)
OREU	Eugene, OR	126 (99 + 27 fw)
SCSC	Sun City-Okatie, SC	126 (118 + 8 fw)
WASE	Seattle, WA	126 (123 + 3 fw)
NYIT	Ithaca, NY	123 (91 + 32 fw)
FLSC	Sanibel-Captiva, FL	122 (120 + 2 fw)
CASF	San Francisco, CA	120 (110 + 10 fw)
SASJ	San Jose, CA	120 (120 + 0 fw)
PAPI	Pittsburgh, PA	119 (88 + 31 fw)
TXMM	Mad Island Marsh, TX	119 (115 + 4 fw)
COBO	Boulder, CO	116 (87 + 29 fw)
DCDC	Washington, DC	115 (114 + 1 fw)
ONOH	Ottawa-Hull, ON	113 (99 + 14 fw)
MANO	Northampton, MA	112 (94 + 18 fw)
CASD	San Diego, CA	110 (110 + 0 fw)
BCWR	White Rock, BC	108 (91 + 17 fw)
WASD	Sequim-Dungeness, WA	108 (80 + 28 fw)
CAOC	Orange County (coastal), CA	106 (105 + 1 fw)
CODE	Denver, CO	106 (65 + 41 fw)
TXFR	Freeport, TX	106 (102 + 4 fw)
BCKE	Kelowna, BC	105 (62 + 43 fw)
PACH	Chambersburg, PA	105 (80 + 25 fw)
ILFB	Fermilab-Batavia, IL	104 (102 + 2 fw)
QCQU	Quebec, QC	104 (104 + 0 fw)
MDSE	Seneca, MD	101 (100 + 1 fw)
ONLO	London, ON	100 (56 + 44 fw)

Christmas Bird Count Canada: 2001-2002

Richard J. Cannings

As the Christmas Bird Count season opened in mid-December 2001, there was an air of expectancy across Canada that hadn't been as strong for years. Most areas hadn't had a significant cold snap, watercourses were at least partly ice-free, and many sites across the southern part of the country didn't have any amount of snow. One of the first birds I saw on the Penticton, British Columbia, count was a Hermit Thrush, the first record in the count's 44-year history. A few days later our team counted not one but two Common Yellowthroats on the Oliver-Osoyoos counts, another new species for that long-standing count. And there were stories like that across the country, many of them much more surprising, such as the Black-necked Stilt at Wallaceburg, Ontario, and the Blue-winged Warbler at Halifax-Dartmouth, Nova Scotia.

This is the second year of Christmas Bird Count coordination for Bird Studies Canada, and the two years could hardly be more different. This year, Canadian CBC participants reported 3.7 million individual birds, up more than 25 percent from last year's 2.9 million. The species tally was up as well, from 283 to 299 species. As the Quebec CBC regional editor, Marcel Darveau, points out, it may not be just the warm weather allowing more species to winter at the northern end of their ranges—pleasant weather also encourages more observers to go out counting, and stay out longer on count day.

Whether it was the warm days, the clear roads, or simply the increasing popularity of birding, the number of field observers on Canadian Christmas Bird Counts was up more than ten percent this year to 7221. The count total rose to 310, compared to 298 last year; of all the new counts we especially welcome Arviat and Rankin Inlet, giving us coverage in Nunavut. The full provincial and territorial breakdown is shown in Table 1. North Bay again had the highest total of participants, with 889, of which 845 were feeder watchers. Both Edmonton and Victoria upped their field observer numbers substantially, but Edmonton held onto that crown with 196, while Victoria had 193. The other counts with more than 100 field observers were Vancouver, Nanaimo, and Quebec.

Local rivalries in Christmas Bird Counts invariably focus on species totals, and this year top bragging rights goes to Ladner, the count that covers the rich Fraser River delta in southwestern British Columbia. Often plagued with rain, fog, or wind, Ladner had a perfect day this year and some very good birds (including an Ivory Gull) to post 152 species, tying the all-time record for species total held by Victoria. Long Point broke its old Ontario record with 119 species. While most other counts in Canada can't hope to ever break 100 species, let alone 150, local records fell like dominoes across the country this year. One record of note was Fort Walsh's total of 51 species, the first count to ever break 50 in Saskatchewan. Winnipeg bested by five their own record for a Manitoba count (set only last year) with 57 species.

Ladner again topped the individual totals with 250,594 birds, mostly Dunlin, American Wigeons, Glaucous-winged Gulls, Mallards and Snow Geese. Other members of the "Hundred Thousand Club" this year were Prince Edward Point (162,454, almost entirely Long-tailed Ducks) and Blenheim (121,574, mostly scaup and Ring-billed Gulls).

It is interesting to look at the changes in the counts of the most common species

Table 1. Provincial and territorial summaries for the 102nd Christmas Bird Count.

Province/ Territory	Counts	Individuals	Species	Field Observers	Feeder-watchers	Highest species total and count
BC	64	1,121,580	231	1902	497	152, Ladner
AB	36	195,954	118	886	988	69, Calgary
SK	12	47,340	80	154	93	51, Fort Walsh
MB	17	65,730	81	273	138	57, Winnipeg
ON	102	1,735,834	188	2572	1807	119, Long Point
QC	27	200,220	135	573	103	85, Quebec
NB	5	20,573	90	96	9	60, Sackville
PEI	3	46,888	89	56	2	62, PEI National Park
NS	18	221,272	165	419	324	116, Halifax-Dartmouth
NF	14	52,794	108	167	67	62, St. John's
YT	5	4055	31	51	16	24, Whitehorse
NWT	3	2157	24	40	2	16, Norman Wells
NU	2	16	1	3	0	1, Arviat, Rankin Inlet
SPM	2	6595	63	29	0	49, Île St. Pierre
TOTAL	**310**	**3,721,008**	**299**	**7221**	**4046**	

(Table 2). All the waterfowl from central and eastern Canada were up in numbers, particularly Long-tailed Duck (although almost 80 percent of the country's Long-taileds were on one count—Prince Edward Point, ON). Ring-billed Gulls were also widespread and abundant; Point Pelee, Ontario had almost as many Ring-billeds as were seen across the entire country last year. On the west coast, numbers of the largest of Canadian waterfowl, the Trumpeter Swan, increased once again to 6964.

Some of the northern finches moved south in impressive numbers this year. Pine Grosbeak reports more than doubled, with over 22,000 seen. But it was the year of the redpoll, especially in western and central Canada. Last year a grand total of 5835 Common Redpolls were reported in Canada, this year that total soared to 96,395. Numbers of Pine Siskins, a close cousin of the redpolls, doubled this year to over 70,000. Unlike the highly skewed Long-tailed Duck reports, redpolls were distributed rather evenly across the country and in fact were tied for third in list of birds seen on the most counts (Table 3).

Since most counts are located near the southern edge of Canada, the true test of a widespread species is whether it was seen in every province and territory, and this year only one species made that list—Common Raven. Birders at Arviat and Rankin Inlet, the only counts in Nunavut, could only find one species on count day—raven.

There were so many reports of interesting birds this year it's difficult to know where to begin. On the Atlantic coast an unprecedented array of warblers and other species not usually associated with Canadian winters hung on after a summer-like fall into the fall-like winter. Four Ash-throated Flycatchers were scattered through the Maritimes last December, but only one was found on count day—at Sackville, New Brunswick—only the second ever for a Canadian CBC. A White-eyed Vireo stuck in the stunted boreal forests of Cape St. Mary's, Newfoundland was completely out of place. Nova Scotia birders found 12 species of warblers, eight of them at Halifax-Dartmouth alone.

Reports of northern owls were down significantly this year after last year's flight of Northern Hawk and Great Gray Owls, but Snowy Owls were much commoner than usual in Atlantic Canada and the BC Interior. Alberta owlers are definitely the keenest in the country, and this year their efforts truly paid off with outstanding numbers for several species, including Boreal and Northern Saw-whet.

While it sounds like field observers had an easy time of it this year, we are still talking about winter in Canada, and I'd like to personally thank all the observers who participated in the Christmas Bird Count.

Table 3. The most widespread species on Canadian Christmas Counts, as measured by the number of counts on which they were reported.

Rank	Species	Number of counts
1	Black-capped Chickadee	280
2	Dark-eyed Junco	278
3	Hairy Woodpecker	273
4	Downy Woodpecker	273
5	Common Redpoll	273
6	Red-breasted Nuthatch	272
7	European Starling	268
8	Common Raven	255
9	House Sparrow	253
10	Rock Dove	245
11	Pine Grosbeak	235
12	Blue Jay	224
13	American Crow	211
14	Mallard	207
15	White-breasted Nuthatch	205

One observer in particular deserves special praise this year—Doug Brown of Osoyoos, British Columbia. While Doug has always done multiple counts each Christmas, this year he outdid himself, taking part in 17 counts, driving 6700 kilometres and seeing 150 species while doing so! I'd also like to thank all the count compilers for their hard work organizing participants and entering the data on the website. Without you there wouldn't be a Christmas Bird Count.

Table 2. The top 15 bird species by total number on the 102nd Christmas Bird Count in Canada, with a comparison of results from the 101st count.

Species	Rank in 101st Count	Rank in 102nd Count	Total in 101st Count	Total in 102nd Count	Percent change
European Starling	1	1	327,825	412,908	26.0
American Crow	2	2	247,369	246,627	-4.3
Canada Goose	5	3	119,675	236,760	97.8
Mallard	3	4	161,270	220,214	36.5
Long-tailed Duck	12	5	71,020	186,460	162.5
House Sparrow	4	6	122,300	142,345	16.4
Rock Dove	6	7	98,815	137,259	38.9
Ring-billed Gull	33	8	21,784	128,703	490.8
Black-capped Chickadee	7	9	98,248	123,571	25.8
Herring Gull	10	10	80,443	117,855	46.5
Glaucous-winged Gull	8	11	91,092	100,746	10.6
Common Redpoll	62	12	5835	96,395	1552.0
Dunlin	9	13	84,728	71,852	-15.2
Pine Siskin	23	14	34,417	70,531	104.9
Greater Scaup	18	15	38,527	64,580	67.6

Warm fall and early winter weather allowed more southern birds to survive farther north this year, including this Summer Tanager (*Piranga rubra*) in a bizarre setting at Deep River, Ontario. Photo/Chris Michener

Using Christmas Bird Count Data in Analysis of Population Change

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The Christmas Bird Count (CBC) is a unique historical database on bird populations, and in recent years the ornithological community has been placing more and more demands on the information it contains. Natural historians, conservationists, wildlife managers, and scientific ornithologists use the CBC to make maps of winter bird distributions to evaluate how these distributions are influenced by environmental features and climate change (e.g., Root 1988), and to estimate population change (Sauer et al. 1996, Dunn and Sauer 1997).

The scientific credibility of these results depends on the development and use of appropriate methods of statistical analysis that identify and accommodate the limitations of the survey design. Unfortunately, statistical methods applied in analysis of CBC data are often overly simple, and lead to flawed analysis. For example, comparisons of simple averages of CBC data are often misleading as measures of population change over space or time. To make reasonable inferences about bird populations from CBC data, it is usually necessary to use statistical methods specifically developed for the survey. Unfortunately, these methods are not well known to many scientists.

To the casual observer, the running of a CBC looks quite chaotic, with both skilled and unskilled observers counting portions of each circle, methods of counting varying among circles, and sometimes use of specialized counting methods for difficult-to-identify or rare taxa such as gulls and eagles. Abundant data are collected near cities but few circles exist in remote regions. Those of us who actively participate in CBCs may occasionally consider how complicated the relationship must be between the number of birds counted during a CBC and the actual population size in the circle. Also, since the first CBC in 1900, both the number of observers and the number of circles have increased greatly. Obviously, if more circles are counted and more observers participate, more birds are counted; changes in counts reflect these changes in the survey. How do we extract the "signal" (change in bird populations) from noise in the data due to these methodological problems?

