Guide to the PIF Population Estimates Database

Version: North American Landbird Conservation Plan 2004

Partners in Flight Science Committee

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Preface

This document describes the content of the Partners in Flight (PIF) Population Estimates Database (http://www.rmbo.org/pif_db/laped/about.aspx), which provides population estimates for North American landbirds at several geographic scales. It also provides details about how the estimates were derived, some information on potential uses of the data and caveats, and future directions for revising these estimates.

This version of the database is intended as a companion to PIF North American Landbird Conservation Plan (Rich et al. 2004), and as such, estimates included in the database have not been modified from those used in that Plan. Most of those estimates were based on Breeding Bird Survey data from the 1990s decade. A future version of the database will contain updated estimates, incorporating more recent data, feedback from users, alternative estimates, and additional adjustments where other data indicate changes are needed.

Contents:

Background

Population size is a central measure in most species assessment schemes, particularly those aimed at identifying species with a high risk of extinction (e.g., IUCN 2001, various national endangered species programs). Small populations are generally considered more vulnerable than large ones, even among those species not immediately at risk. Partners in Flight includes global Population Size as one of several factors assessed to determine species of high conservation importance (Panjabi et al. 2005), using an order of magnitude scale to assess relative risk.

The PIF North American Landbird Conservation Plan (Rich et al. 2004) published global population size estimates for 448 native landbirds of the U.S. and Canada. These estimates were used in assessing conservation importance of individual species, and immediacy of conservation action required. They were also included to give a sense of the magnitude of the task of meeting Plan objectives, for example to achieve a doubling of a species' current population.

Meeting continental objectives requires actions at regional scales, and many requests were received to break the continental population estimates down to smaller geographic scales, where they could be used as a starting point in setting regional objectives or judging the magnitude of actions needed to meet those objectives. AFWA state reports (Rosenberg 2004) provided that breakdown for priority species in each U.S. state. However the data behind the estimates have not been widely provided, making it difficult to interpret or revise estimates in light of other regional data and expertise, or to use the data for other related needs. The purpose of this PIF population estimates database is to make these data broadly available, and to provide a base for future improvements to the estimates.

Relative abundance counts from the North American Breeding Bird Survey (BBS) form the basis of most estimates provided here. Though the BBS was not designed specifically to produce population estimates, and there are difficulties to overcome as a result, there are important advantages. The main ones are that data from across much of North America have been collected according to a single standardized method, surveys employ random start points and directions thus enhancing regional representation of the avifauna (roadside bias notwithstanding), and the data are readily available for the bulk of North American landbirds.

Geographic Scale of Estimates

Estimates are presented in the database at the following geographic scales:

- Global population estimates for North American landbirds;
- North America (Canada and continental U.S.)
- BBS coverage area (North America minus arctic Canada)
- Bird Conservation Regions (BCRs, U.S. NABCI Committee 2000 http://www.nabci-us.org/map.html)
- Individual States, Provinces and Territories; and
- BCRs within States, Provinces and Territories (hereafter referred to as **geopolitical regions**)

For species whose estimates were based on BBS data, estimates within geopolitical regions were the building blocks for estimates at larger scales. For example population estimates for North Dakota have been rolled up from estimates within BCR 11 and BCR 17 portions of North Dakota; estimates for BCR 12 encompass estimates from six states and provinces that intersect that BCR. Estimates within geopolitical regions are more likely to suffer from small sample sizes and/or high variance than those at larger scales (see section on Data Quality & Limitations below). They are provided here so that users have access to all of the data that went into estimates at larger scales, and also for those that want to work with the data at that smaller scale.

Deriving the Population Estimates

For estimates based on BBS data, the general formula used to calculate an estimate within each geopolitical region was:

Population Estimate = BBS Average / Area Sampled x Region Area x Detection Adjustments

Each component of the formula above is described further below:

BBS Average (birds per route):

BBS counts per route provided the basic data on relative abundance. They were used because they provide comparable values according to a standard technique across much of North America. BBS routes are restricted to roadsides, so there is some habitat bias, the amount and direction dependant on species and region. However, start points and direction for BBS routes are randomly determined, minimizing selection bias and providing a reasonably representative sample of the avifauna in most regions.

BBS data were selected from the full 1990s decade (1990 through 1999) in order to create an estimate that would be reasonably robust to year-to-year natural variation in abundance, as well as being relatively insensitive to changes in which BBS routes were run in a given year, or which observers ran the routes. (An exception was made in boreal BCRs 7 and 8, where data from routes surveyed only in previous decades were included to augment geographic coverage.) Only those

data with runtype=1 were included. Counts were averaged across years within each route, with zeros (no birds in a year's count) included in the average. These route averages were themselves averaged across routes within each geopolitical region, again including zeros in the average. As a result, each BBS route sampled under acceptable conditions in at least one year during the 1990s decade was equally weighted with each other BBS route in the same region, regardless of number of years sampled, or presence or absence of individual bird species.

Users should be aware that abundance of some species has changed significantly since the 1990s.

Area Sampled:

The area sampled by a BBS route was based on the 400 m limit within which birds observed are counted, giving a potential area covered of 25.1 km^2 per route (50 x π x $(0.4)^2$). BBS average divided by area sampled per route gives an estimate of density of birds. Of course, not all birds are detectable out to the 400 m limit, and others may be effectively detected at a greater distance (very loud calls, birds that fly into the count area during the count). These species-specific differences in detection distance are dealt with below (see Detection Distance).

Geopolitical Region Area:

The area of each geopolitical region was used to extrapolate estimates from the scale of a BBS route to the full region. Area, reported here in square kilometers, was derived from an overlay of BCR and State and Province shape files. It excludes the area of water in very large lakes the size of Utah's Great Salt Lake or larger (e.g., all of the Great Lakes were excluded, as were several large lakes between Lake Winnipeg, Manitoba and Great Bear Lake, Northwest Territories).

Detection Adjustments:

Clearly not all birds present with the 400 m bounds of each BBS stop are detected within 3 minute counts. Ideally we would like to have a measure of the proportion of birds present that are detected at BBS stops. This proportion will vary by species, habitat and location, and will take much further research and review of existing information to obtain. Instead, we have used three measures to adjust the population estimate to approximate detectability of individual species. Each is intended to be used together with BBS data to get an approximate estimate of population size.

