

The Importance of the CBC to Our Understanding of Boreal Bird Populations



Birders on Christmas Bird Counts from 250 locations across the United States and Canada counted more than 200,000 White-winged Scoters last season. More than 200,000 White-throated Sparrows were enumerated from over 1000 CBC locations. Palm Warblers, numbering more than 16,000, tail-wagged on more than 200 counts. And how about those Bonaparte's Gulls—more than 72,000 at 466 locations! *Probably relatively few of us dedicated CBC counters have given much thought...*

...to what and where it is that makes it possible for us to find this abundance of birds. The White-winged Scoters, for example, that are such a part of winter birding along the Atlantic and Pacific coasts, raise their young in the boreal forest wetlands of northern Canada and Alaska. In fact, there are more than 1.5 million lakes spread out across Canada's boreal forest region, providing nesting habitat for 26 million waterfowl of 35 species. More than 50 percent of the breeding population of 15 species of waterfowl that winter in the United States occurs in the boreal. Favorite CBC birds like Surf Scoter, White-winged Scoter, Black Scoter, Bufflehead, and Common Goldeneye are even more reliant, with 80 percent or more of

their breeding populations within the boreal forest region. Recent satellite telemetry research has provided an even more detailed picture of the linkages between the boreal and the wintering places of many of these birds. We now know that Surf Scoters wintering in Chesapeake Bay breed in the boreal wetlands of northern Quebec and Labrador. Those wintering along the coast of British Columbia travel northeast to the Northwest Territories.

And it's not just ducks. Over 80 percent of all Dark-eyed Juncos, White-throated Sparrows, Palm Warblers, Yellow-rumped Warblers, Northern Shrikes, Ruby-crowned Kinglets, and Bonaparte's Gulls breed in the boreal forest of Canada and Alaska.

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Christmas Bird Counts are inextricably linked to the boreal forest. Most boreal birds leave the boreal region in winter, flooding south to make up significant proportions of winter bird communities across the Americas. And "flood" is probably an apt description, since the numbers are truly staggering—literally billions of individual birds make their way south from the boreal each autumn. This includes some of our most beloved backyard birds—White-throated Sparrow, Golden-crowned Sparrow, Yellow-bellied Sapsucker, Ruby-crowned Kinglet, Yellow-rumped Warbler. It's estimated that 110 million White-throated Sparrows breed each year in Canada's boreal forest, along with 170 million Dark-eyed Juncos, 82 million Yellow-rumped Warblers, and 92 million American Robins (Blancher 2003). More than 200 boreal breeding species winter in the United States,

For information about the author, see page 30.

190 species in Mexico, and as many as 87 as far away as South America.

In the United States, winter bird communities are often overwhelmingly made up of boreal bird species. On many CBCs, boreal birds make up 50–90 percent of the species tallied. This is true even in the southern United States. For example, 60 percent of the species that occurred on the Corpus Christi, Texas, CBC in 2005 (141 of 236 species) were birds that regularly occur in the boreal. Sixty-one percent of the species on the Orange County Coastal, California, CBC in 2005 (131 of 216) were species that regularly occur in the boreal.

For a great many of these species, CBCs also provide one of the only ways to track changes in their abundance. The remoteness of the northern portions of the boreal forest makes it impossible to implement a breeding season survey across the vast region where these birds occur. It is only when they leave the boreal forest for their winter quarters that we can count them effectively. In fact at least 55 species of boreal breeding birds are not monitored at all by the Breeding Bird Survey but are regularly found on Christmas Bird Counts. Audubon scientists, together with U.S. Geological Survey statisticians, are currently working hard to develop rigorous models using CBC data that will continue to help detect changes in abundance of these boreal birds (Niven et al. 2004, Sauer et al. 2004).

Unfortunately, at least 40 boreal breeding bird species are showing significant declines in abundance. This includes the Rusty Blackbird, a species thought to have declined by more than 90 percent over the past 50 years, and also Northern Shrike, Harris's Sparrow, and Bohemian Waxwing (Niven et al. 2004, Greenberg and Droege 1999). Surveys of waterfowl in the western portion of the boreal forest region have indicated declines of 40–50 percent or more in Lesser Scaup and in the three scoter species (Apton and Anderson 2001, Savard et al. 1998).

Boreal Is Facing Major Threats

While the majority of the Canadian boreal is presently considered ecologically intact, oil and gas, agriculture, timber, mining, and hydroelectric development are pushing northward at increasing rates. Timber companies in Canada cut approximately 2.5 million acres of forest per year. Approximately 90 percent of logging in Canada involves clear-cutting. Almost one-third of the boreal has already been allocated to forestry companies. Oil and gas extraction, mining, and hydro are bringing additive pressure on the boreal. And less than 6 percent of the boreal in Canada is currently protected. Given existing and proposed development in virtually every Canadian province and territory, the future of the boreal ecosystem will be largely determined over the next 5–10 years.

Much of the resource development in the boreal is being driven by United States consumption. Approximately 80 percent of Canada's forest product exports go to the United States. Almost two-thirds of the wood that is cut in Canada's boreal is used to make paper, including catalogs, junk mail, magazines, and newspapers. The United States uses more paper than any other nation. And many Americans would be surprised to learn that the United States buys more of its oil and gas from Canada than from any other single source. (Canadian Boreal Initiative 2005, ForestEthics undated).

The Boreal Conservation Framework: Largest Conservation Initiative in History

Canada's Boreal Forest offers an unparalleled opportunity to conserve one of the earth's most important remaining ecological treasures. In December 2003 an extraordinary alliance of conservation organizations, First Nations, and resource companies proposed a made-in-Canada solution to safeguard Canada's vast boreal forest and wetland region. A unique approach coupling long-term economic development and broad conservation goals

for the entire region, the Boreal Conservation Framework calls for the following.