Design of Wildlife Surveys

The CBC is quite typical of many historical datasets. It was developed for reasons vastly different from many of its modern uses, and it seems a bit unfair to criticize the survey design based on modern goals and standards. However, the only way to avoid flawed analyses is to determine whether the CBC meets modern standards, and if it does not, to determine whether modern analysis methods can at least partially accommodate the design limitations of the survey. Two critical components of survey design are: (1) selecting sample locations so that the sample is spatially representative of the population of interest, and (2) understanding how the counts collected in the survey are related to the actual population sizes at the sampled sites. The scientific field of survey sampling has emphasized (1), but (2) has been a topic of particular interest to wildlife statisticians. When surveys do not meet accepted standards with regard to either of these attributes, one can still analyze the results, but inferences are weaker as we must make assumptions (that are usually untestable) about how the survey data relate to the actual bird populations.

Choice of Sample Locations

One goal of survey design is to ensure that sample sites are selected in such a way as to allow inference to a larger population. This can be accomplished by a variety of random sampling schemes, collectively known as probability sampling. Sites that are easily sampled or are located in places where people are interested in counting, such as national wildlife refuges or national parks, are likely not to be representative of larger areas. An enormous statistical literature exists on how to select samples for inference, and methods such as stratification, dual frame sampling, and adaptive sampling all provide efficient means of selecting samples that still preserve some notion of probability sampling (Thompson 1992).

Unfortunately, most CBC circles are not selected in conjunction with a statistical design, but reflect sample locations accessible to counters or of particular interest to local coordinators. The tendency to place circles near areas of particular bird abundance ensures that birds will be available to count, but also virtually guarantees that the sampled area is not representative of the surrounding region. A cautious approach to use of CBC data would require that inference be restricted to the sites that are actually sampled. Results summarized for a larger geographic area from the survey should have a caveat label "from CBC circles within" to ensure that users understand the lack of representativeness.

There are cases in which the CBC sample may be used for reasonable inference, even though the sites are not representative of the landscape. First, often the area covered by the circle (or a collection of circles) is itself of primary interest, and the circle data can be used in evaluations of population change. Second, even though the sites themselves are not randomly located, it is sometimes possible to extrapolate to the region of interest by making assumptions about how the information at a site relates to the regional information, then using the model defined by these assumptions to extrapolate to the region of interest. This model-based approach is generally used in any regional analysis of CBC data. For

example, by defining strata for analysis (e.g., physiographic regions within states), the sample is partitioned into strata within which the circles are at similar densities, hence accommodating regional patterns in sample intensity. However, any model-based approach to analyses of the survey does impose a series of assumptions that must be stated explicitly. For example, in the stratum-based approach, there is an assumption that within the region the CBC circles are a reasonable sample. This assumption is untested, but unlikely to be true. Because all reasonable analyses of CBC data are model-based, it is clear that the success of the analysis depends on development of clearly defined and reasonable assumptions.

Relating Counts to Population Sizes

A second controversial aspect of sampling from the CBC is the issue of detectability of birds within sites. Almost no bird species are truly censused (i.e., completely counted) within CBC circles, and no direct method exists to estimate detectability of birds in CBCs. In order to conduct any analysis of CBC data we have to make some assumptions about the relationship between the counts of birds within circles and the actual population sizes. This necessity is common with bird surveys. Counts that are not clearly related to the actual population size are called indices. Unfortunately, any analysis of indices requires an assumption of consistency: If indices are to be used as surrogates for population sizes in analysis of population change, it must be assumed that patterns in detectability are not confounded with patterns in population size.

Detectability problems bedevil all bird surveys, and even the most stubborn field biologist can recognize that something has to be done to accommodate detectability differences in counts from the CBC. A plethora of methods have been proposed for estimating detectability during field studies of birds, and some of these could (but have not as yet) be applied during CBC sampling. However, we must do something to accommodate differences in detectability over time and space in the historical data. A common strategy is to identify some observable factor that could be associated with variation in detectability, to model this variation, and ultimately, to adjust the counts for variation in detectability. For the Christmas Bird Count, the most obvious factor associated with counting is effort expended in the circle. Effort is recorded for a variety of activities associated with CBCs, and total party-hours is most often used as a covariate representing effort in counting.

Adjusting Counts for Effort

The effects of effort on the counts obtained in CBC circles are undoubtedly enormously complicated. No one questions that, for the bulk of CBC species, there is some association between effort and counts. However, it is not a simple association and could be influenced by many factors. For example, some species are frequently only counted by a specially designated skilled observer, rare species and unique habitats are often covered regardless of effort, and the different types of effort could have very different associations with counts. Clearly, some thought is necessary before attempting to apply effort adjustments to any counts, and the form of the effort adjustment is likely to vary among species. Nevertheless, changes in effort have been so great over the interval of the CBC (see Butcher and McCulloch 1990 for a summary of changes in effort over time), that failure to consider effort as a factor influencing counts will undermine the credibility of any analysis of CBC data. A flexible approach to modeling the influence of effort on counts is needed.

Historically (Bock and Root 1981, Dunn and Sauer 1997), analyses have simply divided counts by party-hours or party-miles. (Here, we do not dissect the various kinds of effort, but simply consider total party-hours as the effort index). This simple scaling has some limitations, and in particular it does not allow for the possibility that increased effort may have less effect when effort is high. Instead, additional effort is always assumed to influence counts regardless of the amount of effort already occurring. Butcher and McCulloch (1990) suggested a nonlinear adjustment, and Link and Sauer (1999a,b) proposed a general set of effort adjustments similar to the Box-Cox family of transformations that permit a variety of alternative relationships between counts and effort. This effort relationship has form $(\xi^p - 1)/p$, where ξ is the effort value and p is an exponent that changes the shape of the relationship of effort to count.

This family of curves includes a variety of realistic forms. Some allow the effect of effort to have an asymptote, to allow diminishing returns; others include the simple effort adjustment (as p approaches 0) and the Butcher and McCulloch (1990) adjustment (as p approaches 1). To actually find the appropriate effort adjustment, Link and Sauer (1999a,b) suggest conducting the analysis of interest (e.g., fitting a linear model to the data) using a variety of values of p, then choosing the value of p that minimizes the scaled deviance (a measure of goodness of fit).

An Example of This Analysis: Population Change in Red-tailed Hawks

The Red-tailed Hawk (*Buteo jamaicensis*) has a widespread winter distribution in North America (Figure 1). We estimated population change for wintering North American Red-tailed Hawks using a generalized linear model that included effort adjustments. Because the CBC sample has a great deal of spatial heterogeneity, we chose to analyze the results by Bird Conservation Regions (BCRs). These regions were developed to provide a common framework for bird conservation, and generally tend to divide the continent into regions containing consistent habitats. We used CBC data for the period from 1955 to 1999 in this analysis.

The actual model we fit was a "year effects" model, in which we estimated separate composite year indices for each BCR using the log-linear model,

$$\ln(\mu_{i,j}) = \theta_i + B\,(\xi^p - 1)/p + \varphi_j$$

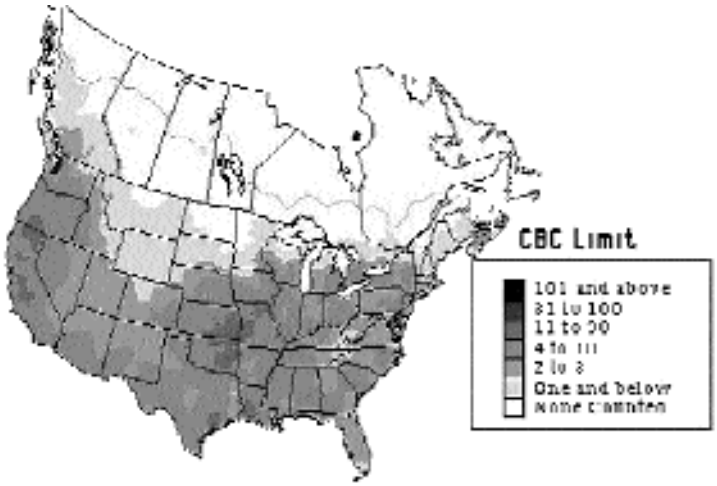

Figure 1. Map of winter distribution of Red-tailed Hawks from CBC data. These maps were produced using a simple index of mean (1966–1989) abundance by circle (counts/total party hours), and smoothed using a distance-weighted average of information from nearby CBC circles.

Figure 2. Population trajectories for Red-tailed Hawks in the Southeastern Coastal Plain Bird Conservation Region from CBC data, using three alternative exponents for the relationship between effort and count.

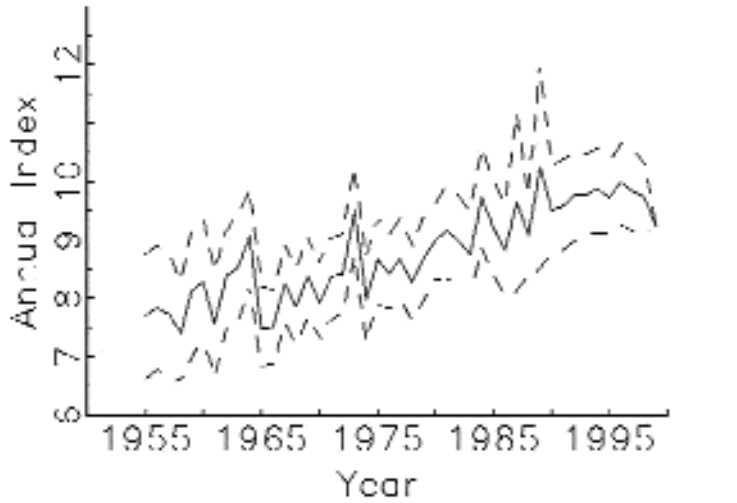

Figure 3. Composite annual indices for Red-tailed Hawks from the CBC data, 1955–1999, with associated 95 percent confidence intervals.

where i indexes CBC circle, j indexes year, $\mu_{i,j}$ is the expected count in the circle, θ_i is a "baseline" abundance value for a circle, B is the slope parameter associated with effort, and φ_j is the year effect corresponding to year j. This generalized linear model was not based on a normal distribution, but instead permitted counts to be Poisson in distribution and incorporated overdispersion in the Poisson counts. Readers interested in the technical details of fitting this log linear model should read the discussion in Link and Sauer (1999b).

In our analysis, we fit the year effects model for each stratum, using a series of eight candidate exponents (p = -2.0, -1.5, -1, -0.5, 0, 0.5, 1.0, 1.5) for the effect of effort. We selected the value of p that minimizes the total deviance.

Getting composite estimates of change and annual indices from the CBC is complicated by regional differences in precision of regional estimates. Some BCRs have very precise estimates of change, while others are very imprecisely estimated. Empirical Bayes procedures accommodate the differences in precision by using all regional indices to estimate a set of prior mean year effects. Revised BCR year effects are then calculated as a weighted average of the BCR year effect and the prior mean year effect, with weights depending on the relative precision of the BCR year effects. The empirical Bayes estimates thus are "shrunken" toward the prior means, with the amount of shrinkage associated with the amount of information contained in the original estimates (Link and Sauer 1998). After we calculate the empirical Bayes estimates of year effects for each BCR, we then scale them to reflect a comparable level of effort among regions, and calculate a composite annual index as an area-weighted average of the BCR indices. Note that we use the term "year effect" to denote the relative measures of yearly change from the generalized linear model analysis, but "annual indices" are year effects that are scaled by a median effort for the region.

Effects of Effort Adjustment

Results of the analysis for the Southeastern Coastal Plain BCR clearly document the effects of choice of the exponent *p* on the analysis (Figure 2). Negative values of *p* tend to limit the influence of large effort values but increase the effects of small changes in effort when effort is low. On the other hand, positive values of *p* tend to retain an increasing effect of effort even when effort is high. Consequently, the analysis fit with the highest value of *p* (1.5) suggests an increase of about 29 percent over the interval, while indices fit with the lowest *p* (-2.0) indicate a population increase of 16 percent over the interval. It is clear that choice of *p* (and hence of the shape of the effort adjustment) can have important consequences for the estimation of population change from the CBC.