Detection Distance:

Each species has been placed into one of 5 detection distance categories: 80, 125, 200, 400 and 800 m, based on literature (Rosenberg and Blancher 2005), and a consideration of habitat, strength of song, and behaviour of the bird (amount of time spent in flight, secretiveness). Distance classes used here tend to be larger than estimates from empirically derived effective distances (e.g. from program Distance http://www.ruwpa.st-and.ac.uk/distance/), in part because we have also adjusted density with pair and time of day adjustments (see below), but also because movement of birds during counts means that a larger area has been sampled than is indicated by the distance to bird detections. Population estimates in this database are strongly sensitive to detection distance used,

for example if detection distance is halved, the population estimate is quadrupled. Refinement of detection distances is thus an important area for future work.

Pair adjustment:

In all estimates based on BBS we have assumed that on average there are 2 birds within detection distance for every one detected at peak time of day. That is, we have multiplied bird counts by 2 to estimate number of breeding birds. For many songbirds, counts at the peak time of day are of singing males, with females relatively rarely detected. For other breeding birds, time spent out of view at nests or perched in silence will often result in only one member of a pair being detected. This pair adjustment may lead to an overestimate of population if detected birds are often unpaired, if both sexes are conspicuous when present, or when family groups are counted. It will lead to an underestimate for birds in which both members of pairs are often not detected, even at peak detection time of day within typical detection distance.

Time of Day adjustment:

Detectability of most bird species is strongly influenced by the time of day a count is taken, often showing a strong increase and/or decrease during the 4-5 hours of a BBS survey. We calculated a species-specific time of day adjustment to adjust the BBS average upwards to the peak time of detection, by dividing the count at peak BBS stops by the average count across all BBS stops. The main assumption here is that birds are missed at all other times of the survey in proportion to the degree to which counts are below this peak of detection. This adjustment will be an underestimate for species whose peak time of detection falls outside of BBS morning hours, principally some crepuscular and nocturnal species.

The peak time of detection was determined using stop-by-stop data from all BBS routes survey-wide (data were available primarily from the period 1997 to 2002). Average number of birds counted per stop was calculated for each BBS route, then birds at each BBS stop number (1 through 50) were summed across all BBS routes. A 6^{th}-order polynomial regression was fitted to these data to produce a smoothed maximum count. Smoothing was necessary to remove variation among stops unrelated to time of day. The time of day adjustment was then simply the smoothed maximum count divided by the average count (see Fig. 4 and 5 in Appendix 1, also Rosenberg & Blancher 2005).

Calculation of the peak time of detection assumes that suitable habitat is found in similar amounts early or late in the BBS survey morning, when summed across many BBS routes. For many species, data from large numbers of routes results in a relatively robust time of day adjustment. For species detected on few BBS routes, or for species that are highly colonial, time of day patterns are more difficult to separate from random variation among stops. For species found on fewer than 50 routes, where no pattern was discernable, an average time of day adjustment for all diurnal landbirds (1.32) was assigned, or else the time adjustment of a close congener was used. For a few species with peak of detection late in the BBS survey day, smoothed maximums were limited to stops 47 or below, to avoid potential over fitting of imprecise counts with high order polynomials.

Regional variation in time of day adjustments is not considered here, because most species do not have sufficient sample sizes to calculate separate adjustments in each region. However examination of daily patterns for a selection of widespread landbirds indicated generally similar adjustments and time of day patterns across regions for most species.

Other Possible Adjustments:

No adjustments have been made to correct for habitat bias in BBS coverage, seasonal peaks in detection outside of BBS survey dates, or for low detection rates among secretive birds. Where data exist to address these issues, users may wish to apply their own adjustments to the data (see section on Uses of Data below).

Population Estimates based on NT/NU checklists:

There were no BBS data in the 1990s in arctic Canada (Canadian part of BCR 3). Because this region is so large (approx. 2.6 million km^2), it was not useful to extrapolate estimates from the Alaskan part of BCR 3. Instead we used a combination of density estimates from the Breeding Bird Census (BBC, Kennedy et al. 1999) and relative abundance from the Northwest Territories and Nunavut Bird Checklist Survey (hereafter NT/NU checklist) to estimate population size of landbirds in the arctic. Details of the methods are presented in Appendix B of Rich et al. (2004, pg. 79). Checklist data came from 649 sites visited between 1995 and 2001.

Extrapolation to Global Estimates:

Fewer than half of the landbird species in the database have breeding ranges confined to North America. For the rest, estimates of global population size were extrapolated from North American estimates based on the proportion of the world's population that breeds in North America, estimated from published range maps. Where a species had more than 90% of breeding range outside of North America, global population size was estimated to an order of magnitude by the PIF Science Committee, rather than rely on a very large extrapolation from North America.

Global population estimates are used for two purposes by PIF:

- for calculating a Population Size assessment score (PS), which required an order of magnitude resolution on the estimate;
- for estimating the proportion of global population that breeds in North American or in any region within North America. This helps understand a region's responsibility for the species.

Other Sources of Population Estimates:

For some species, better sources of population estimates were available at a continental scale. Sources for these estimates are provided in "Source" fields in the database. For these species, estimates are generally provided only at a continental scale, and are not yet included in regional breakdowns.

Data Quality & Limitations

We provide a rating system to give users a measure of the quality and quantity of data on which the population estimates have been based. Lower ratings indicate some combination of low sample size, high variance in BBS counts, or an otherwise poorly sampled species. Species estimates are more often rated poorly at smaller geographic scales, mainly because of smaller sample sizes resulting in reduced precision.

It is important to note that these ratings are specific to calculation of the BBS average used in the estimate, and do not cover other aspects of the population estimate, such as uncertainty in detection adjustments, or potential for habitat bias. For that reason, users should be aware that an estimate that is based on good quality data, with green data quality ratings, will still have substantial uncertainty associated with it (see Thogmartin et al. 2006 for a review of limitations associated with these methods). For example, estimates are particularly sensitive to the detection distance chosen for use with each species.

The database also includes population estimates from other sources for a limited number of species, including some subject to intensive species-specific surveys. In most cases, data quality ratings have not been included for those estimates.

Regional Data Quality Ratings

All ratings were scaled from green (relatively good data quality and quantity), through beige, yellow and orange to red (very little data or based on extrapolation from a neighbouring region), reflecting a decreasing quality and/or quantity of data on which estimates were based. The following four types of ratings have been included with regional data:

BBS Variance Rating

Variance in the average count among BBS routes within a region is reflected in this rating. A ninety-five percent confidence interval was calculated about the regional average, and then expressed as a percent of the regional average (see example in Appendix 1). This confidence interval reflects the magnitude of variance in counts among routes, and is also sensitive to the number of routes run in the region. Population estimates based on BBS averages with high variance will themselves be imprecise.