- The establishment of a network of large interconnected protected areas covering at least half of Canada's 1.3 billion acre boreal region.
- The use of cutting-edge sustainable development practices, such as the Forest Stewardship Council's certification, in remaining areas.

The report that begins on page 30 summarizes, for the first time, the overwhelming importance of the boreal forest of Canada and Alaska to all bird species. Read on to see how many of your CBC birds come from North America's bird nursery—the boreal forest.

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Swamp Sparrow
Photo/Mary Kay Rubey

The Boreal Forest Region: *North America's Bird Nursery*

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The Boreal Forest Region of North America, stretching from Alaska across 6,000 kilometers (3,500 miles) to Newfoundland and Labrador, at 5.9 million square kilometers (1.5 billion acres), is the largest wilderness left in North America and represents 25 percent of the world's remaining intact forests (CBI 2005). Its vastness also makes it one of the few remaining places on earth where entire ecosystems function. These ecosystems support some of the greatest abundance of wildlife on the continent, including massive caribou herds, intact predator-prey systems with healthy populations of top predators like wolves, and large numbers of birds (Ricketts et al. 1999).

This report was originally published in April 2005. The study was commissioned by the Boreal Songbird Initiative and the Canadian Boreal Initiative.

While all this has been known about North America's Boreal Forest Region, its importance has sometimes been overlooked precisely because of its abundant wildlife. Most global level conservation assessments of large ecoregions have focused on the number of different species of animals and plants (Karieva and Marvier 2003). Areas with a high number of different species tend to be

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given more attention, especially when many of those species have become rare so that they can rightly be considered endangered. In contrast, the Boreal Forest Region has lower species diversity and fewer rare species than most tropical regions, and significant threats to the Boreal Forest Region ecosystem have only recently become more widely understood (CBI 2005, Schmiegelow et al., unpubl. ms).

In recent years, some scientists and conservation organizations have begun considering abundance and intactness of ecosystems as equally important factors in developing conservation priorities (Karieva and Marvier 2003, Ricketts et al. 1999, Schmiegelow et al., unpubl. ms). Through its Important Bird Areas program, BirdLife International was one of the first organizations to explicitly consider abundance as well as rarity in conservation (Chiple et al. 2003, Fishpool and Evans 2001, Heath and Evans 2000, Wells 1998, Wells et al. 2005). More recently, the Partners In Flight coalition and its members have highlighted the concept that some regions have a high stewardship responsibility for maintaining species that are still abundant (Rich et al. 2004, Rosenberg and Wells 2005, Rosenberg and Wells 2000, Wells and Rosenberg 1999, Rosenberg and Wells 1995).

This report analyzes, for the first time, the stewardship responsibility of a global scale ecosystem toward a continent's wildlife—in this case, North America's avian populations. Specifically we answer the following questions.

How many bird species use North America's Boreal Forest Region?

What types of birds use North America's Boreal Forest Region?

How many birds in total rely on North America's Boreal Forest Region?

How many and what kinds of species are particularly reliant on North America's Boreal Forest Region?

How important is North America's Boreal Forest Region for birds during spring and fall migration?

Where do birds that breed in North America's Boreal Forest Region spend the winter?

Delineation of North America's Boreal Forest Region

Analyses in this report are based on the area within the following four Bird Conservation Regions (BCRs, U.S. NABCI Committee 2000; Figure 1).

- BCR 4: Northwestern Interior Forest
- BCR 6: Boreal Forest Region Taiga Plains
- BCR 7: Taiga Shield and Hudson Plains
- BCR 8: Boreal Forest Region Softwood Shield



Figure 1. Bird Conservation Regions in North America's Boreal Forest Region¹. 1: Northwestern Interior Forest (BCR 4), 2: Boreal Forest Region Taiga Plains (BCR 6), 3: Taiga Shield and Hudson Plains (BCR 7), 4: Boreal Forest Region Softwood Shield (BCR 8).

¹ The Canadian Boreal Initiative (CBI) defines the Canadian Boreal region using the National Ecological Framework for Canada Ecozones (NEFC). The following NEFC ecozones are considered to be Boreal: Boreal Shield, Boreal Cordillera, Boreal Plains, Taiga Shield, Taiga Cordillera, Taiga Plains, and Hudson Plains. The Canadian Bird Conservation Regions in Figure 1 approximate Canada's Boreal region according to the CBI definition, although some differences exist.

Key Findings

- Eighty percent of the waterfowl species of North America, 63 percent of finch species, and 53 percent of warbler species breed in the Boreal Forest Region.
- In at least 96 species, 50 percent or more of their entire breeding populations occur within the Boreal Forest Region.
- Nearly 100 percent of the global populations of the Bonaparte's Gull, the Palm Warbler, and the Short-billed Dowitcher nest within the Boreal Forest Region.
- Over 80 percent of the populations of the coastal wintering White-winged Scoter, the rapidly disappearing Rusty Blackbird, and the massive Great Gray Owl nest in the Boreal Forest Region.

How many bird species use North America's Boreal Forest Region?

Nearly 400 species (399 or 57 percent of regularly occurring birds of the United States and Canada) are known to occur within some portion of the Boreal Forest Region of Alaska and Canada. Excluding species that are exclusively marine or coastal or that occur in only a tiny portion of the Boreal Forest Region, there are 325 species (47 percent) that occur regularly in the Boreal Forest Region (Appendix 1). Of these, 303 species (43 percent) breed in the forests, thickets, and wetlands of the Boreal Forest Region. The remaining 22 species occur as migrants or winterers within the region.

What types of birds use North America's Boreal Forest Region?