Population Change Analysis

We used information from 2681 circles and calculated annual indices for Red-tailed Hawks from 30 BCRs. When we sum up the deviances from the analysis of the 30 BCRs, the minimum occurred with $p = -2.0$. Consequently, we used this effort adjustment in summary analyses. The composite annual indices (Figure 3) indicate an increasing population over the interval 1955–1999. The composite index value at 1955 (7.69, 95 percent confidence interval: 6.62, 8.76) is well below the index value in 1999 (9.24), indicating a population increase of 20.1 percent over the interval. Year effects and variances are all relative to the final year, hence the variance of the final year effect is 0.

The North American Breeding Bird Survey (BBS, Robbins et al. 1986) has extensive data on breeding populations of Red-tailed Hawks for the regions surveyed by the CBC. Even though the actual breeding and wintering populations are unlikely to match, it is of general interest to compare the patterns of continent-scale population indices produced by the surveys. To facilitate comparison, we scaled both time series of annual indices by subtracting the mean of the series then dividing by the variance of the indices from each value (Figure 4). The general pattern of increase over time in the population is consistent between the two sets of results, although patterns of year-to-year change tend not to coincide. Although detailed discussions of the associations between annual indices of wintering and breeding populations is beyond the scope of this paper (see Dunn and Sauer [1997] or Sauer et al. [1998] for further results and discussion of this topic), it is not surprising to observe a lack of year-to-year coincidence; clear differences exist in precision between the surveys, in part associated with unmodeled effects of winter weather in CBC tallies.

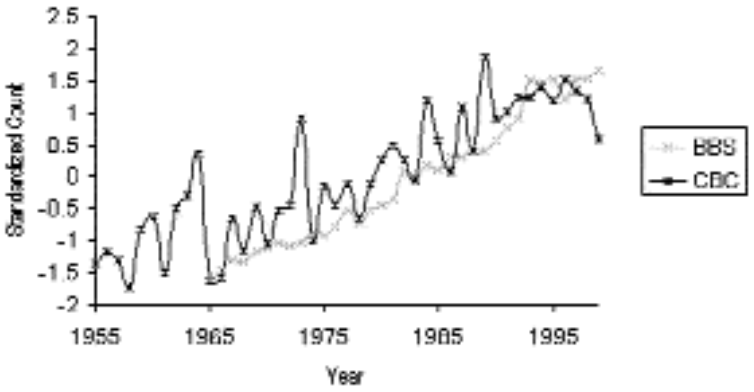

Figure 4. Annual indices for breeding populations and wintering populations of Red-tailed Hawks in North America, based on data from the North American Breeding Bird Survey and the CBC. Results are scaled to facilitate comparisons.

Accommodating Survey Design Issues During the Analysis of CBC Data

The key to any successful analysis of CBC data is to begin with a careful review of how the limitations of the data are likely to influence the results of the analysis, then to choose methods of analysis that accommodate as much as possible the limitations of the survey. For example, in our analysis we included a flexible model for effort adjustment, then used information from the data to guide the selection of the best model. We then stratified the analysis by BCRs, which provided some geographic structuring to accommodate the regional variation in number of samples. We used a model that allowed for overdispersed Poisson data appropriate for counts, and employed empirical Bayes procedures to accommodate differences in quality of information in regional summaries. The generalized linear model approach is very flexible, and can be applied to a variety of studies focused on factors influencing wintering bird populations. In particular, the model can be easily modified to contain covariates, allowing for assessment of associations between CBC counts and winter weather, disturbance, and a variety of other environmental factors.

All count-based surveys have the limitation that it is often difficult to distinguish factors that influence counts from factors that influence the actual populations (e.g., Bennetts et al. 1999). For the CBC, it is clear the effort influences counts, and hence, that increases in effort over time must be accommodated in any analysis. Because it is difficult to specify exactly how effort will influence counts, methods such as we present here are important in that they provide tools for quantitative assessment of the form and significance of the effort adjustment. Of course, the approaches to effort adjustment are all model-based. We must assume that the models applied to the data are actually appropriate; misspecification may introduce bias. Unfortunately, effort adjustment is likely to be quite subtle, and variation among regions could introduce heterogeneity

that is difficult to model. Uncertainty will always exist in modeling the association between effort and counts, and this uncertainty limits our use of CBC data. It would be useful to consider modifying the field procedures for data collection so that changes in effort are not associated with changes in counts, and to evaluate experimentally alternative approaches to counting birds in CBCs that would allow estimation of detectability as part of the design (e.g., through double counting methods, Nichols et al. 2000).

Analyses and Survey Methods Should Be Subject to Constant Revision

The generalized linear model approach we describe is only one of many approaches that can be used to estimate population change from CBC counts and associated effort information. Other procedures that could be used for CBC analyses include smoothing procedures such as generalized additive models (e.g., Fewster et al. 2001). We have recently implemented a hierarchical modeling approach for BBS data that allows for summary among regions as part of the primary analysis rather than as a separate procedure (Link and Sauer 2002), and intend to apply similar models to CBC data, allowing for direct estimation of composite annual indices.

These new methods for survey analysis provide insights into changes in survey design that can enhance the value of the information. The CBC has been extremely successful as a tool for increasing public interest in birding and bird conservation. Use of the information for bird conservation creates new demands on quality of information. It is important to maintain a dialogue between users of the information, information needs for the analyses, and survey coordinators and participants. Our work as survey analysts emphasizes the value and limitations of existing data, and provides some indications of what features of the survey could be modified to make the survey a more reliable source of bird population data. These results should feed back into decisions on future survey methods and design. For example, it would be useful to further evaluate the relationship between effort and detectability of birds within circles, and to obtain better information regarding within-circle protocols. Surveys only remain useful if they adapt to current needs, while maintaining consistency with historical goals.

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Long-term Trends of Raptors on CBCs in the Midwest

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Abstract

The Quad City Audubon Society has conducted and compiled five Christmas Bird Counts (CBC) since the mid 1950s. Each of these counts is centered on or near the Mississippi River in eastcentral Iowa and northwest Illinois. Counts have accumulated 40 years of data regarding avian populations wintering in the Midwest. Long-term information concerning regional raptor populations is often very minimal. Therefore we decided to use this CBC data set, generated from a relatively small geographic area, to examine the observed changes in midwestern raptor populations since the mid 1950s. During our analysis, we pooled the total number of individuals for each species from all five CBCs each year. Furthermore, we combined the data into five-year increments. Seven species (Sharp-shinned Hawk [*Accipiter striatus*], Cooper's Hawk [*A. cooperii*], Red-tailed Hawk [*Buteo jamaicensis*], American Kestrel [*Falco sparverius*], Bald Eagle [*Haliaeetus leucocephalus*], Barred Owl [*Strix varia*], and Eastern Screech-Owl [*Otus asio*]) have been characterized by populations that were stable until the early 1970s to late 1980s, after which they have increased steadily. The Red-shouldered Hawk (*B. lineatus*), Long-eared Owl (*Asio otus*), and Short-eared Owl (*Asio flammeus*) have undergone substantial declines and have not yet rebounded. Northern Harriers (*Circus cyaneus*) and Rough-legged Hawks (*B. lagopus*) fluctuated since the mid 1950s, and Great Horned Owls (*Bubo virginianus*) have steadily increased. Although our project included data from a relatively small geographic area, our results indicate that long-term data generated by the CBC program can assist in monitoring regional raptor populations over time.

Introduction

It is extremely difficult to monitor regional populations of raptors. Due to their ecology, behavior, and natural low densities (Newton 1979, Craighead and Mindell 1981, Fuller and Mosher 1981, Millsap and LeFranc 1988, Bibby et al. 1992, Preston and Beane 1996), most raptors do not lend themselves well to being monitored during the breeding season by programs such as the Breeding Bird Survey, Breeding Bird Atlases, or by MAPS projects (Ralph et al. 1993, Price et al. 1995, Spess-Jackson et al. 1996). In contrast, during migration, monitoring sites along migratory corridors have proven to be relatively effective in monitoring regional raptor population trends (Spofford 1969, Hackman and Henny 1971, Nagy 1977, Hussell 1981, Hussell 1985, Zalles and Bildstein 2000). Especially effective are sites that concentrate migrating raptors along "leading lines" such as mountain ridges and coastlines (Mueller and Berger 1967, Dunne et al. 1984, Bednarz and Kerlinger 1989, Kerlinger 1989, Bibby et al. 1992, Bildstein et al. 1993, Zalles and Bildstein 2000). Unfortunately, relatively few long-term monitoring sites exist (Bildstein et al. 1998).

The only long-term, large-scale avian monitoring project that occurs during the winter season is the Christmas Bird Count (CBC) sponsored by the National Audubon Society (Bock and Root 1981, Drennan 1981, Arbib 1981, Root 1988). The Quad City Audubon Society has coordinated and compiled data from five CBCs along the Mississippi River in eastcentral Iowa and northwest Illinois since the middle 1950s (McKay 1998, McKay 1999). The CBC program dates from 1900 when it began as an organized protest by early conservationists to the tradition of Christmas holiday "hunts" carried out primarily by the wealthy (Root 1988). During these events, people shot as much wildlife as they could in a day, including enormous numbers of songbirds.

The CBC program has evolved from this early form of protest to become the premier avian monitoring project during the early winter period in North America. By the late 1900s, between 1,700 and 1,800 CBCs were conducted annually across North America. The program has several advantages and disadvantages closely associated with it.

CBCs possess several sampling biases. Among these are differences in the number of observers, field parties, and hours of observation effort (Bibby et al. 1992). Count methodologies and strategies also vary widely. For example, some counts have a large number of small territories that are primarily walked, while others employ a small number of larger territories that are driven. Owl tapes are used on some counts to attract passerines, while other compilers are opposed to this strategy. Counts also differ on the use of owl tapes to elicit call-back responses. Each year between 45,000 and 50,000 people participate and contribute data to CBCs. This introduces the problem of extreme differences in observer abilities to detect and identify the various avian species (Bibby et al. 1992). Additionally, there are no weather

parameters to adhere to. Thus, weather can significantly influence a count from year to year (Bibby et al. 1992). Finally, the CBC program provides a small amount of overall sampling effort, with each count only being conducted one day per year. These biases are inherent with the CBC program and cause a reduction in the scientific validity of the data (Bibby et al. 1992).

Despite these problems, the CBC program has several definite advantages. With counts being conducted all across North America each year, it is one of the few programs that provides valuable information regarding long-term avian population trends over a broad geographic area (Root 1988). CBCs are semi-standardized, in that the same study area is surveyed each year at the same approximate time and often by the same approximate number of observers. The CBC program also is extremely cost-effective since it uses all volunteer participants (Bibby et al. 1992). In fact, the five dollar per count participation fee allows the CBC program to be financially self-sufficient. The program also is highly productive, with thousands of birders on the continent actively participating each year. The vast geographic area covered, as well as the participation and expertise required, precludes a more scientifically and statistically valid project from being conducted (Bibby et al. 1992).

CBCs provide one of the few sources of data for monitoring long-term avian population trends. Given the difficulty in monitoring raptor populations, our objective was to examine the long-term population trends for 13 raptor species in eastcentral Iowa and northwest Illinois, using data from the five CBCs compiled by the Quad City Audubon Society over a 40-year period. We also offered possible explanations for the observed trends.

Study Area

We analyzed count results from five CBCs on or near the Mississippi River in eastcentral Iowa and northwest Illinois (Figure 1). All five CBCs are in the eastcentral Iowa counties of Louisa, Muscatine, Scott, Clinton, and Jackson, and in the northwest Illinois counties of Mercer, Rock Island, Whiteside, and Carroll. Count areas included Western Mercer County (centered at 41˚10'N and 90˚55'W, Illinois), Muscatine (41˚25'N and 91˚00'W, Iowa), Davenport (41˚31'N and 90˚30'W, Iowa), Princeton-Camanche (41˚45'N and 90˚21'W, Iowa), and Clinton (41˚58'N and 90˚09'W, Iowa) (National Audubon Society 1999).

Methods

CBCs consist of a 15-mile diameter count circle (Bibby et al. 1992). Count circles usually are divided into several territories, each surveyed by an individual field party. Counts are conducted during a 24-hour period extending from midnight to midnight. The overall CBC count period is 16-17 days long, encompassing the latter half of December through the first few days of January (Bibby et al. 1992, National Audubon Society 1999). During a CBC, the total number of individuals for each species identified is recorded.