The cutoffs used were:
Green rating – 95% confidence limits on the regional average were within 25% of the average;
Beige – 95% confidence limits within 50% of the regional average;
Yellow – 95% confidence limits within 100% of the regional average;
Orange – 95% confidence limits within 200% of the regional average;
Red – 95% confidence limits exceed 200% of the regional average, or insufficient data to calculate a confidence interval.

Species Sample Size Rating

For the most part, the BBS variance rating above is sufficient to indicate limitations due to low sample size, i.e., regional estimates based on few BBS routes. However some regional BBS averages with low variance are associated with species presence on very few routes, even though many routes have been sampled in the region. These are flagged with a low species sample size rating, since detection of a species on one more, or one fewer, route could significantly alter the population estimate.

Cutoffs used were:
Green – species detected on at least 5 BBS routes in the region;
Beige – species detected on 3-4 BBS routes in the region;
Yellow – species detected on 2 BBS routes in the region;
Orange – species detected on 1 BBS route in the region;
Red – species not detected on BBS routes in the region; regional average extrapolated from neighbouring region(s).

BBS Range Coverage Rating

BBS routes were run in the 1990s in almost every degree block of latitude and longitude across southern Canada and the lower 48 U.S. states. However in Alaska and most parts of Canada, BBS coverage of degree blocks is intermittent, and is often not evenly distributed. The BBS range coverage rating reflects the percentage of a species' breeding range in a region that is within degree blocks covered by BBS, with cutoffs as follows:

Green – 2/3rds or more of breeding range covered by BBS, at scale of lat/long degree blocks;
Beige – 1/3 or more of range covered by BBS;
Yellow – 10% or more of range covered by BBS;
Orange – < 10% of range covered by BBS;
Red – no BBS sampling in region; regional average extrapolated from neighbouring region(s).

Overall Data Quality Rating

This rating summarizes the previous 3 ratings, and is the one rating that appears on screen in regional web queries. Its value simply reflects the poorest of the three previous ratings; for most species in most regions it has the same value as the Variance Rating.

Continental and Global Data Quality Ratings

Data quality ratings at continental and global scales are the same as those presented above for regional estimates, with the following two exceptions:

Coverage Ratings:

In the continental / global estimate part of the database, coverage ratings are presented for BBS survey-wide, for North America as a whole, and for the species' global range. In each case the rating cutoffs are the same:

Green – 2/3rds or more of breeding range covered by BBS;
Beige – 1/3 or more of range covered by BBS;
Yellow – 10% or more of range covered by BBS;
Orange – < 10% of range covered by BBS;
Red – no BBS sampling in region; regional average extrapolated from neighbouring region(s).

For example, Turkey Vulture (*Cathartes aura*) range within the BBS survey area is almost completely sampled by BBS routes (98%), as is its range in North America as a whole (i.e. including arctic Canada, 98%), so BBS coverage and North American coverage ratings are both green. However only about 29% of its breeding range is in North America, resulting in 28% coverage at the global scale (98% x 29%), and a yellow Global coverage rating. That is, there is greater uncertainty in the global estimate due to the rather large extrapolation from the North American estimate to the global scale.

BBS Species Flag:

A species-specific flag has been added at the continental scale to indicate species that are potentially poorly sampled by BBS methods. This includes nocturnal and crepuscular species whose peak of activity may not be captured by BBS, species with imprecise BBS trends indicating poor sampling by BBS (identified as "Mo2" species under "Monitoring Need" in Appendix A of Rich et al. 2004), species detected on few routes within their breeding range (<100 routes per 1 Million km^2 of range), as well as species that are otherwise thought to be poorly sampled by BBS.

Overview of Estimates

About ¾ of the 456 North American landbird species included in this database have global population estimates of 1 Million or more breeding birds (Fig. 1). Close to half have global estimates in the 1 to 10 Million range, whereas fewer than 3% of species have estimates below 10,000.

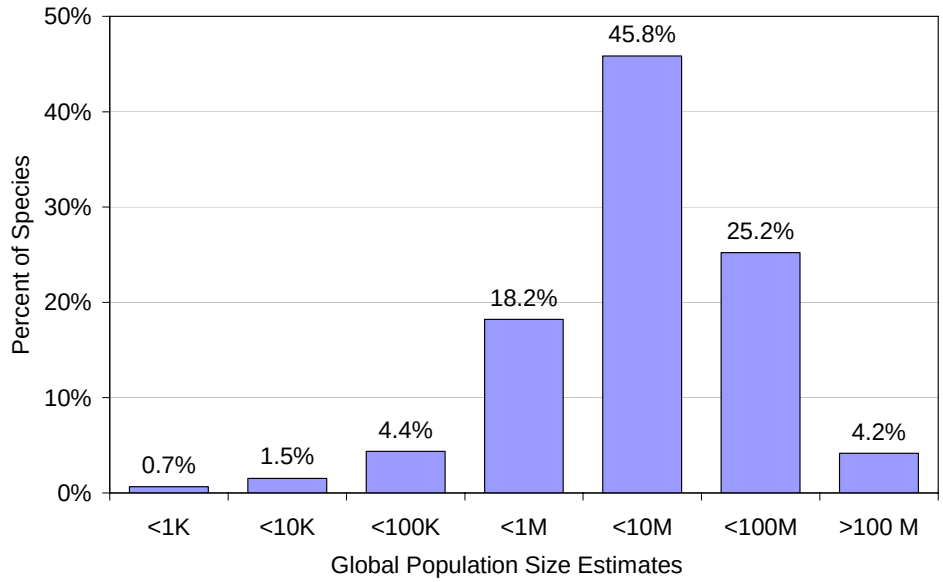

Figure 1: Histogram of global population size estimates for 456 North American landbirds

The total of all estimates for North America is approximately 5 billion breeding birds, not much higher than historical estimates for the extinct Passenger Pigeon (3-5 billion individuals, Schorger 1955, cited in Blockstein 2002). This is likely a conservative total, however, as densities from Breeding Bird Censuses suggest the total could be 2 to 3 times higher in some regions (Rosenberg and Blancher 2005). Four of the 45 landbird families represented in the database account for more than 50% of landbird abundance and 30% of species: sparrows (Emberizidae), wood warblers (Parulidae), thrushes (Turdidae) and blackbirds (Icteridae, Fig. 2). Adjustment of habitat bias in BBS data would likely alter relative abundance among some families, though these four families would remain important. Dominant families also vary regionally, for example sparrows & allies are prominent in the arctic and prairies, wood warblers are particularly abundant in northern forests, and blackbirds are the most abundant family across many parts of the contiguous U.S. and in agricultural parts of Canada.