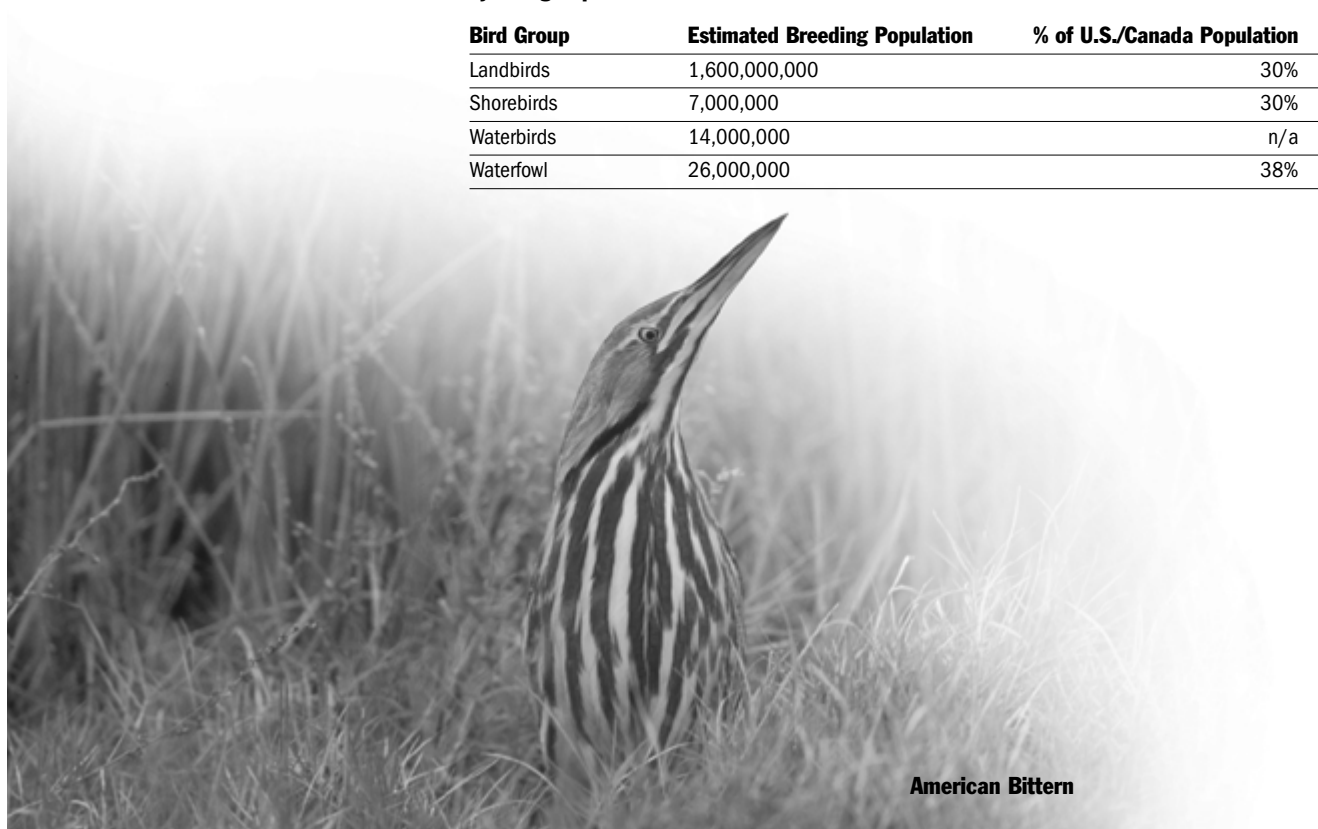
The array of types and families of birds that regularly use the Boreal Forest Region is impressive. At least 47 families of birds are represented, making up 67 percent of all bird families that regularly occur in the United States and Canada. The list includes loons, grebes, swans, ducks, hawks, sandpipers, gulls, owls, vireos, flycatchers, warblers, and sparrows. Certain families have an especially high representation in the Boreal Forest Region. Thirty-five of 44 waterfowl species (80 percent) in the United States or Canada breed in the Boreal Forest Region. Similarly, among warblers, 27 of 51 species (53 percent) that nest in the United States or Canada breed in the Boreal Forest Region. Among thrushes, 13 of the 14 thrush species (93 percent) that nest in the United States and Canada are Boreal Forest Region breeders. Among finches, the number is 10 of 16 (63 percent).

How many birds in total rely on North America's Boreal Forest Region?

The number of birds breeding in North America's Boreal Forest Region is estimated at between 1.65 and 3 billion (Table 1). Of these, landbirds are by far the most numerous, making up 97 percent of all birds that breed in the Boreal Forest

Table 1. Estimated number of birds breeding in North America's Boreal Forest Region by bird group.

Bird Group	Estimated Breeding Population	% of U.S./Canada Population
Landbirds	1,600,000,000	30%
Shorebirds	7,000,000	30%
Waterbirds	14,000,000	n/a
Waterfowl	26,000,000	38%



American Bittern

Region. The importance of the Boreal Forest Region as a breeding ground for many bird groups is staggering. An estimated 38 percent (26 million) of all of the waterfowl of Canada and the United States breed in the Boreal Forest Region. Approximately 30 percent of all shorebirds (7 million) and 30 percent of all landbirds (1–3 billion) that breed in the United States and Canada do so within the Boreal Forest Region.

How many and what kinds of species are particularly reliant on North America’s Boreal Forest Region?

A total of 276 species have 5 percent or more of their breeding range within the Boreal Forest Region. Of these, at least 96 species representing 14 percent of the total U.S./Canada avifauna have 50 percent or more of their estimated total breeding population within the Boreal Forest Region (Table 2). Another 55 species have 25 percent to 49 percent of their breeding population within the Boreal Forest Region (Table 3). A wide variety of birds are represented among these Boreal Forest Region birds, including several species from each major bird group: waterfowl, waterbirds, shorebirds, and landbirds.