Root (1988) and Bibby et al. (1992) recommend examining the data as the mean number counted per CBC over 10-year periods. They maintain that using means and 10-year increments will reduce biases due to weather or abnormal bird movements (Bibby et al. 1992). However, we believed that this method may not adequately detect more subtle changes in populations, as well as the historical timing of such changes. Thus, for our analysis we combined the total number of individuals recorded for each species from all five count circles. Additionally, we pooled the data into five-year increments.

In order for a species to be considered in our examination, it had to meet two basic qualifications. First, it had to be considered at least a regular winter resident within the study area (Bohlen 1989, Kent and Dinsmore 1996, Petersen 1996). Second, the species had to be recorded on at least one of the counts for a minimum of 25 years. Thirteen diurnal and nocturnal raptors met these criteria. These 13 species were separated into five groups based on the general habitat type in which they typically occurred during the winter season (Bohlen 1989, Kent and Dinsmore 1996). The first group of three species (Sharp-shinned Hawk [*Accipiter striatus*], Cooper's Hawk [*A. cooperii*], and Long-eared Owl [*Asio otus*]) prefers dense mixed deciduous – coniferous woodlands, especially pine groves during the winter. The second group (American Kestrel [*Falco sparverius*] and Red-tailed Hawk [*Buteo jamaicensis*]) prefers upland woodland – agricultural edge habitat, as well as open agricultural fields. The third group (Great Horned Owl [*Bubo virginianus*] and Eastern Screech-Owl [*Otus asio*]) is found in upland woodland habitats. The fourth group (Rough-legged Hawk [*B. lagopus*], Northern Harrier [*Circus cyaneus*], and Short-eared Owl [*Asio flammeus*]) is typically found in grassland habitats. The remaining three species (Barred Owl [*Strix varia*], Red-shouldered Hawk [*B. lineatus*], and Bald Eagle [*Haliaeetus leucocephalus*] are found in flood plain bottomland forest habitat.

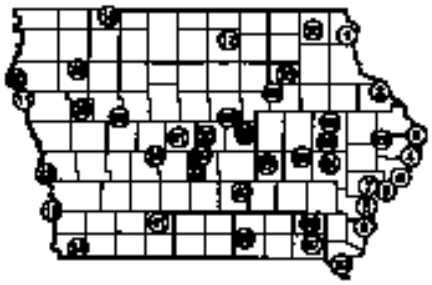

Figure 1. Map illustrating all CBC circles in Iowa. Circles 3, 4, 5, 7, and 8 represent counts compiled by the Quad City Audubon Society.

Results

The two accipiter species (Sharp-shinned Hawk and Cooper's Hawk) have exhibited similar population trends over the past 40 years. Both maintained low but stable populations until the latter half of the 1970s, at which time the Sharp-shinned population increased substantially (Figure 2). They have

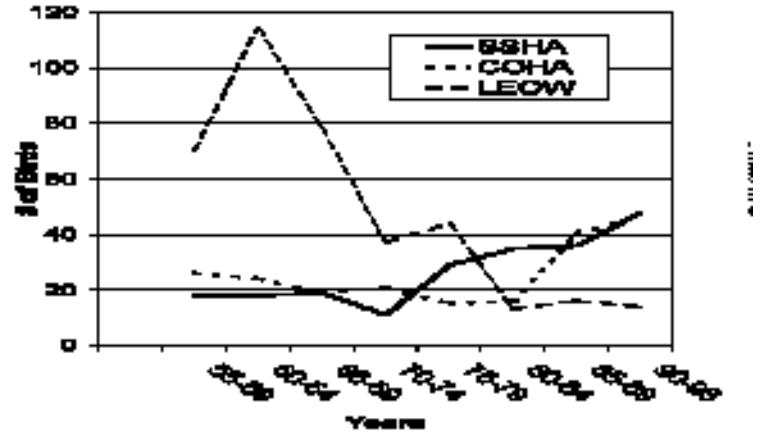

Figure 2. Population trends of dense woodland raptors (Sharp-shinned Hawk, Cooper's Hawk, Long-eared Owl).

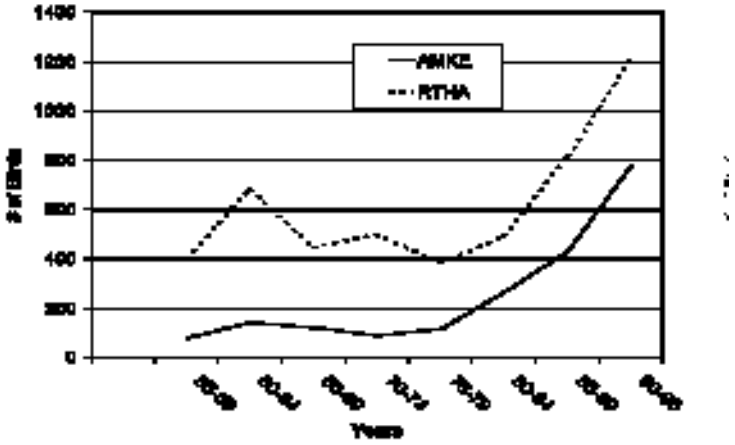

Figure 3. Population trends of upland woodland and agricultural edge raptors (Red-tailed Hawk, American Kestrel).

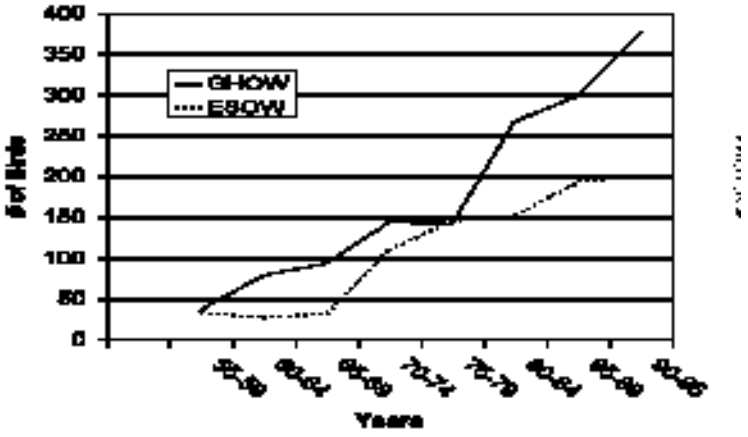

Figure 4. Population trends of upland woodland owls (Great Horned Owl, Eastern Screech-Owl).

continued to increase gradually since. The Cooper's Hawk population remained stable until the latter 1980s, when they also demonstrated a substantial increase. Cooper's Hawks also have increased since then. Long-eared Owls occurred in fairly large numbers through the late 1960s, after which the population substantially declined during the early portion of the 1970s (Figure 2). This species suffered another severe decline during the early 1980s and has not recovered (Figure 2).

The two upland woodland and edge raptors have exhibited similar population trends over the 40-year study period (Figure 3). The Red-tailed Hawk population fluctuated somewhat, but remained fairly stable until the latter 1980s when it exhibited a rather strong increase (Figure 3). This increase has continued through the early 1990s. The American Kestrel population was stable until the early 1980s, when it began to increase (Figure 3). Kestrels have continued to exhibit a rather pronounced increase in numbers since then.

Great Horned Owls have increased steadily throughout the entire 40-year period (Figure 4). The rate of increase seems to have accelerated slightly since the early 1980s. Eastern Screech-Owls were stable until the early 1970s, when they began to increase substantially (Figure 4). They have continued to increase in the 1990s.

Among the grassland species, Rough-legged Hawk numbers have been characterized by relatively large fluctuations over the last 40 years (Figure 5). The Northern Harrier and Short-eared Owl exhibited somewhat similar population trends through the 1970s (Figure 5). Both species increased during the late 1950s and 1960s, with the Short-eared Owl peaking in the late 1960s and the Northern Harrier in the early half of the 1970s. Likewise, both species experienced substantial declines during the latter 1970s. Since this time, their population trends have diverged. Northern Harrier numbers have stabilized and began to increase fairly substantially

during the latter 1980s and early 1990s (Figure 5). Short-eared Owl numbers have continued to decline and have never recovered (Figure 5).

The population trends of Barred Owls and Red-shouldered Hawks have differed substantially. Barred Owl numbers were stable until the early 1980s when they exhibited a strong increase (Figure 6a). The increase, which continued through the late 1980s, has since leveled off. Red-shouldered Hawks "crashed" in the late 1960s and have yet to recover (Figure 6a). The Bald Eagle population was very stable until the latter half of the 1970s when it displayed a substantial increase (Figure 6b). For the most part, the population has continued to increase substantially since, particularly during the late 1980s and early 1990s.

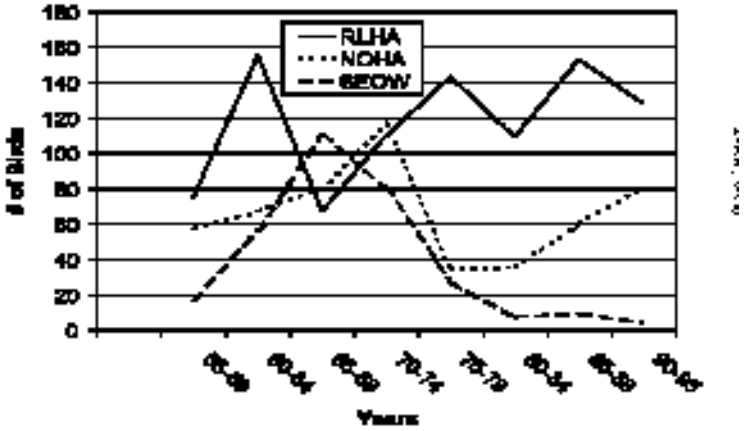

Figure 5. Population trends of grassland raptors (Rough-legged Hawk, Northern Harrier, Short-eared Owl).

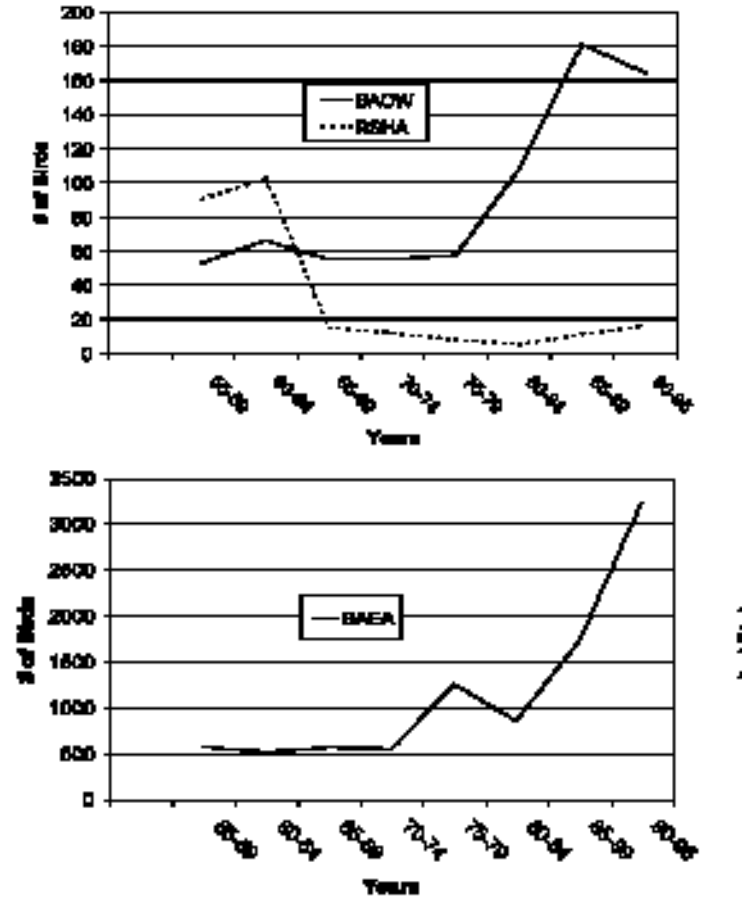

Figure 6. Population trends of flood plain bottomland forest raptors: (a) Barred Owl and Red-shouldered Hawk, (b) Bald Eagle.