Landbird density varies regionally as well, from lows in the arctic and western mountains to highest densities in BCRs south of the Great Lakes to the Gulf of Mexico and along the Pacific coast (Fig. 3).

Fewer than 40% of North American landbird species have breeding grounds restricted to North America, the rest sharing breeding grounds with other countries in the Western Hemisphere (55%

of species), and/or with countries elsewhere in the world (11%). However, 70% of these landbirds rely on North America for at least half of their breeding range/population.

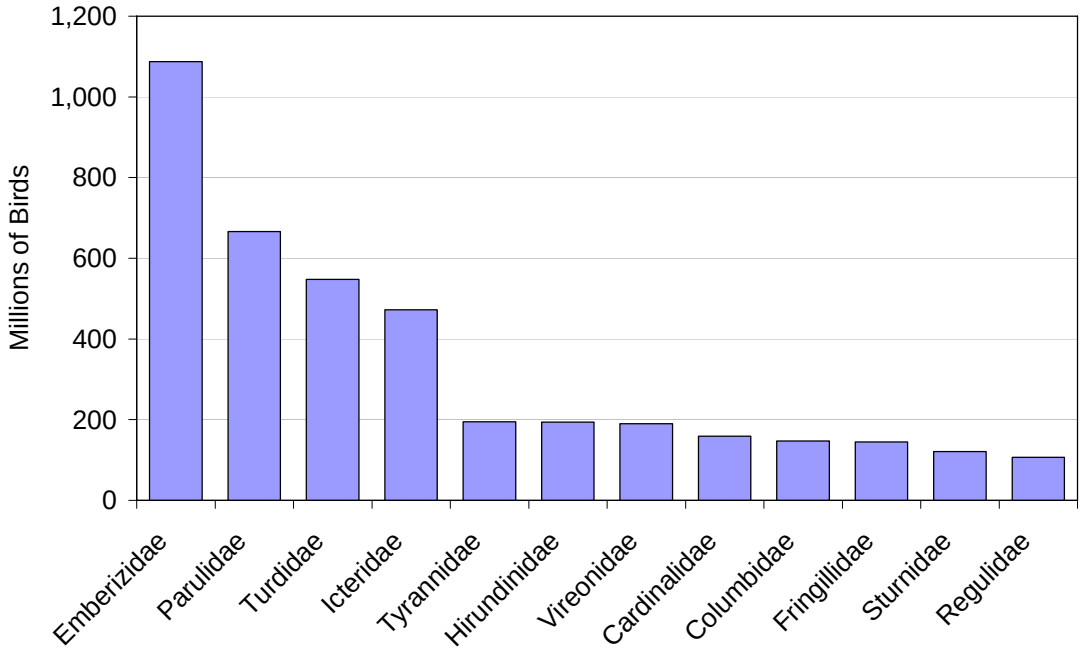

Figure 2: North American population estimates by landbird family (12 of 45 families shown)

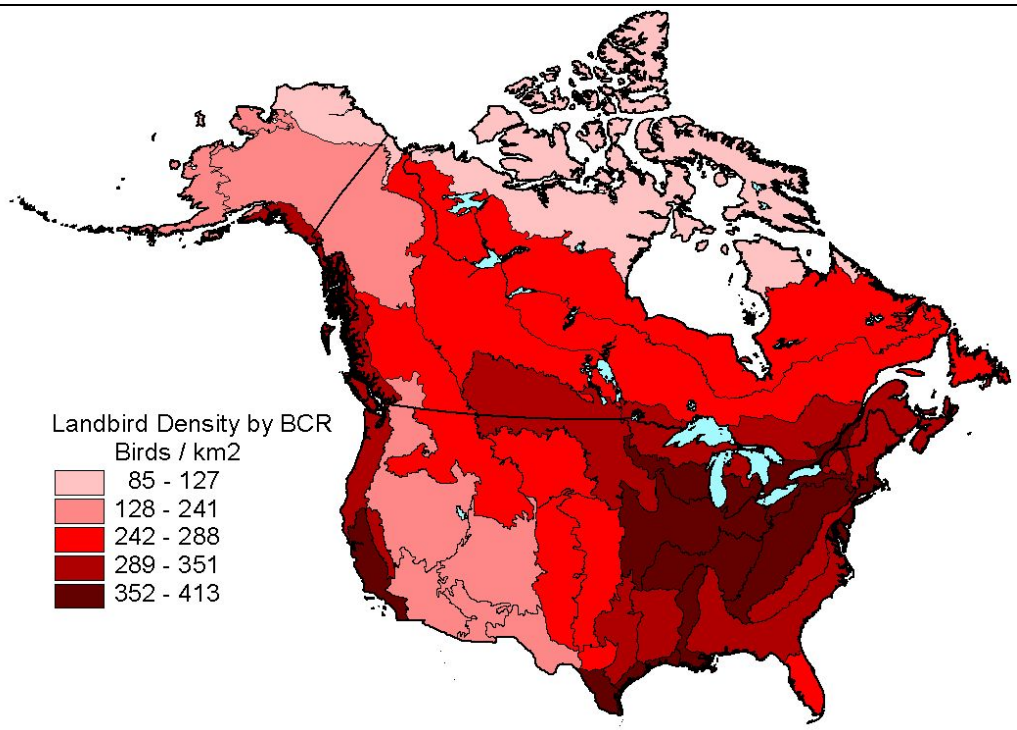

Figure 3: Estimated Landbird Density by Bird Conservation Region

Potential Uses of the Data

These population estimates are rough approximations for landbirds breeding in the U.S. and Canada. The estimates are based on data from the Breeding Bird Survey, which was designed to derive indices of population trend, not measures of population density. (Thogmartin et al. 2006). In particular, the number and proportion of undetected birds present during BBS counts are unknown, and only roughly estimated here. Nevertheless, the results and the underlying data of this first effort to estimate population numbers for all North American landbirds can be used for several different purposes, including a few outlined briefly below.

To set regional objectives and advance conservation design. Success in meeting objectives outlined in the PIF North American Landbird Conservation Plan will depend heavily on setting biologically sound, measurable, population-based habitat targets at regional and local scales and implementing actions toward these targets (Will et al. 2005). Data and estimates provided here may advance conservation design by framing the magnitude and connectivity of the resource. Users should look critically at regional habitat bias in BBS counts, habitat-specific detection distances where known, and supplement or replace BBS averages with better data from other sources where available.