Table 2. Species with 50 percent or more of estimated Western Hemisphere breeding population in North America’s Boreal Forest Region (96 species).

Trumpeter Swan	Hudsonian Godwit	Bohemian Waxwing
American Wigeon	Surfbird	Tennessee Warbler
American Black Duck	Least Sandpiper	Orange-crowned Warbler
Green-winged Teal	Short-billed Dowitcher	Nashville Warbler
Ring-necked Duck	Wilson’s Snipe	Magnolia Warbler
Greater Scaup	Red-necked Phalarope	Cape May Warbler
Lesser Scaup	Little Gull	Yellow-rumped Warbler
Surf Scoter	Bonaparte’s Gull	Black-throated Green Warbler
White-winged Scoter	Mew Gull	Blackburnian Warbler
Black Scoter	Herring Gull	Palm Warbler
Bufflehead	Common Tern	Bay-breasted Warbler
Common Goldeneye	Arctic Tern	Blackpoll Warbler
Barrow’s Goldeneye	Northern Hawk Owl	Black-and-white Warbler
Hooded Merganser	Great Gray Owl	Northern Waterthrush
Common Merganser	Boreal Owl	Connecticut Warbler
Ruffed Grouse	Yellow-bellied Sapsucker	Mourning Warbler
Spruce Grouse	American Three-toed	Wilson’s Warbler
White-tailed Ptarmigan	Woodpecker	Canada Warbler
Pacific Loon	Black-backed Woodpecker	Clay-colored Sparrow
Common Loon	Olive-sided Flycatcher	Le Conte’s Sparrow
Horned Grebe	Yellow-bellied Flycatcher	Fox Sparrow
Red-necked Grebe	Alder Flycatcher	Lincoln’s Sparrow
Merlin	Least Flycatcher	Swamp Sparrow
Yellow Rail	Northern Shrike	White-throated Sparrow
Sora	Blue-headed Vireo	White-crowned Sparrow
Whooping Crane	Philadelphia Vireo	Golden-crowned Sparrow
Semipalmated Plover	Gray Jay	Dark-eyed Junco
Greater Yellowlegs	Boreal Chickadee	Rusty Blackbird
Lesser Yellowlegs	Gray-headed Chickadee	Gray-crowned Rosy-Finch
Solitary Sandpiper	Ruby-crowned Kinglet	Pine Grosbeak
Wandering Tattler	Gray-cheeked Thrush	White-winged Crossbill
Spotted Sandpiper	Swainson’s Thrush	
Whimbrel	Hermit Thrush	

Table 3. Species with 25–49 percent of estimated Western Hemisphere breeding population in North America’s Boreal Forest Region (55 species).

Greater White-fronted Goose	Franklin’s Gull	Varied Thrush
Canada Goose	Black Tern	American Pipit
Northern Shoveler	Long-eared Owl	Cedar Waxwing
Northern Pintail	Belted Kingfisher	Yellow Warbler
Common Eider	Hairy Woodpecker	Chestnut-sided Warbler
Long-tailed Duck	Northern Flicker	American Redstart
Red-breasted Merganser	Western Wood-Pewee	Ovenbird
Double-crested Cormorant	Eastern Phoebe	American Tree Sparrow
American Bittern	Red-eyed Vireo	Chipping Sparrow
Osprey	Black-billed Magpie	Savannah Sparrow
Sharp-shinned Hawk	Tree Swallow	Nelson’s Sharp-tailed Sparrow
Northern Goshawk	Bank Swallow	Smith’s Longspur
Broad-winged Hawk	Black-capped Chickadee	Rose-breasted Grosbeak
Sandhill Crane	Red-breasted Nuthatch	Purple Finch
American Golden-Plover	Winter Wren	Common Redpoll
Semipalmated Sandpiper	Golden-crowned Kinglet	Pine Siskin
Dunlin	Arctic Warbler	Evening Grosbeak
Stilt Sandpiper	Veery	
American Woodcock	American Robin	

Table 4. Species with more than 80 percent of estimated Western Hemisphere breeding population in North America’s Boreal Forest Region (35 species).

Surf Scoter	Bonaparte’s Gull	Bohemian Waxwing
White-winged Scoter	Herring Gull	Tennessee Warbler
Black Scoter	Great Gray Owl	Cape May Warbler
Bufflehead	American Three-toed Woodpecker	Palm Warbler
Common Goldeneye	Black-backed Woodpecker	Blackpoll Warbler
Spruce Grouse	Yellow-bellied Flycatcher	Connecticut Warbler
Red-necked Grebe	Alder Flycatcher	Lincoln’s Sparrow
Whooping Crane	Northern Shrike	White-throated Sparrow
Lesser Yellowlegs	Philadelphia Vireo	Dark-eyed Junco
Solitary Sandpiper	Gray Jay	Rusty Blackbird
Surfbird	Boreal Chickadee	Pine Grosbeak
Short-billed Dowitcher		White-winged Crossbill

More than 80 percent of the populations of 35 species are found in the Boreal Forest Region (Table 4). This includes a surprising variety of species, including Palm Warbler (> 90 percent of population in Boreal Forest Region), Short-billed Dowitcher (> 90 percent of population in Boreal Forest Region), Northern Shrike, (> 90 percent), Bonaparte’s Gull (> 90 percent), Spruce Grouse (> 90 percent), Red-necked Grebe (> 90 percent), Gray Jay (80–90 percent), Bufflehead (80–90 percent), White-winged Scoter (80–90 percent), Rusty Blackbird (80–90 percent), and Great Gray Owl (80–90 percent). For these species, the Boreal Forest Region is virtually their only stronghold on earth.