Discussion

Sharp-shinned and Cooper's Hawks are secretive accipiters that typically occur in relatively low densities, which explains their low numbers on CBCs (Root 1988). The recent recoveries of these two accipiters may be linked to the banning of organochlorine pesticides, like DDT, in 1972 (Bohlen 1989). Many of their passerine prey species are insectivorous. As a consequence, DDT may have accumulated to detrimental levels in accipiters causing reduced reproductive success and associated declines in populations. Much of the recovery of these two species also can be attributed to the rapid increase in "bird feeding" by people since the 1970s (DeGraaf and Thomas 1974, Root 1988). Bird feeding is undoubtedly aiding the populations of Sharp-shinned and Cooper's Hawks by maintaining a larger avian prey base further north during the winter months (Bohlen 1989, Kent and Dinsmore 1996). The delay in the recovery of the Cooper's Hawk population may be related to the fact that their breeding range extends much further south throughout the Midwest than does the breeding range of the Sharp-shinned Hawk (National Geographic Society 1983, Bielefeldt and Rosenfield 1994). The Cooper's Hawk population was suspected to be severely impacted by DDT, as well as extensive loss of nesting habitat primarily to agricultural development. Long-eared Owl populations began declining in the early 1970s and have continued this trend ever since. The overall severe reduction in Long-eared numbers is not well understood (Kent and Dinsmore 1996). However, we believe this trend is directly linked to the continuing loss of dense, moist woodland habitats throughout much of the Midwest (Bohlen 1989).

Red-tailed Hawk and American Kestrel populations have increased substantially in recent years (Byre et al. 1991, Castrale 1991). The similar trends exhibited by red-tails and kestrels are thought to be associated with their adaptability and use of edge-dominated habitats (Kent and Dinsmore 1996). Throughout the Midwest, the amount of upland woodland—agricultural edge habitat has been increasing steadily. This increase in edge-oriented habitat, which was possibly detrimental to Cooper's Hawks and Long-eared Owls, appears to favor Red-tailed Hawks and American Kestrels (Spess-Jackson et al. 1996). The Red-tailed Hawk has undoubtedly benefited from decreased human persecution (Newton 1979). Being a large raptor, often found in open areas, Red-tails were frequent victims of shootings. Since a large part of the American Kestrel's diet in summer consists of insects, this species probably suffered population declines due to DDT (Burns et al. 1994). Consequently, kestrels have no doubt benefited from the banning of this chemical. However, we also believe the kestrel population has been assisted in Iowa by the Department of Natural Resources' nest box program, which has been extremely successful (Varland et al. 1992).

The steady increase in Great Horned Owls is most likely due to the extreme adaptability of the species. Horned owls thrive in many habitat types, including all stages of woodland succession (Dinsmore et al. 1984). Additionally, as with most of the other species we examined, Great Horned Owls may have benefited from decreased human persecution, which has resulted from public education programs and laws designed to protect predators (Newton 1979). The increasing trend in the Eastern Screech-Owl population may be at least partially linked to our increasing knowledge of the importance of snag habitat. Holes in snags are very important to Screech-Owls for roosting and nesting (Bohlen 1989, Spess-Jackson et al. 1996). This species prefers smaller, more open, wood lots. As such, they have probably benefited from the widespread fragmentation of larger forests throughout the Midwest (Spess-Jackson et al. 1996). Alternatively, we believe that a large part of the increase in Screech-Owl numbers is actually the result of an increasing use of owl audio tapes to elicit call-back responses (Kent and Dinsmore 1996). We began to widely use tapes in the early 1970s. This was the same time period that we detected a spike in Eastern Screech-Owl numbers. As a result, the increasing population trend in this species may be an artifact of changing count methodology more than an actual increase in the number of birds.

Widely fluctuating numbers of Rough-legged Hawks are not unexpected. This is a tundra-nesting species, which probably experiences cyclic migrations as well as population "irruptions" and "crashes" similar to other species of the far north (Bohlen 1989, Kent and Dinsmore 1996). These cycles would certainly help account for their fluctuating populations on midwestern CBCs. The severe population declines noted for Northern Harriers and Short-eared Owls in the late 1970s was attributed to the extensive alteration and loss of grassland habitats throughout the Midwest (Hands et al. 1989, Martell 1991, Herkert et al. 1993). Interestingly, although Harrier numbers began to increase in the late 1980s and early 1990s, Short-eared Owl numbers continued to decline. During this same period, there was a substantially large increase in the amount of available grassland habitat due to the Conservation Reserve Program (CRP) (Spess-Jackson et al. 1996). Consequently, Northern Harriers appear to benefit from CRP land (Spess-Jackson et al. 1996), while Short-eared Owls may not (Martell 1991).

The Barred Owl population was stable until it increased substantially during the 1980s. A large part of this strong increase may be due to our growing knowledge of the importance of snag habitat. As with the Eastern Screech-Owl, holes in snags are crucial to Barred Owls for nesting and roosting sites (Craighead and Craighead 1956). However, we also believe that part of the increase was due to an increase in the use of owl playback tapes by Christmas counters (Kent and Dinsmore 1996). Additionally, as with most other raptors, this species has undoubtedly benefited from decreased human persecution. In contrast, the Red-shouldered Hawk population has not recovered from the severe "crash" of the late 1960s. Red-shoulders are a species of the flood plain periphery, preferring areas with contiguous flood plain bottomland and upland bluff forest components (Stravers and McKay 1994). Unfortunately, throughout much of Illinois and Iowa, the bluff forests have either been lost to development or the bluff and flood plain forests have been isolated from each other, primarily by agricultural and residential development within the flood plain (Stravers 1992, Stravers and McKay 1994, Spess-Jackson et al. 1996). By comparison, the Bald Eagle population has been increasing substantially since the latter 1970s. We believe the strong recovery of this species was directly linked to the banning of DDT, along with the extra emphasis and protection afforded the Bald Eagle, which, until recently, was a federally endangered species (Grier 1988). Throughout the 40-year study period, Bald Eagles always maintained impressive numbers. This was due to the fact that all five of our CBCs contained large stretches of river, located within one of the major wintering concentration sites for the species (Millsap 1986, McKay 1992).

Our results suggest that CBCs may provide valuable information regarding long-term raptor population trends. Nevertheless, our explanations for population increases or declines remain speculative. More research on the individual species is needed. Several species including the Sharp-shinned Hawk, Cooper's Hawk, American Kestrel, Red-tailed Hawk, Barred Owl, Eastern Screech-Owl, and Bald Eagle had relatively stable populations which have exhibited increases recently. Red-shouldered Hawk, Long-eared Owl, and Short-eared Owl populations have experienced severe declines from which they have yet to recover. Northern Harrier and Rough-legged Hawk populations have fluctuated,

while Great Horned Owl numbers have increased steadily. Finally, we caution that our results are based on data from only five CBCs. In order to truly examine regional raptor population trends, data from a much larger number of CBCs over a broader geographic area must be analyzed. What we report here is a preliminary pilot study.

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Yellowstone National Park: A Look at an Individual Count Circle

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Editor's note: This article, originally published as "2001 Yellowstone Christmas Bird Count Results," was reprinted with permission from Yellowstone Science *(Vol. 10, No. 1), Winter 2002 to show the workings of an individual count circle. A more detailed summary of past Yellowstone Christmas Bird Count results and methods can be found in the Winter 2001 issue of* Yellowstone Science *(Vol. 9, No. 1). We hope to explore changes over time in the Yellowstone National Park count circle in a future issue of* American Birds.

On December 16, 2001, the Yellowstone Christmas Bird Count was conducted in the Gardiner, Montana—Mammoth, Wyoming, area. This YCBC marks the 29th year for this traditional bird survey. The established center point for this bird count is the North Entrance of Yellowstone National Park and extends 7.5 miles from this point in any direction, with boundary limits basically east to Blacktail Ponds, north to the mining town of Jardine, Montana, and northwest to Corwin Springs, Montana. The YCBC is divided into teams of observers to maximize landscape coverage. All bird species and total individual birds detected during the count day are included in the final results. Additional birds incidentally observed three days before and three days after official count day are included in another category called the count week totals.

Since the YCBC is totally voluntary, the number of observers showing up in any given year is never known until count day. However, each year at least a half dozen skilled observers repeatedly return to participate in the YCBC. Weather conditions highly influence overall participant turnout as do personal holiday plans. The number of people participating in the YCBC has little bearing on the number of bird species or individuals detected during count day. In fact, weather plays a greater role in finding birds than does the number of participants. Because of access limitations in the winter, experience has shown birds can be best counted in specific habitats. The more inclement the winter weather (e.g., cold temperatures and deep snows) the better the birding, since birds are concentrated primarily near bird-feeding stations, riparian areas, and geothermal or open water areas. Birds are also less concentrated during mild weather conditions, since natural foods are more available. Ironically, the largest number of participants show up during years of mild weather conditions when birding is just average or below average (Figure 1). Hence, mild weather

Yellowstone Christmas Bird Count
December 16, 2001

Species	Yell.-Wy.	Yell.-Mt.	Outside Yell. N.P.- Mt.	Totals
Green-winged Teal	25	11		36
Mallard	51	66		117
Barrow's Goldeneye		12		12
Common Merganser			5	5
Bald Eagle	6	5	6	17
Rough-legged Hawk		1		1
Golden Eagle		2	2	4
Common Snipe	2			2
Rock Dove	26		22	48
Belted Kingfisher	1	1		2
Northern Flicker	1		3	4
Horned Lark	1			1
Gray Jay	4			4
Steller's Jay	1		4	5
Pinyon Jay			35	35
Clark's Nutcracker	39		22	61
Black-billed Magpie	63	8	46	117
Common Raven	49	13	58	120
Black-capped Chickadee	3		8	11
Mountain Chickadee	50		21	71
Red-breasted Nuthatch	9		10	19
Marsh Wren	2			2
American Dipper	10	28	4	42
Townsend's Solitaire	22	5	20	47
Bohemian Waxwing	19		50	69
Yellow-rumped Warbler	2			2
Song Sparrow	4		3	7
Gray-crowned Rosy Finch			120	120
Black Rosy Finch			2	2
House Finch			36	36
Common Redpoll	75		314	389
Red Crossbill	17			17
Pine Siskin	55		60	115
House Sparrow	15		120	135
Totals	**552**	**152**	**971**	**1675**

Total Species: 34 (Additional Species Count Week: 2)

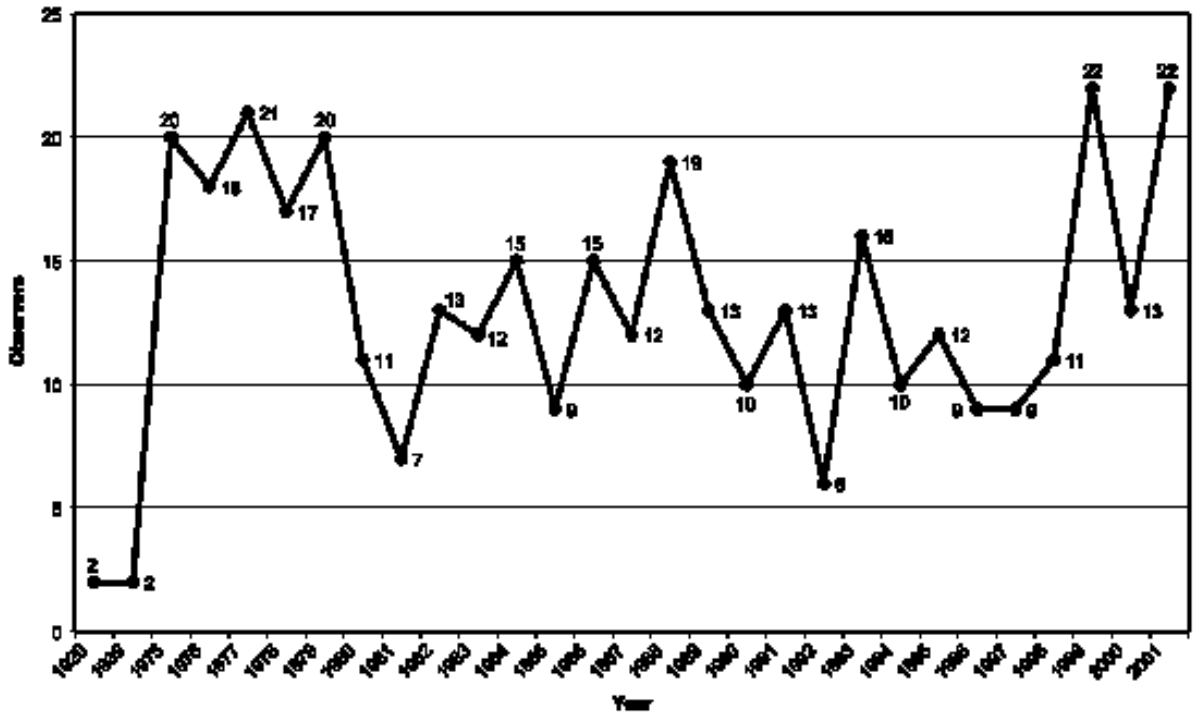
years for the YCBC result in few bird rarities being detected.