To compare with independent estimates of population size and mortality. Species status reports rely on population estimates from a variety of sources, and this database may be useful in that context. These estimates can also provide continental and regional context for environmental impact assessments and the cumulative effects of various sources of mortality on bird populations, population vulnerability and resiliency.

To obtain more accurate estimates. The current data or the approach used here could be modified to be more accurate in a given region, for example by measuring the degree of habitat bias in a region and adjusting results accordingly, by modifying detection distances based on independent data, or by supplementing BBS data with other abundance or density data. The PIF Science Committee plans to provide revised version(s) of this database in future.

To provide data on a region's importance to a species. The database contains information on the proportion of population in each region, as well as the area of breeding range of each species in each region (range sizes were based on an overlay of NatureServe 2.1 digital maps (Ridgely et al. 2005) on regional shape files). These measures give an indication of how important a region is to the species breeding population, and how much of the region is occupied.

Next Steps

The Partners in Flight Science Committee will update this database in the next year or two. Much constructive input has been received already from readers of the North American landbird plan, and from users of earlier versions of spreadsheets contained in this database. The committee is

currently working on some of the improvements suggested by Thogmartin et al. (2006). Here are a few revisions likely to be included in a future version of the database:

- update to the most recent decade of BBS data
- revised time of day adjustment factors
- species-specific pair correction factors
- refinement of detection distances used, based on data from surveys where distances and/or detection probability were estimated
- inclusion of additional independent estimates, from the literature or unpublished data
- consideration of additional adjustments, e.g., seasonal adjustment for early spring breeders, regional adjustment for habitat coverage bias
- additional measures of variance

Acknowledgements

Thanks to Chandman Sambuu for developing the web application for this database, to Rocky Mountain Bird Observatory for hosting it, and to the National Fish and Wildlife Foundation for funding the web application work.

The database is heavily reliant on the North American BBS dataset; we are grateful to the thousands of volunteers and many BBS coordinators who helped with collection of the data, and to the U.S. Geological Survey and Canadian Wildlife Service for screening and making the data readily available on line. We also thank Craig Machtans, Judith Kennedy, Environment Canada and all others responsible for collecting and providing data from the Northwest Territories and Nunavut Bird Checklist Survey and from Breeding Bird Censuses in arctic Canada.

For quantifying range sizes we relied on digital distribution maps of birds 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 (see Ridgely et al. 2005).

A peer review of this project organized and hosted by the USGS in 2004 led to publication of a review (Thogmartin et al. 2006) that provides many constructive avenues for improving population estimates and future versions of this database. Thanks to members of the peer review committee and to the USGS for undertaking that task.

Finally we appreciate the feedback on various estimates we have received from a variety of scientists since publication of the North American Landbird Conservation Plan. That input has not been incorporated into the current version of database, since it reflects the data as they were constructed for the Plan, but will be very useful as revisions are made.

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Appendix 1: Examples of population estimates based on BBS data

The following examples illustrate how BBS data have been combined with detection adjustment factors and distribution maps to estimate regional and continental population sizes.

Wood Thrush – Regional estimates

BBS Regional Data: Wood Thrush (*Hylocichla mustelina*) is a common woodland bird in the Lower Great Lakes / St. Lawrence Plain bird conservation region (BCR 13). It was detected on 149 of 157 BBS routes run in the region in the 1990s (Table 1a,b). Average birds per route per year varied from 0.8 in Quebec to 12.3 in Vermont, with an overall area-weighted mean of 5.3 (Table 1c). The 95% confidence limits on the mean were 0.39 above and below the mean, or 7% of the mean (Table 1e), reflecting a relatively low standard error (0.20, Table 1d) and relatively high number of routes run in the region (157, $t_{(.05,156)}$=1.98). BBS coverage of breeding range was 100% in the region (Table 1g), meaning that at least one BBS route was run in every lat/long degree block within Wood Thrush breeding range in the region.

	(a) BBS Routes	(b) Species Routes	(c) BBS Average	(d) BBS SE	(e) 95% Conf Limits	(f) Land Area km^2	(g) BBS Range Coverage
BCR 13 New York	53	53	10.75	1.02	19 %	53,568	100 %
BCR 13 Ontario	59	54	2.77	0.44	32 %	84,741	100 %
BCR 13 Ohio	14	14	4.14	0.53	27 %	21,933	100 %
BCR 13 Pennsylvania	9	9	10.65	2.96	64 %	8,220	100 %
BCR 13 Vermont	6	6	12.33	3.74	78 %	4,583	100 %
BCR 13 Quebec	16	13	0.83	0.27	70 %	28,237	100 %
BCR 13 All	157	149	5.31	0.20	7 %	201,292	100 %

Table 1: Wood Thrush data from Bird Conservation Region 13 (BBS data from the 1990s)

Detection Adjustments: Three detection adjustment factors were used throughout Wood Thrush breeding range (h, j, k, below). Users may wish to modify them to better suit individual regions. Wood Thrush is a relatively loud forest bird, with detection distance estimated by the PIF Science Committee to be about 200 m at BBS stops during the peak of singing. Area sampled per BBS route is then the area of 50 circles of 200 m radius, or 6.3 km^2. The pair adjustment (x 2) assumes that on average only 1 member of a pair present at a stop is detected, at the peak time of detection. The time of day adjustment (x 2.3) is based on BBS stop-by-stop data (Fig. 4) which shows that the peak of detection is at dawn and is 2.3 times higher than the average across all stops. Use of the time of day factor adjusts the population estimate upwards to what it would be if all stops were sampled at the BBS peak of detection.