How important is North America’s Boreal Forest Region for birds during spring and fall migration?

Virtually all species of boreal nesting birds also make use of parts of the Boreal Forest Region during migration. Some birds rely more on the Boreal Forest Region for migratory stopover habitat than for breeding or wintering. These 29 bird species (Table 5) include some that do not breed anywhere in the Boreal Forest Region. For

Lesser Yellowlegs
Photo © Ducks Unlimited Canada



Table 5. Species in which the area of North America's Boreal Forest Region occupied during migration exceeds the area occupied during breeding or wintering (29 species).

Greater White-fronted Goose	American Golden-Plover	Dunlin
Snow Goose	Pacific Golden-Plover	Stilt Sandpiper
Ross's Goose	Semipalmated Plover	Buff-breasted Sandpiper
Brant	Hudsonian Godwit	Long-billed Dowitcher
Cackling Goose	Red Knot	American Pipit
Tundra Swan	Sanderling	Harris's Sparrow
Gadwall	Semipalmated Sandpiper	Lapland Longspur
Rough-legged Hawk	White-rumped Sandpiper	Smith's Longspur
Whooping Crane	Baird's Sandpiper	Snow Bunting
Black-bellied Plover	Pectoral Sandpiper	

example, the White-rumped Sandpiper does not breed in the Boreal Forest Region but makes extensive use of wetlands within the Boreal Forest Region during its fall and spring migration. Other shorebirds, like the Pectoral Sandpiper, which have insignificant portions of the breeding range in the Boreal zone, are also highly reliant on Boreal Forest Region wetlands during migration. Waterfowl, like the Greater White-fronted Goose, Snow Goose, Cackling Goose, Tundra Swan, and Greater Scaup, also regularly migrate through a large part of the Boreal Forest Region. Not quantified here is use of the Boreal Forest Region by "molt-migrants," birds that migrate north into the Boreal Forest Region after breeding to undergo molt, a practice common among many waterfowl species.

Where do birds that breed in North America's Boreal Forest Region spend the winter?

Approximately 94 percent of individual birds migrate out of the Boreal Forest Region after breeding, judging by migratory shifts in range between breeding and wintering grounds. These Boreal migrants winter in many countries throughout the Western Hemisphere, with several species wintering outside of the hemisphere. More species winter in the United States (lower 48) than in any other country or region—a total of 204 species or approximately 63 percent of Boreal Forest Region breeding birds (Table 6). Mexico is a close second in importance, with 190 species (59 percent), followed by Central America (115 species, 36 percent), South America (87 species, 27 percent) and the Caribbean (86 species, 27 percent). If species with less than 10 percent of their breeding range in the Boreal Forest Region are excluded, the number of migrant species wintering in all of these regions is still high, ranging from 59 species wintering in South America, to 137 in the United States (Table 6).

Several of these species winter largely in a single country or region. American Black Ducks, Yellow Rails, Rusty Blackbirds, Smith's Longspurs, Harris's Sparrows, and Golden-crowned Sparrows are among species in which virtually the entire wintering population occurs only within the United States. Virtually all Cape May Warblers winter in the Caribbean. Most Baird's Sparrows winter in Mexico, while Yellow-bellied Flycatchers, Philadelphia Vireos, Wilson's Warblers, and Magnolia Warblers are restricted in winter to Mexico and Central America. Birds like the



Green-winged Teal
Photo © Ducks Unlimited Canada

Table 6. Number of species of boreal migrants by wintering region (excluding species with <1 percent of winter range in the wintering region).

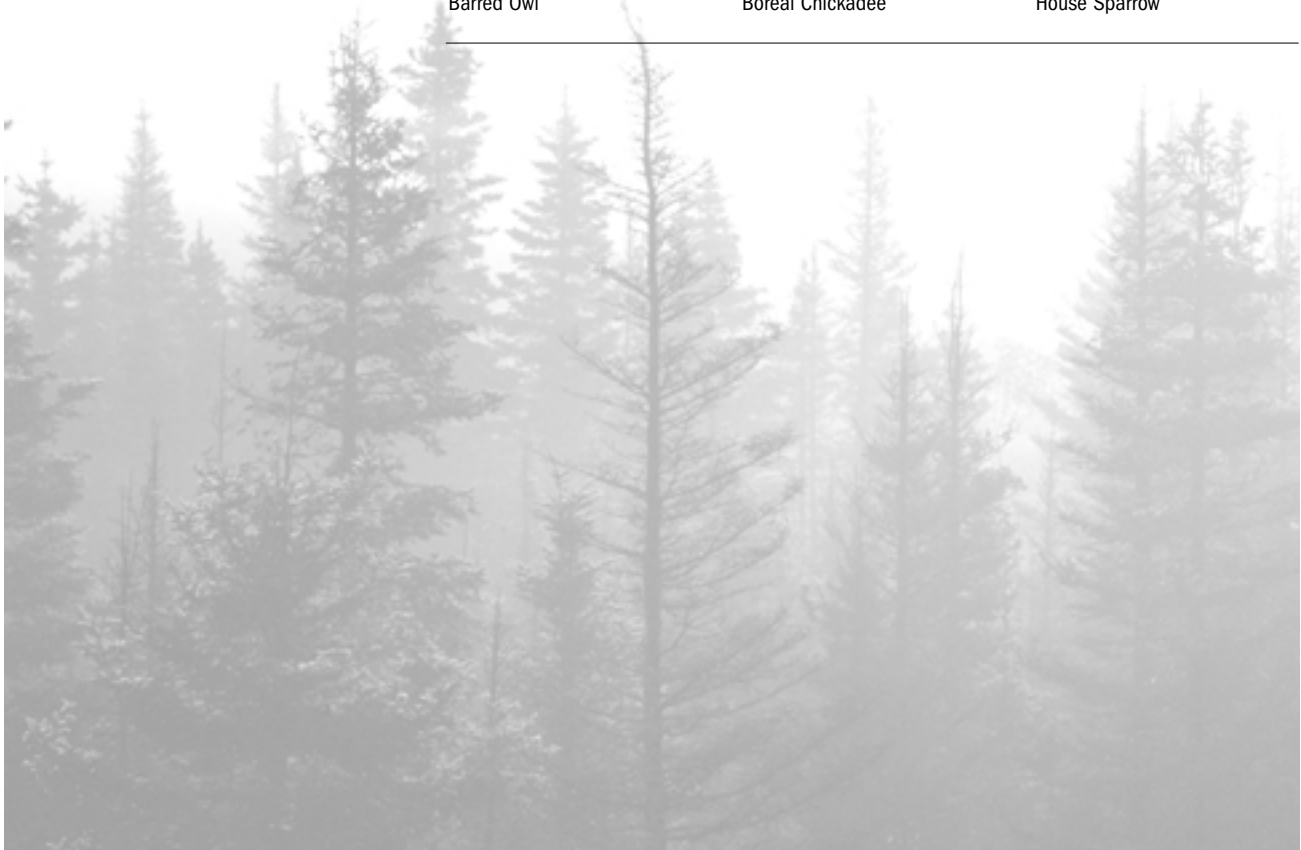
Boreal Migrant Species	Wintering Region				
	United States (lower 48)	Mexico	Central America	Caribbean	South America
>1% breed in Boreal Forest Region	204	190	115	86	87
>10% breed in Boreal Forest Region	137	128	81	65	59