The 2001 Yellowstone Christmas Bird Count tallied a total of 34 bird species and 1675 individual birds. The mild weather conditions resulted in an average number of species and a slightly above average number of individual birds observed. As expected due to the mild weather, a record of 22 observers showed up for the 2001 YCBC tying the previous record set in 1999, another mild year. Temperatures during the 2001 YCBC ranged from 12-27 degrees F., with 3-12 inches of snow, depending on the elevation, and the edge of the rivers were not even frozen.

Three bird records were broken during the 2001 YCBC. A total of 389 Common Redpoll were detected in the count area this year, compared to the previous record of 148 set in 1989. The irruption of Common Redpolls was the result of a rare superabundance of food, namely Douglas-fir seed cones, alder catkins, and exposed grass seed heads, coupled with an early winter storm forcing redpolls into the area in November. Two Yellow-rumped Warblers were also detected, whereas in the past only one was seen in 1983, 1987, and 1990. Additionally, seven Song Sparrows were found this year compared to the previous record of six observed in 1988. Two Marsh Wrens were also found during the 2001 YCBC; this ties the record set last year. Four Northern Flickers were found in 2001, tying the previous record set in 1987. Interestingly enough, species that are regularly detected such as the Common Goldeneye, Hairy Woodpecker, Downy Woodpecker, Dark-eyed Junco and American Tree Sparrow could not be located due to the mild winter weather conditions.

In conclusion, a grand total of 95 species have been recorded on the YCBC (97 species with the YCBC and count week combined) during the 29 years the count has taken place. This year, mild weather conditions resulted in an average number of bird species detected, and a slightly above average number of individuals observed. Tolerable weather conditions also resulted in tying a record number of 22 participants attending the count. However, experience has shown that colder temperatures and above average snow depths are the optimum times for finding the greatest bird richness and abundance during the YCBC. Participants are reminded of these factors when deciding on attending future YCBC's. Regardless, the Yellowstone Christmas Bird Count tradition continues and a fun time was had by all.

Figure 1. Number of participants



The Use of Christmas Bird Count Data to Monitor Populations of Exotic Birds

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An "exotic" species is one that occurs in a region to which it is not native. Except for those few that are (or may eventually be) "countable" on personal lists, exotics are ignored by most birders. Likewise, few ornithologists have shown an interest in exotic species, despite several fertile topics of study. Lately however, interest is rising, as the distribution, numbers, and diversity of exotics continue to increase, and impacts to native species (if any) need to be assessed. Here, I demonstrate how CBC data can be used to analyze population trends of exotic birds. This paper barely skims the surface of the information available. Exotics are most widespread in southern California, southeastern Florida, and throughout the main Hawaiian islands, states that share mild climates, urban areas extensively landscaped with exotic vegetation, and major ports of entry for imported wildlife. Most of the species present in California and Florida are the result of accidental escapes of cagebirds, but dozens of species have been deliberately released into Hawaii—Long (1981) documented 75 species of gamebirds alone! This paper is biased toward California and Florida because data from several studies were easily available. Population trends of gamebirds can be difficult to track because of the possibility of continual releases by state agencies and private hunting clubs. Numbers of doves, parrots, and other cagebirds may also be supplemented by accidental or intentional releases, but these likely are much smaller in scale, especially in recent years.

Populations of exotics often experience rapid increases in numbers followed by severe declines. A few species, such as the Black Francolin (*Francolinus francolinus*) in Florida and Louisiana, and the Blue-gray Tanager (*Thraupis episcopus*) and Java Sparrow (*Padda oryzivora*) in Florida, have died out completely. Because of such population fluctuations, large-scale, long-term monitoring of exotics is needed. CBC data provide several advantages for monitoring these populations: 1) counts have been conducted in some areas for decades, allowing long-term trends to be determined; 2) counts occur throughout the United States and Canada, allowing for large-scale monitoring; 3) CBC circles are all the same size, and survey methodology is standardized; 4) CBCs quantify observer effort, thereby allowing direct comparison of counts that differ widely in the number of participants or daylight hours; 5) most CBC circles are located in urban or suburban areas, to which most exotics are restricted; 6) exotics generally are sedentary, so CBC data should be as valuable as breeding-season surveys; and 7) CBC participants are expected to report all birds seen, even those that are not "countable" on personal lists.

Despite these advantages, several caveats need to be mentioned when using the CBC database to track exotics: 1) confusing genera, such as *Streptopelia* doves, *Amazona* parrots, *Aratinga* parakeets, *Euplectes* bishops, and *Lonchura* munias, are poorly known to most participants and inadequately covered by most field guides, creating the potential for errors of identification. Recently for example, some Florida CBCs have listed dozens of Ringed Turtle-Doves (*Streptopelia 'risoria'*) where none were known to occur previously (i.e., outside of St. Petersburg), and these almost certainly represent misidentified Eurasian Collared-Doves; 2) the reporting of exotics on CBCs is inconsistent and depends on the willingness of participants to count them and of compilers and editors to include them. Two examples involve the Rock Dove (*Columbia livia*), which has been present in North America for nearly 400 years, but was not widely reported on CBCs until December 1974, and the Muscovy Duck (*Cairina moschata*), which is locally abundant in Florida but was not listed on CBCs in the state until this season; 3) populations of some exotics, such as the Purple Swamphen (*Porphyrio porphyrio*) and Red-whiskered Bulbul (*Pycnonotus jocosus*) in Florida, are entirely outside CBC circles, while the ranges of probably all other species are only partially covered by CBCs; and 4) the online database contains errors (e.g., Pranty 2001 and below), so researchers should verify all data from the CBC issues of *Audubon Field Notes*, *American Birds*, and *Field Notes*.

Graphs in this paper were created from the database accessible from the Audubon website (www.audubon.org/bird/cbc). These graphs are based on the number of birds observed per party-hour, which allows for comparison among CBC circles and years with variable observer effort. Scientific

Figure 1.

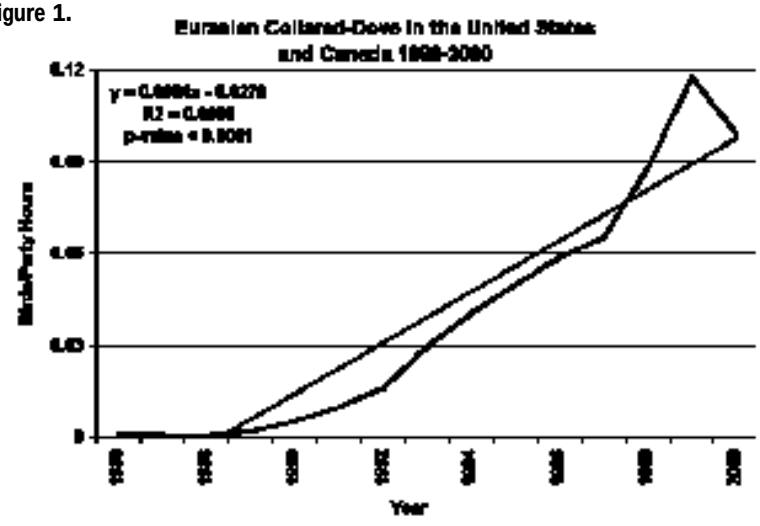

Figure 2.

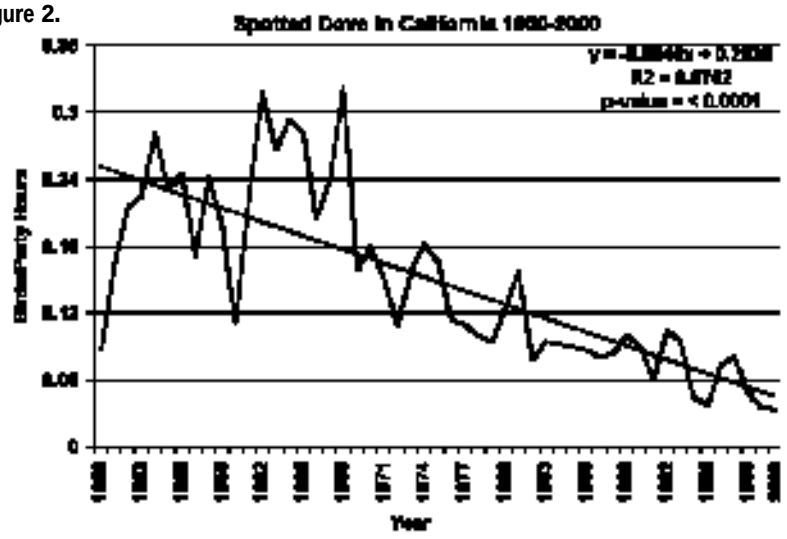

Figure 3.

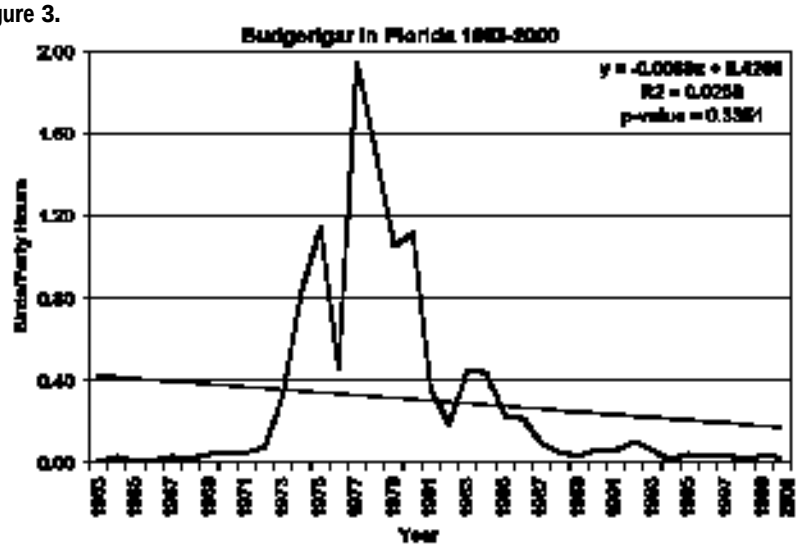

Figure 4.

studies must analyze the data statistically to ensure the validity of the results. Because the graphs presented here have not been analyzed, most of the species selected for this paper are under formal study.

Eurasian Collared-Dove
(Streptopelia decaocto)

The colonization of North America by this species since the early to mid-1980s well illustrates how CBC data can track expansion of a highly successful exotic (Figure 1). Birds colonized southeastern Florida in the late 1970s or early 1980s from a population accidentally released into the Bahamas (Smith 1987). Collared-doves now occur west of the Mississippi River and continue to increase in range and numbers (LeBaron 1999, Romagosa and McEneaney 1999, Romagosa and Labisky 2000). Concerns about expanding collared-dove populations on native doves were mentioned by Steadman (1998), Romagosa and McEneaney (1999), and Romagosa and Labisky (2000), but true impacts remain to be quantified.