(h) Detection Distance (m): ~ 200 (i) Area Sampled per BBS route (km^2): 6.3
(j) Pair Adjustment: 2
(k) Time of Day Adjustment: 2.3

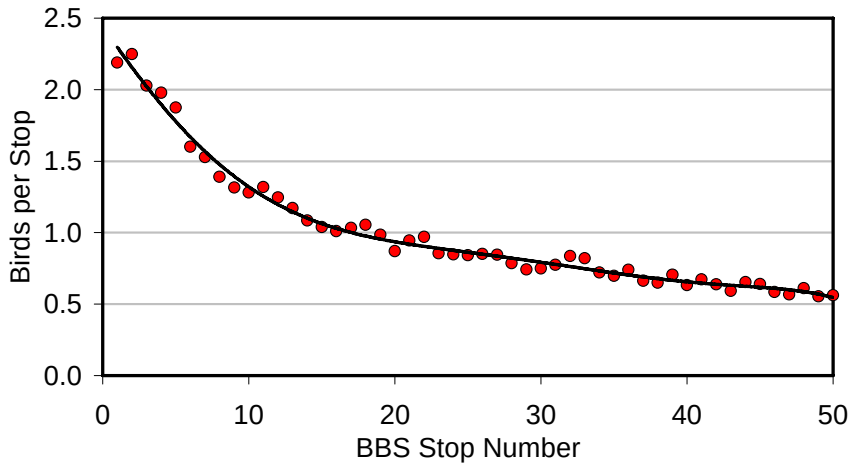

Figure 4: Wood Thrush relative abundance by BBS stop number, standardized to an average of 1

Regional Population Estimates and BBS Data Quality:

Regional population for the 1990s was estimated as BBS Average (c) times Land Area (f) divided by Area Sampled per BBS route (i) times Pair (j) and Time of Day (k) adjustments. Thus New York was estimated to have nearly a half million breeding Wood Thrushes in BCR 13 (Table 2), due to a relatively high BBS average and relatively large land area.

	Population Estimate	BBS Data Quality Ratings			
		Variance	Sample	Coverage	Overall
BCR 13 New York	~ 420,000	Green	Green	Green	Green
BCR 13 Ontario	~ 170,000	Beige	Green	Green	Beige
BCR 13 Ohio	~ 70,000	Beige	Green	Green	Beige
BCR 13 Pennsylvania	~ 60,000	Yellow	Green	Green	Yellow
BCR 13 Vermont	~ 40,000	Yellow	Green	Green	Yellow
BCR 13 Quebec	~ 17,000	Yellow	Green	Green	Yellow
BCR 13 All	~ 780,000	Green	Green	Green	Green

Table 2: Wood Thrush population estimates and data quality in Bird Conservation Region 13

BBS data quality is good overall for Wood Thrush in BCR 13 ("Green" data quality rating, Table 2). That is, variance about the mean is relatively low ((e) < 20% of the mean); thrushes are found on many routes ((b) > 5); and BBS samples a high proportion of lat/long degree blocks within Wood Thrush breeding range in the region ((g) > 66%).

In most individual states and provinces, data quality is rated lower due to increased variance, either "Beige" ((e) = 20-40% of mean), or "Yellow" ((e) = 40-80% of mean). This results mainly

from the lower number of BBS routes run in these smaller geopolitical regions, though in Ontario and Quebec it is also a reflection of variance associated with few birds detected per route.

Lesser Nighthawk – Continental / Global estimates

The sum of BBS regional population estimates for Lesser Nighthawk (*Cordeiles acutipennis*) was approximately 1.5 million individuals (Table 3), based on 16 geopolitical regions where the species was detected by BBS. Regional estimates were based on a detection distance of 400 m and a time of day adjustment of 7.1. The relatively large time of day adjustment is a result of the crepuscular activity pattern of this species, with most birds detected near dawn on BBS routes (Fig. 5). The relatively large detection distance reflects the rapid and continuous flights of foraging birds, which can be detected over a large area during a 3-minute count at their peak of foraging activity.

	Population Estimate	Data Quality Ratings				
		Variance	Sample	Coverage	Species	Overall
BBS survey-wide	~ 1,500,000	Green	Green	Green	Beige	Beige
North America	~ 1,500,000			Green		Beige
Global Range	~ 6,000,000			Yellow		Yellow

Table 3: Lesser Nighthawk population estimates and data quality BBS-wide

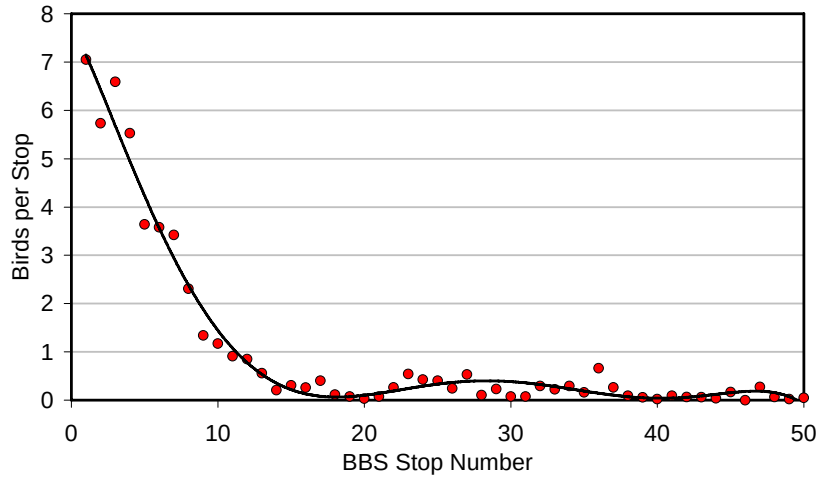

Figure 5: Lesser Nighthawk abundance by BBS stop number, standardized to an average of 1

Because this species is crepuscular, BBS surveys may not capture its peak of activity, so its data quality rating has been lowered to "Beige" from "Green" for the purpose of BBS-based population estimates (Table 3). Otherwise, BBS data quality is considered good survey-wide, with low variance (95% confidence limits on the BBS average are 8% of the mean), detection on 120 routes, and BBS sampling coverage in 95% of breeding range within the U.S.

The North American population estimate for U.S. and Canada is the same as the BBS survey-wide estimate; i.e., all of the North American population is within BCRs and states sampled by BBS. Globally, about 25% of breeding range is within the BBS survey area, so the Global population is estimated to be 4 times the BBS survey-wide estimate, or about 6 million birds. Because only 10-33% of the estimate is based on BBS data, resulting in a fairly large extrapolation to global population, global data quality is flagged as poor ("Yellow" data quality rating for range coverage and overall, Table 3).

Appendix 2: Data Dictionary

The following two tables describe the data fields contained in the database. Further details are contained elsewhere in this guide. Table 4 describes data fields applicable to continental / global population estimates; Table 5 describes data fields applicable to regional population estimates. These tables are also found in a "Definitions" worksheet in each spreadsheet downloaded from this database.