Hudsonian Godwit, Blackpoll Warbler, and Connecticut Warbler are among those found only in South America in winter. And the Arctic Tern, a breeding bird of wetlands in the western Boreal Forest Region, winters in the sub-Antarctic Ocean.

Of the 276 species with 5 percent or more of their breeding range in the Boreal Forest Region, only a hardy 44 have 5 percent or more of their wintering range within the Boreal Forest Region (Table 7). Fifteen species are highly reliant on Boreal Forest Region lands for 50 percent or more of their winter range. Some of these—the essentially non-migratory species—rely on the Boreal Forest Region year-round. Such species include the Boreal Chickadee, Northern Hawk-Owl, Gray Jay, Spruce Grouse, Great Gray Owl, Boreal Owl, American Three-toed Woodpecker, Black-backed Woodpecker, and Willow Ptarmigan.

Table 7. Species with more than 5 percent of Western Hemisphere wintering range in North America's Boreal Forest Region (44 species).

Gray Partridge	Great Gray Owl	Gray-headed Chickadee
Ruffed Grouse	Boreal Owl	Red-breasted Nuthatch
Spruce Grouse	Downy Woodpecker	Brown Creeper
Willow Ptarmigan	Hairy Woodpecker	American Dipper
Rock Ptarmigan	American Three-toed Woodpecker	European Starling
White-tailed Ptarmigan	Black-backed Woodpecker	Bohemian Waxwing
Blue Grouse	Pileated Woodpecker	Snow Bunting
Sharp-tailed Grouse	Northern Shrike	Pine Grosbeak
Northern Goshawk	Gray Jay	Red Crossbill
Golden Eagle	Blue Jay	White-winged Crossbill
Gyr Falcon	Black-billed Magpie	Common Redpoll
Great Horned Owl	Common Raven	Hoary Redpoll
Snowy Owl	Black-capped Chickadee	Pine Siskin
Northern Hawk Owl	Boreal Chickadee	Evening Grosbeak
Barred Owl		House Sparrow



Data, Analyses, and Limitations

Most analyses in this report rely on two datasets, chosen for their applicability to the greatest number of species and comparability with other parts of North America and the Western Hemisphere.

The first is Digital Distribution Maps of the Birds of the Western Hemisphere (Ridgely et al. 2003). Shape files of these maps were overlain with jurisdictional outlines and Bird Conservation Regions to measure the proportion of breeding, wintering, and transient range of each species in the Boreal Forest Region and elsewhere.

An implicit assumption in the use of distribution maps is that a region's importance to a species is strongly related to the proportion of that species' range in the region. This assumption is reasonable for most species, but may break down for species with highly clumped distributions, such as breeding seabirds and other colonial waterbirds. For these species, use of colony counts if available across a species range would provide a more accurate assessment of relative importance of the Boreal Forest Region.

The second dataset is from the North American Breeding Bird Survey (BBS) <www.pwrc.usgs.gov/bbs/>. Data from the 1990s decade were analyzed to provide an alternative measure of the proportion of breeding birds of each species in combinations of jurisdiction and BCR within the United States, and within Canada south of the Arctic. These data also provided a means to estimate population sizes of landbirds (for methods, see Rich et al. 2004) and for some additional species without published estimates in continental conservation plans.

BBS analyses in the Boreal Forest Region were based on a reasonably high number of individual survey routes (265 with data from the 1990s). However, the distribution of routes is biased toward the southern parts of the Boreal Forest Region. Routes were stratified by province/state/territory and BCR to minimize effects of this bias, but low sample size in the northern parts of the Boreal Forest Region results in low precision in estimates of bird numbers for many species. Some species, particularly many non-landbirds, are not sampled well by BBS surveys. For this reason, estimates of population sizes of shorebirds, waterfowl, and waterbirds relied on continental estimates provided in continental plans (Donaldson et al. 2000 and Brown et al. 2001 for shorebirds, Kushlan et al. 2002 and Milko et al. 2003 for waterbirds, and NAWMP 2004 for waterfowl). Continental estimates were multiplied by proportion of range or proportion of BBS population in the Boreal Forest Region to give an approximate estimate of breeding population size in the Boreal Forest Region. For waterfowl in particular, a more accurate estimate of the proportion of continental populations that occur in the Boreal Forest Region should be possible with the use of various waterfowl survey datasets, not treated in this report.