Spotted Dove
(Streptopelia chinensis)

This native of southeast Asia was released into southern California around 1915 as a gamebird. Although it is locally abundant and range expansion continues, numbers at Los Angeles and Pasadena began to decline in the late 1970s. Causes of the population decline may be related to increased urbanization and loss of agricultural and native habitats (Johnston and Garrett 1994, Garrett and Walker 2001). Overall numbers within CBC circles show a steady decline since the early 1980s (Figure 2).

Budgerigar
(Melopsittacus undulatus)

Pranty (2001) used CBC data to graph the startling "boom and bust" pattern (Figure 3) of this popular Australian cagebird. Numbers on CBCs in west-central Florida increased from 269 parakeets during 1972–1973 to 2910 individuals two years later. The CBC population peaked at 6895 individuals during 1977–1978 but had crashed to 385 parakeets ten years later. Since December 1995, Budgerigars have been limited to

two CBC circles, and numbers have ranged between 43 and 92 individuals. The primary cause of the decline was thought to be nesting competition with House Sparrows (Pranty 2001).

Monk Parakeet
(Myiopsitta monachus)

This native of South America is the most successful parrot in North America, aided by its nest-building behavior (which allows it to avoid competition with native and exotic cavity-nesting species), and its ability to survive sub-freezing temperatures. Van Bael and Pruett-Jones (1996) used CBC data to document that the U.S. population was doubling every 4.8 years, an exponential increase. Recent CBC data confirm that the population continues to increase (Figure 4). Eradication programs during 1972–1975 killed dozens of parakeets in several states (Neidermyer and Hickey 1977). These programs were successful at reducing small populations, but probably would be ineffective today. Eradication efforts in one Argentinean province between 1958 and 1960 killed **427,206** Monk Parakeets with no apparent reduction in the overall population (Neidermyer and Hickey 1977). Florida contains the bulk of the U.S. population, with 3015 individuals tallied on CBCs this past season, followed by 908 parakeets in Connecticut, and dozens of individuals in other states. Further increases in range and numbers are likely.

Black-hooded Parakeet
(Nandayus nenday)

This currently "uncountable" South American native bears watching in Florida, where it is the second most widespread and abundant parrot. Pranty and Lovell (in prep.) used CBC data and other observations to document a significant, long-term population increase (Figure 5), especially in the St. Petersburg area. Smaller populations are found in southern California.

European Starling
(Sturnus vulgaris)

This species probably is the most successful, widespread, and abundant exotic bird in North America. Starlings colonized the continent from 100 birds released at New York City in 1890–1891. Within a

Figure 5.

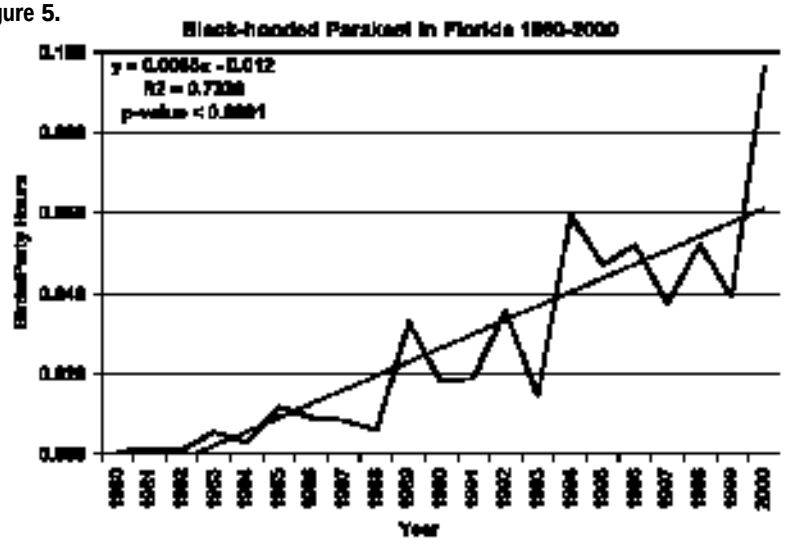

Figure 6.

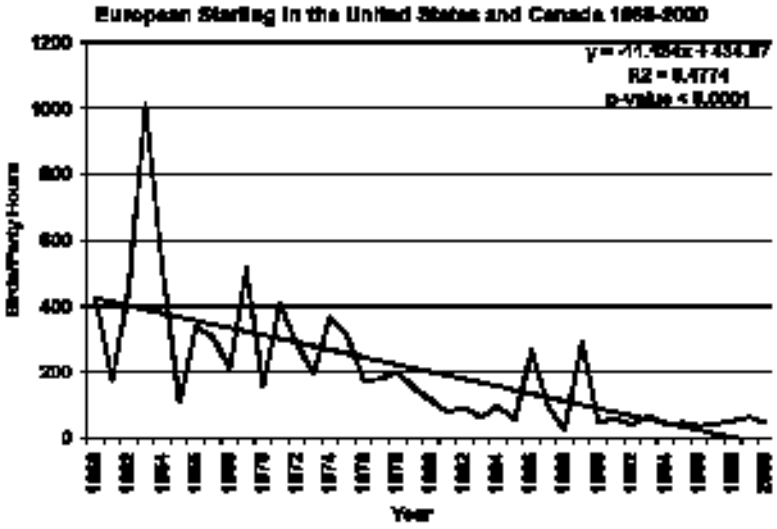

Figure 7.

Figure 8.

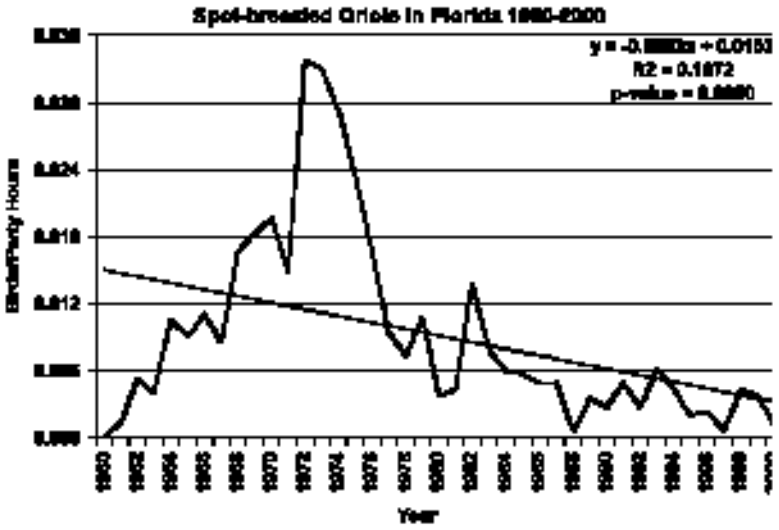

Figure 9.

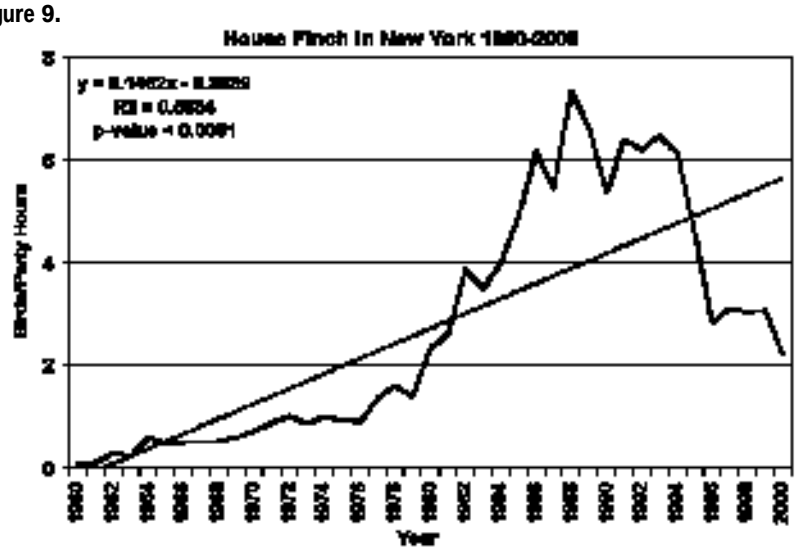

Figure 10.

century, their population was estimated at 200 million individuals, and breeding populations were distributed essentially continuously from Alaska and Newfoundland south to Baja California and Florida (Cabe 1993). CBC data show great variation in annual numbers (probably dependent upon whether large winter roosts are inside or outside CBC circles), but numbers of birds observed per party-hour (Figure 6) suggest a population decrease exceeding 66 percent in the past 30 years.

Crested Myna
(Acridotheres cristatellus)

One or two pairs of mynas from Hong Kong were released into the Vancouver, British Columbia, area between 1894 and 1897. By the 1930s, the population had surpassed 5000 individuals, but had declined over 50 percent by 1959 (Johnson and Campbell 1995). CBC data (Figure 7) show a dramatic decline beginning in the early 1970s, with numbers on CBCs dropping below 100 individuals by the mid-1990s. Since December 1995, only one to four mynas have been found annually—all on the Vancouver CBC—and the species is nearly extirpated. Johnson and Campbell (1995) suggested several causes of the population decline, including increased nesting competition with European Starlings, loss of foraging habitat from urbanization, and maladaptation to the local climate.

Spot-breasted Oriole
(Icterus pectoralis)

This native of Central America escaped from a Miami, Florida, tourist facility in 1948 and began to increase in range and numbers. However, in the 1970s the population declined rapidly and has not recovered. Robertson and Woolfenden (1992) attributed the decline to a series of severe freezes, which began in January 1977, that killed much of the exotic vegetation on which the orioles fed. However, CBC data (Figure 8) indicate that the population decline began two years earlier. Since the late 1970s, numbers on Florida CBCs have totaled less than 60 individuals annually.

House Finch
(Carpodacus mexicanus)

This native of western North America was accidentally released into New York

City in 1940 and has been expanding its range since that time. The population increase, one of the most successful colonizations in the New World, has been documented by several authors (e.g., Bosakowski 1986 and references therein). During 1994–1996, an epidemic killed *tens of millions* of House Finches in the eastern United States (Nolan et al. 1998), and CBC data from New York (Figure 9) clearly show its impact on the population.

House Sparrow
(Passer domesticus)

Another one of the most successful exotics in North America, this Old World species colonized the continent from 100 individuals released at New York City in 1851–1852 (Lowther and Clink 1992). By the early 1940s, the population was estimated at 150 million birds. CBC data (Figure 10) show a very gradual decline over the past 40 years, with numbers during the 1990s less than half of those during the 1960s. (An error in the database was corrected to produce this graph accurately). Kricher (1983) noted that House Sparrow populations in the northeastern United States decreased as House Finch populations increased. However, House Sparrow numbers also declined (though less severely) in the southeastern United States, where House Finches had not yet colonized. Lowther and Clink (1992) attributed the sparrow's decrease primarily to the decline of horse transportation, and, since the 1960s, to an increase in large farms and monoculture crop production.

Christmas Bird Count data can greatly aid the monitoring of local, regional, and national populations of exotic birds. However, consistent reporting of exotics is a must, and their identification needs to be given the same degree of study and documentation as native rarities (Garrett 1993). Participants should not try to "force" an identification based upon some perceived likelihood of occurrence, but rather should be willing to invest in reference materials and time to hone their identification skills. In some cases, this means going beyond standard North American guides, as well as bringing along a camera to document observations. Finally, CBC compilers should encourage participants to pay closer attention to all exotics found in their area, not just those that are officially "countable."