Table 4: Description of Data Fields associated with Continental / Global Population Estimates

Fields viewable in on-screen queries:

Field	Explanation
Common Name	AOU English common name, from 47th supplement (except Blue Grouse)
Scientific Name	AOU scientific name, from 47th supplement
Sequence AOU 47	sequence of species in AOU 47th supplement
Population Estimate BBS	Estimated breeding population in the BBS survey area (Canada and U.S.) - individuals, not pairs. Estimates have been rounded.
Data Quality Rating BBS	Indicates relative scale of data quality in BBS survey area, from Green (good BBS coverage of species), through Beige, Yellow, Orange, to Red (very poor BBS coverage of species). Based on one or more of the following (whichever is poorest): high variance in BBS counts, low sample size, poor geographic coverage of North American breeding range by BBS, or other species-specific limitations of BBS survey methods.
Population Estimate North America	Estimated breeding population in North America (Canada and U.S.), a sum of BBS-based and NWT checklist-based estimates - individuals, not pairs. Estimates have been rounded.
Data Quality Rating N Amer.	Indicates relative scale of data quality in North America, from Green (good species coverage), through Beige, Yellow, Orange, to Red (very poor species coverage). Based on BBS Data Quality Rating where >2/3rds of population estimate was from BBS, based on NWT Data Quality Rating where >2/3rds of population estimate was from arctic Canada, and on both BBS and NWT ratings where population was between 1/3 and 2/3rds from each.
Population Estimate Global	Estimated global breeding population, based on extrapolating North American population to range outside of North America - individuals, not pairs.
Data Quality Rating Global	Indicates relative scale of data quality for Global estimate, from Green (good species coverage), through Beige, Yellow, Orange, to Red (very poor species coverage). Based on North American Data Quality Rating, and estimated proportion of global range covered by BBS and NWT / Nunavut checklist programs in North America.
Source for North American Estimate	Lists source of data used for North American Population Estimate; "bbs" - North American Breeding Bird Survey, 1990s; "nwt" - Northwest Territories & Nunavut Checklist survey; "piftc" - estimated by Partners in Flight Technical Committee; "range" - estimate from part of range extrapolated to the remainder on basis of relative size of range in range maps; for other refs, see "source refs" worksheet

Source for Global Estimate	As above; in most cases the North American estimate has simply been extrapolated to broader range on the basis of range map areas; "piftc" indicates that population size was estimated to an order of magnitude

Additional fields available in downloadable tables:

BBS Average (birds / rte)	Average BBS Count per route per year in the 1990s across all regions where species was detected ("regions" here means BCRs within Provinces, States and Territories)
SE of BBS Avg	standard error of the Average BBS Count
BBS Routes	Number of BBS routes with acceptable data (RunType=1) in the 1990s. Includes all routes run in regions where species was detected
Species Routes	Number of BBS routes with acceptable data on which the species was detected in the 1990s
Detection Distance (m)	estimated effective distance (meters) for detection of 1 member of a pair at peak time of day during a 3-minute BBS count, accounting for movement of birds during the count
Pair Adjustment	Pair Adjustment - multiplies estimate by 2, on assumption that typically only one member of a pair is detected
Time Adjustment	time of day adjustment, adjusts average count across all 50 BBS stops to a smoothed peak count
Area of BBS route (km^2)	Area covered by one BBS route (in km^2), assuming 400m radius at each of the 50 stops
BBS Variance Rating	Rating based on standard error of BBS average count, so is sensitive to both high variance in counts and low number of BBS routes run. Scaled from Green (95% Confidence Limit around the BBS Average is within 10% of the Average itself) through Beige (within 20%), Yellow (40%), Orange (80%), to Red (insufficient data to calculate variance, or Confidence Limit more than 80% of the Average itself).
BBS Sample Rating	Flags estimates when species was detected on relatively few BBS routes survey-wide. Scaled from Green (100 or more routes) through Beige (40+), Yellow (20+), Orange (10+), to Red (<10).
BBS Coverage Rating	Rating based on proportion of species range south of arctic Canada that is sampled by BBS, at the scale of lat/long degree blocks. Scaled from Green (>2/3rds of range sampled by BBS at scale of lat/long degree blocks), through Beige (>1/3rd), Yellow (>1/10th), Orange (<1/10th), to Red (range not sampled).
BBS Species Flag	Flags species that are potentially poorly sampled by BBS methods: nocturnal / crepuscular species (time adjustment > 3); low BBS trend precision ("Mo2" species in Rich et al. 2004); detected on few routes within their breeding range (<100 routes per 1 Million km^2 of range); or are otherwise thought to be poorly sampled by BBS
Range within BBS estimate (km^2)	Area of species breeding range in continental U.S. and in Canada south of the arctic (i.e. excluding BCR 3 in Canada), for which population estimates were based on BBS. Areas based on NatureServe version 2.1 digital distribution maps

% of BBS range sampled	Proportion of species breeding range in continental U.S. and in Canada south of the arctic that was sampled by BBS in the 1990s, at the scale of degree blocks; used in "BBS Coverage Rating"
BBS Sampling Intensity (rts / M km^2)	Number of BBS Routes on which the species was detected, per 1 Million km2 of breeding range. Used to identify species poorly detected by BBS (<100 routes per Million km2 of range, see "BBS Species Flag").
% Global Estimate from BBS	Estimated percent of global population that breeds in the BBS survey area, based on range maps outside of North America, combined with proportion of North American population estimated to be within BBS survey area
BBS Pop'n Estimate (unrounded)	Estimated breeding population in the BBS survey area (Canada and U.S.) - individuals, not pairs. Estimates as calculated, without rounding (see column D for rounded values).
North American Coverage Rating	Rating based on proportion of species range in Canada and the U.S. that is sampled by BBS or by the NWT/Nunavut checklist program, at the scale of lat/long degree blocks. Scaled from Green (>2/3rds of range sampled at scale of lat/long degree blocks), through Beige (>1/3rd), Yellow (>1/10th), Orange (<1/10th), to Red (range not sampled).
North American Range (km^2)	Area of species breeding range in North America, based on NatureServe version 2.1 digital distribution maps
% of N Amer. Range sampled	Proportion of species breeding range in North America (Canada and U.S.) that was sampled by BBS or NWT / Nunavut checklists, at the scale of degree blocks; used in "North American Coverage Rating"
% Global Estimate in North America	Estimated percent of global population that breeds in North America (Canada and U.S.), based on range maps
% Global Estimate in West. Hemisphere	Estimated percent of global population that breeds in the Western Hemisphere, based on range maps
Global Coverage Rating	Rating based on approximate proportion of species global range that is sampled by BBS or by the NWT/Nunavut checklist program. Scaled from Green (>2/3rds of range sampled at scale of lat/long degree blocks), through Beige (>1/3rd), Yellow (>1/10th), Orange (<1/10th), to Red (range not sampled).
% of Global Range sampled	Proportion of species global breeding range that is sampled by BBS or NWT / Nunavut checklists; used in "Global Coverage Rating"

Additional fields in downloadable tables specific to Northwest Territories and Nunavut:

Population Estimate NWT	Estimated breeding population in arctic Canada (BCR 3) based on NWT & Nunavut checklist data combined with Breeding Bird Census density - individuals, not pairs.
Data Quality Rating NWT	Indicates relative scale of data quality in NWT survey area, from Green (good coverage of species), through Beige, Yellow, Orange, to Red (very poor coverage of species). Based on one or more of the following (whichever is poorest): low sample size, poor geographic coverage of breeding range in arctic Canada, or other species-specific limitations of checklist methods. Details in Guide.