Proportions of Western Hemisphere population for all birds were based on a combination of BBS proportions within the BBS survey area, and proportion of breeding range elsewhere in the hemisphere.

Lists of birds present in the Boreal Forest Region were screened against lists of birds assigned to Boreal BCRs in continental bird conservation plans (those in previous paragraph, plus Rich et al. 2004 for landbirds), and in various breeding bird atlases, resulting in some additions and deletions from BBS and range data.

Acknowledgments

This report was modeled after a previous report on the importance of Canada's Boreal Forest Region to landbirds in the Western Hemisphere (Blancher 2003). However, analyses reported here were updated to incorporate more recent data, and expanded to include non-landbirds and the full extent of the North American Boreal Forest Region, including much of Alaska.

Bird Studies Canada is recognized nationwide as a leading and respected not-for-profit conservation organization dedicated to advancing the understanding, appreciation, and conservation of wild birds and their habitats, in Canada and elsewhere, through studies that engage the skills, enthusiasm, and support of its members, volunteers, staff, and the interested public.

The Boreal Songbird Initiative (BSI) is a non-profit organization dedicated to educating Americans about the importance of the Boreal Forest to migratory birds. BSI is part of the Boreal Songbird Network, a network of U.S. organizations, including the American Bird Conservancy, Ducks Unlimited, the National Wildlife Federation, Defenders of Wildlife, the Audubon Society, and the Natural Resources Defense Council, working to raise awareness about the Boreal Forest and assist efforts in Canada and Alaska to conserve it.

The Canadian Boreal Initiative was created in response to both the opportunities and threats facing Canada's Boreal Forest Region. Based in Ottawa, CBI brings together a wide range of conservation organizations, First Nations, industry leaders, and others to create new solutions for boreal conservation and sustainable development. It supports scientific research to advance thinking on conservation-based planning for the Boreal Forest Region, and acts as a catalyst by supporting a variety of on-the-ground efforts across the boreal by conservation groups, First Nations, and others.

In 2003, CBI convened the Boreal Leadership Council, an extraordinary group of conservation organizations, First Nations, and resource companies. In concert with members of the council, CBI developed and launched the Boreal Forest Conservation Framework—a vision for the protection and sustainable development of Canada's entire boreal ecosystem.

Species range information came largely from Ridgely et al. (2003) shape files. These data were provided by NatureServe in collaboration with Robert Ridgely, James Zook, The Nature Conservancy-Migratory Bird Program, Conservation International-Center for Applied Biodiversity Science, World Wildlife Fund-US, and Environment Canada-Wildspace. Thanks especially to Andrew Couturier, Bird Studies Canada, who

overlaid these shape files onto jurisdictional maps, a BCR layer, and lat/long degree blocks, thus enabling us to calculate proportions of range for each species. And thanks to Environment Canada, Ontario Region, for providing the BCR shape file used for analyses in this report.

Breeding Bird Survey data were obtained from the very useful U.S. Geological Survey web pages devoted to

this survey. The methods of estimating population size from BBS data were developed in conjunction with Ken Rosenberg (Cornell Lab of Ornithology) and with input from the Partners in Flight Science Committee during development of the PIF North American Landbird Conservation Plan (Rich et al. 2004). We would also like to thank the thousands of volunteers who collected the data used here.

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Appendix 1. Bird species that regularly occur in North America's Boreal Forest Region during breeding, migration, or wintering seasons (325 species).