Acknowledgments

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WatchList Species as Viewed Through the Christmas Bird Count Database

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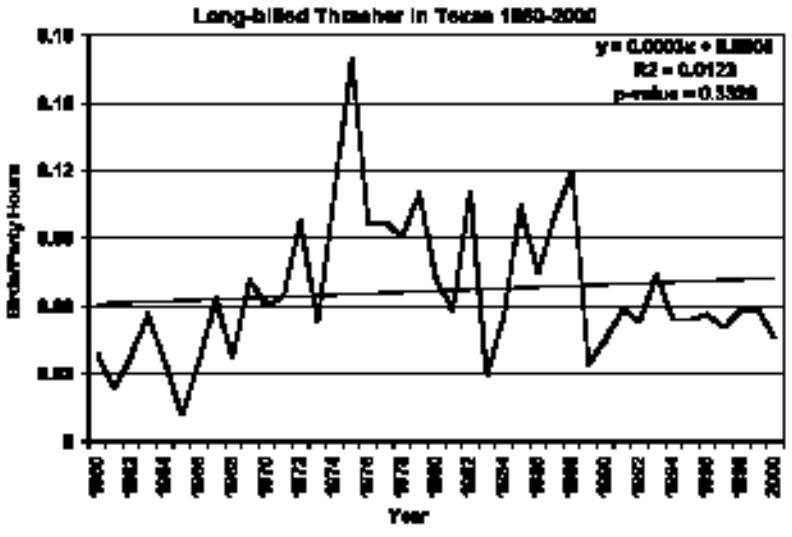
The Audubon WatchList 2002 identifies North American bird species that need our help. WatchList species are those with population declines, limited geographic range, and/or threats such as habitat loss on breeding and wintering grounds. A centerpiece of conservation at Audubon, the WatchList focuses attention on at-risk bird species so that limited resources are spent where they are most needed.

Audubon's WatchList 2002, an update of the WatchList presented on the Audubon website in 1998, for the first time includes birds of Hawaii and Puerto Rico. Because the list is an independent, science-based, and unbiased evaluation, it includes an assessment of all bird species, regardless of whether or not they are listed as endangered or threatened under the Federal Endangered Species Act.

The WatchList message is clear: We must harness the energy of individuals and groups to work collaboratively for birds and their habitats. By doing so, we can save birds, their habitats, and the other wildlife that depend on those habitats, for the enjoyment and benefit of ourselves and of our children.

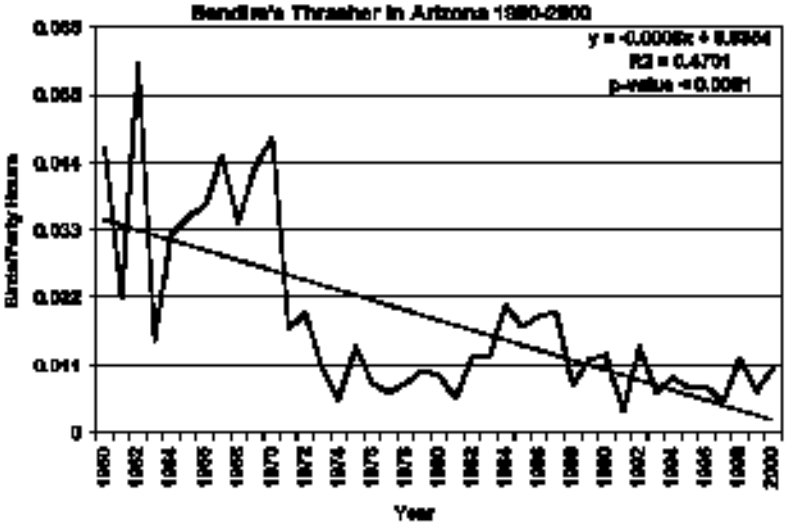
Long-billed Thrasher (*Toxostoma longirostre*). Photo/A. Papadatos/VIREO

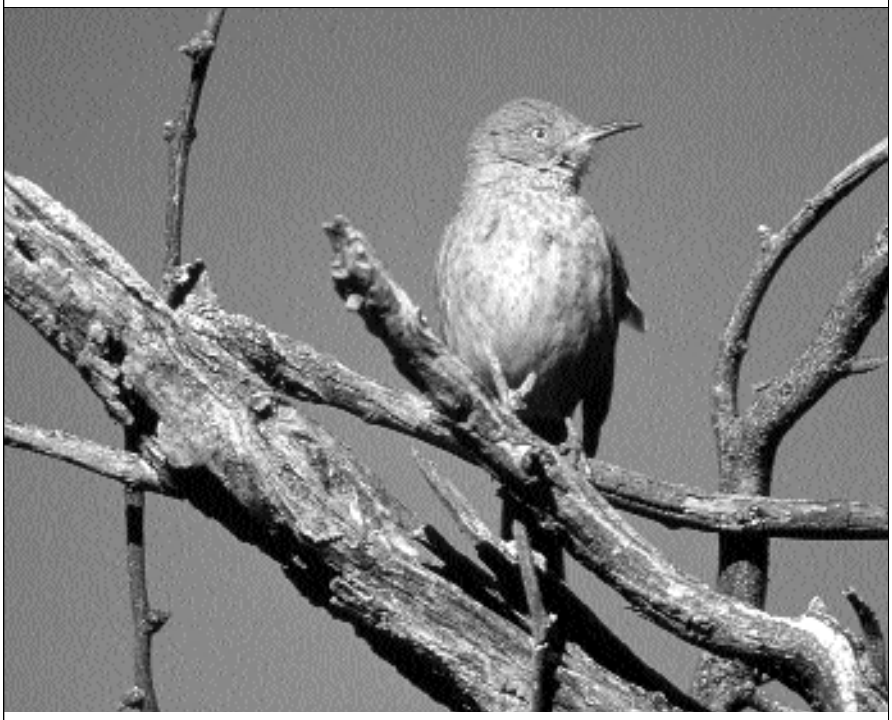


Until recently, WatchList criteria have been primarily based upon declines as shown by breeding-season data. Population trends in other seasons are important for assessment of the status of species as well, and the Christmas Bird Count provides the primary tool to look at early-winter bird population trends on a continentwide basis. Data collected by CBC participants via the standardized methodology of the count, always in the same areas and at the same time of year (and often by the same people), may show long-term trends in the species censused.

While declines in wetland and grassland species in many areas have been much studied and well documented, shrubland species have received considerably less attention. Many shrubland species are also showing consistent declines as transitional thicket habitats are either lost to natural succession or developed for use by humans. Here I present preliminary analyses of Christmas Bird Count data for several shrubland species included on the current Audubon WatchList 2002—Long-billed Thrasher (*Toxostoma longirostre*), Bendire's Thrasher (*Toxostoma bendirei*), California Thrasher (*Toxostoma redivivum*), and Le Conte's Thrasher (*Toxostoma lecontei*).

Long-billed Thrasher occurs in dense thickets, brush, and tangles from southern Texas south into eastern Mexico. Climatic variability (e.g., temperatures, precipitation) probably influences abundance and distribution of this species at the northern limits of its range in Texas. The accompanying graph generated using the on-line CBC data output tool shows data in birds per party hours from Texas CBCs between 1960 and 2000. Note the possible manifestation of climatic variability in the large fluctuations in birds per party



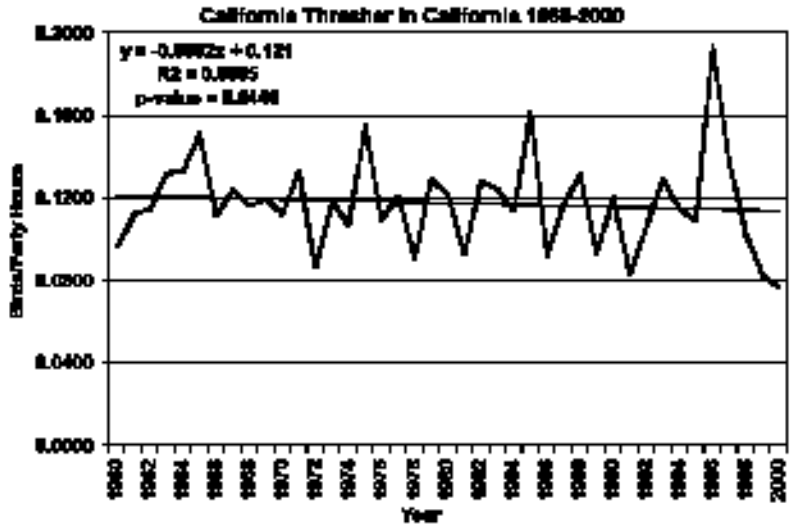


Bendire's Thrasher (*Toxostoma bendirei*). Photo/R.& N. Bowers/VIREO

hours among years. The trend for these data suggests a slight increase during this period, although this trend is not significant (p-value = 0.3326, n = 41). The peak in 1975 represents larger-than-average numbers of thrashers reported on several count circles—seven count circles reported at least 30 thrashers that year.

Bendire's Thrasher occurs locally in desert grasslands of the southwestern United States. This species has apparently experienced declines in some parts of its range, possibly a result of overharvesting of yuccas, overgrazing of desert grassland habitats, increasing agricultural activity, urban sprawl, or exclusion by Curve-billed Thrasher (*Toxostoma curvirostre*). Using the "Historical Results" link on the CBC home page, quick analysis of CBC data is an easy way to identify areas of decline within a species' range. The accompanying graph shows data in birds per party hours from Arizona CBCs between 1960 and 2000. The trend for these data shows a decline during this time period that is significant (p-value < 0.0001, n = 41). However, this species is apparently migratory in much of its U.S. range, and more research is necessary to evaluate the extent of its decline.

California Thrasher is a highly localized species that occurs in chaparral, dense thickets, and brushy habitat in central and southern California and adjacent Baja California.

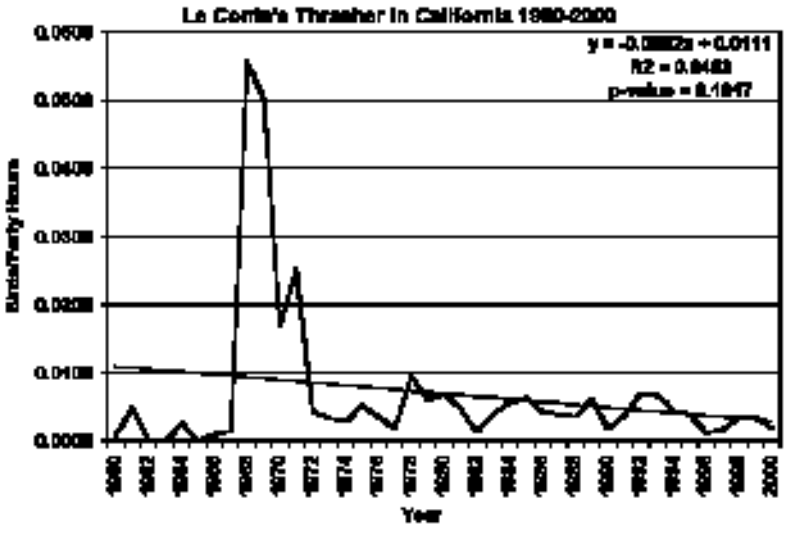


California Thrasher (*Toxostoma redivivum*). Photo/H.P. Smith Jr./VIREO

Because species with limited ranges are perhaps at greater risk for population declines, quick and easy methods for analyzing population trends could be very useful for highlighting areas or species of concern. This preliminary analysis of data in birds per party hours from California CBCs between 1960 and 2000 shows how CBCs can be used in this way. These data on California Thrasher suggest that this species has not exhibited significant declines since 1960 (p-value = 0.5446, n = 41).

Le Conte's Thrasher occurs in arid and sparsely vegetated desert habitats of southern Nevada, southwestern Arizona, southeastern California, and in the adjacent Mexican states of Baja California and Sonora. The WatchList highlights a need for more research on this species, because Breeding Bird Survey data may not accurately reflect its true population trends (e.g., thrasher breeding season relative to timing of data acquisition). Again, CBC data can be used for quick and easy analysis of trends over time. The trend for this species from California CBCs between 1960 and 2000 shows a slight decline since 1960, although this trend is not significant (p-value = 0.1817, n = 41). The large spike in the graph that occurs in the late 1960s represents the effects of a single count circle that reported large numbers of thrashers during its brief existence (Taft-Maricopa CBC, 1968-1971).

Le Conte's Thrasher (*Toxostoma lecontei*). Photo/J. Fuhrman/VIREO



The 102nd Christmas Bird Count
Alphabetical Index to Regional Summaries

The regional summaries in the pages that follow are presented in a geographical order. This alphabetical index will assist you in finding the summary for a particular region.

Species appearing in boldface in the regional summaries are deemed "unusual" by the regional editors, unless otherwise noted.

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