NWT Average (birds / rte)	Population estimate from arctic Canada (BCR 3) converted to the BBS Count per route per year that would result in an equivalent population estimate
NWT Sites	Number of NWT/Nunavut checklist sites sampled in arctic Canada (to 2001)
Species Sites	Number of NWT/Nunavut checklist sites where species was detected
NWT Sample Rating	Flags estimates when species was detected at relatively few checklist sites in arctic Canada. Scaled from Yellow (100 or more sites) through Orange (40+), to Red (<40).
NWT Coverage Rating	Rating based on proportion of species range in arctic Canada (BCR 3) that is sampled by the NWT/Nunavut checklist program, at the scale of lat/long degree blocks. Scaled from Green (>2/3rds of range sampled by checklists at scale of lat/long degree blocks), through Beige (>1/3rd), Yellow (>1/10th), Orange (<1/10th), to Red (range not sampled). Details in Guide.
NWT Species Flag	Flags estimates when species was detected on relatively few checklist sites in arctic Canada. Scaled from Green (100 or more sites) through Beige (40+), Yellow (20+), Orange (10+), to Red (<10).
Range within NWT estimate (km2)	Area of species breeding range in arctic Canada (BCR 3), for which population estimates were based on NWT / Nunavut checklists and Breeding Bird Censuses. Areas based on NatureServe version 2.1 digital distribution maps
% of NWT range sampled	Proportion of species breeding range in arctic Canada that was sampled by NWT / Nunavut checklists (to 2001), at the scale of degree blocks; used in "NWT Coverage Rating"
NWT Sampling Intensity (sites / M km2)	Number of NWT / Nunavut checklist sites in BCR 3 at which the species was detected, per 1 Million km2 of breeding range. Used to identify species poorly detected by checklists (<100 sites per Million km2 of range, see "NWT Species Flag").
% Global Estimate from NWT	Estimated percent of global population that breeds in the BBS survey area, based on range maps outside of North America, combined with proportion of North American population estimated to be within BBS survey area

Table 5: Description of Data Fields associated with Regional Population Estimates

Fields viewable in on-screen queries:

Field	Explanation
Common Name	AOU English common name, from 47th supplement (except Blue Grouse)
BCR	Bird Conservation Region number
Province / State / Territory	Canada and continental U.S. NT/NU = Northwest Territories & Nunavut combined
Area of Region (km^2)	Area of region (e.g., BCR within Province / State / Territory) in square-kilometres (km^2)
Population Estimate	Estimated breeding population in the region - individuals, not pairs. Estimates have been rounded.
Data Quality Rating	Indicates relative scale of data quality, from Green (good BBS coverage of species in region), through Beige, Yellow, Orange, to Red (very poor BBS coverage of species in region or estimate extrapolated from neighbouring region). Based on one or more of the following (whichever is poorest): high variance in BBS counts, low sample size, or poor geographic coverage of species range by BBS within the region.
Estimated % of Global Population	Estimated percent of global population that breeds in the region, based on BBS relative abundance among regions, and percent of global range in North America
BBS Average (birds / rte)	Average BBS Count per route per year in the 1990s across all routes within this region [For BCR 3 in Canada, values were converted from checklist and breeding bird census data]
SE of BBS Avg	standard error of the Average BBS Count
BBS Routes	BBS routes with acceptable data (RunType=1) in the region in the 1990s [For BCR 3 in NT/NU, values are number of checklist sites, mainly from 1995-2000]
Species Routes	BBS routes in the region where the species was detected in the 1990s [For BCR 3 in NT/NU, values are number of checklist sites where the species was recorded]

Additional fields available in downloadable tables:

Scientific Name	AOU scientific name, from 47th supplement
Sequence AOU 47	sequence of species in AOU 47th supplement
Province / State / Territory	written out
Country	Canada or U.S.A.
Detection Distance (m)	estimated effective distance (meters) for detection of 1 member of a pair at peak time of day during a 3-minute BBS count, accounting for movement of birds during the count
Pair Adjustment	Pair Adjustment - multiplies estimate by 2, on assumption that typically only one member of a pair is detected

Time Adjustment	time of day adjustment, adjusts average count across all 50 BBS stops to a smoothed peak count
Area of BBS route (km^2)	Area covered by one BBS route (in km^2), assuming 400m radius at each of the 50 stops
BBS Variance Rating	Rating based on standard error of BBS average count in the region, so is sensitive to both high variance in counts and low number of BBS routes run. Scaled from Green (95% Confidence Limit around the BBS Average is within 25% of the Average itself) through Beige (within 50%), Yellow (100%), Orange (200%), to Red (insufficient data to calculate variance, or Confidence Limit more than 200% of the Average itself).
Species Sample Size Rating	Flags estimates when species was detected on very few BBS routes in the region. Scaled from Green (5 or more routes) through Beige (3-4), Yellow (2), Orange (1), to Red (0 routes, estimate extrapolated from neighbouring regions).
Range Coverage Rating	Rating based on proportion of species range in the region that is sampled by BBS, at the scale of lat/long degree blocks. Scaled from Green (>2/3rds of range sampled by BBS at scale of lat/long degree blocks), through Beige (>1/3rd), Yellow (>1/10th), Orange (<1/10th), to Red (range not sampled in region).
Area of Range (km^2)	Area of species breeding range in the region, based on NatureServe version 2.1 digital distribution maps
Global Estimate from BBS	"Yes" indicates species whose global pop'n estimates in Rich et al (2004) were based on BBS estimates
Population Estimate (unrounded)	Estimated breeding population in the region - individuals, not pairs. Estimates as calculated, without rounding (see column D for rounded values).