Greater White-fronted Goose	Black-crowned Night-Heron	Rock Sandpiper	Red-naped Sapsucker	Brown Creeper	Common Yellowthroat
Snow Goose	Osprey	Dunlin	Red-breasted Sapsucker	House Wren	Wilson's Warbler
Ross's Goose	Bald Eagle	Stilt Sandpiper	Downy Woodpecker	Winter Wren	Canada Warbler
Brant	Northern Harrier	Buff-breasted Sandpiper	Hairy Woodpecker	Sedge Wren	Scarlet Tanager
Cackling Goose	Sharp-shinned Hawk	Short-billed Dowitcher	American Three-toed Woodpecker	Marsh Wren	Western Tanager
Canada Goose	Cooper's Hawk	Long-billed Dowitcher	Black-backed Woodpecker	American Dipper	Spotted Towhee
Trumpeter Swan	Northern Goshawk	Wilson's Snipe	Woodpecker	Golden-crowned Kinglet	Eastern Towhee
Tundra Swan	Red-shouldered Hawk	American Woodcock	Woodpecker	Ruby-crowned Kinglet	American Tree Sparrow
Wood Duck	Broad-winged Hawk	Wilson's Phalarope	Northern Flicker	Arctic Warbler	Chipping Sparrow
Gadwall	Swainson's Hawk	Red-necked Phalarope	Pileated Woodpecker	Bluethroat	Clay-colored Sparrow
American Wigeon	Red-tailed Hawk	Red Phalarope	Olive-sided Flycatcher	Northern Wheatear	Brewer's Sparrow
American Black Duck	Rough-legged Hawk	Pomarine Jaeger	Western Wood-Pewee	Eastern Bluebird	Vesper Sparrow
Mallard	Golden Eagle	Parasitic Jaeger	Eastern Wood-Pewee	Mountain Bluebird	Savannah Sparrow
Blue-winged Teal	American Kestrel	Long-tailed Jaeger	Yellow-bellied Flycatcher	Townsend's Solitaire	Baird's Sparrow
Northern Shoveler	Merlin	Franklin's Gull	Alder Flycatcher	Veery	Le Conte's Sparrow
Northern Pintail	Gyr Falcon	Little Gull	Least Flycatcher	Gray-cheeked Thrush	Nelson's Sharp-tailed Sparrow
Green-winged Teal	Peregrine Falcon	Black-headed Gull	Hammond's Flycatcher	Bicknell's Thrush	Fox Sparrow
Canvasback	Prairie Falcon	Bonaparte's Gull	Dusky Flycatcher	Swainson's Thrush	Song Sparrow
Redhead	Yellow Rail	Mew Gull	Pacific-slope Flycatcher	Hermit Thrush	Lincoln's Sparrow
Ring-necked Duck	Virginia Rail	Ring-billed Gull	Eastern Phoebe	Wood Thrush	Swamp Sparrow
Greater Scaup	Sora	California Gull	Say's Phoebe	American Robin	White-throated Sparrow
Lesser Scaup	American Coot	Herring Gull	Great Crested Flycatcher	Gray Catbird	Harris's Sparrow
Common Eider	Sandhill Crane	Thayer's Gull	Eastern Kingbird	Brown Thrasher	White-crowned Sparrow
Harlequin Duck	Whooping Crane	Iceland Gull	Loggerhead Shrike	European Starling	Golden-crowned Sparrow
Surf Scoter	Black-bellied Plover	Lesser Black-backed Gull	Northern Shrike	Eastern Yellow Wagtail	Dark-eyed Junco
White-winged Scoter	American Golden-Plover	Glaucous-winged Gull	Yellow-throated Vireo	Red-throated Pipit	Lapland Longspur
Black Scoter	Pacific Golden-Plover	Glaucous Gull	Cassin's Vireo	American Pipit	Smith's Longspur
Long-tailed Duck	Semipalmated Plover	Sabine's Gull	Blue-headed Vireo	Sprague's Pipit	Snow Bunting
Bufflehead	Piping Plover	Ross's Gull	Warbling Vireo	Bohemian Waxwing	Rose-breasted Grosbeak
Common Goldeneye	Killdeer	Caspian Tern	Philadelphia Vireo	Cedar Waxwing	Indigo Bunting
Barrow's Goldeneye	Eurasian Dotterel	Common Tern	Red-eyed Vireo	Tennessee Warbler	Bobolink
Hooded Merganser	American Avocet	Arctic Tern	Gray Jay	Orange-crowned Warbler	Red-winged Blackbird
Common Merganser	Greater Yellowlegs	Forster's Tern	Blue Jay	Nashville Warbler	Eastern Meadowlark
Red-breasted Merganser	Lesser Yellowlegs	Black Tern	Clark's Nutcracker	Northern Parula	Western Meadowlark
Ruddy Duck	Solitary Sandpiper	Rock Pigeon	Black-billed Magpie	Yellow Warbler	Yellow-headed Blackbird
Gray Partridge	Willet	Mourning Dove	American Crow	Chestnut-sided Warbler	Rusty Blackbird
Ring-necked Pheasant	Wandering Tattler	Black-billed Cuckoo	Common Raven	Magnolia Warbler	Brewer's Blackbird
Ruffed Grouse	Spotted Sandpiper	Great Horned Owl	Horned Lark	Cape May Warbler	Common Grackle
Spruce Grouse	Upland Sandpiper	Snowy Owl	Purple Martin	Black-throated Blue Warbler	Brown-headed Cowbird
Willow Ptarmigan	Whimbrel	Northern Hawk Owl	Tree Swallow	Yellow-rumped Warbler	Baltimore Oriole
Rock Ptarmigan	Bristle-thighed Curlew	Northern Pygmy-Owl	Violet-green Swallow	Black-throated Green Warbler	Gray-crowned Rosy-Finch
White-tailed Ptarmigan	Hudsonian Godwit	Barred Owl	Northern Rough-winged Swallow	Townsend's Warbler	Pine Grosbeak
Blue Grouse	Bar-tailed Godwit	Great Gray Owl	Bank Swallow	Blackburnian Warbler	Purple Finch
Sharp-tailed Grouse	Marbled Godwit	Long-eared Owl	Cliff Swallow	Pine Warbler	Red Crossbill
Red-throated Loon	Ruddy Turnstone	Short-eared Owl	Barn Swallow	Palm Warbler	White-winged Crossbill
Pacific Loon	Black Turnstone	Boreal Owl	Black-capped Chickadee	Bay-breasted Warbler	Common Redpoll
Common Loon	Surfbird	Northern Saw-whet Owl	Mountain Chickadee	Blackpoll Warbler	Hairy Redpoll
Yellow-billed Loon	Red Knot	Common Nighthawk	Chestnut-backed Chickadee	Black-and-white Warbler	Pine Siskin
Pied-billed Grebe	Sanderling	Whip-poor-will	Boreal Chickadee	American Redstart	American Goldfinch
Horned Grebe	Semipalmated Sandpiper	Chimney Swift	Gray-headed Chickadee	Ovenbird	Evening Grosbeak
Red-necked Grebe	Western Sandpiper	Ruby-throated Hummingbird	Red-breasted Nuthatch	Northern Waterthrush	House Sparrow
Eared Grebe	Least Sandpiper	Rufous Hummingbird	White-breasted Nuthatch	Connecticut Warbler	
Western Grebe	White-rumped Sandpiper	Belted Kingfisher		Mourning Warbler	
American White Pelican	Baird's Sandpiper	Lewis's Woodpecker		MacGillivray's Warbler	
Double-crested Cormorant	Pectoral Sandpiper	Red-headed Woodpecker			
American Bittern	Purple Sandpiper	Yellow-bellied Sapsucker			
Great Blue Heron					