Completeness_Report_NABBS_Dataset_1966-2022.pdf (07/03/2023)

This file is an addendum to the "Completeness Report" section of the metadata file "North American Breeding Bird Survey Dataset (1966-2022).xml". It describes the scope of the BBS dataset.

The North American Breeding Bird Survey (BBS) is an ongoing annual survey. This data set is considered complete at the time of release. Late data returns not included in this release will be included in subsequent releases. BBS Data are housed in MS-SQL database. Numerous scripts and SQL queries developed by USGS staff are used to repackage data into the flat files for the data set release. Users are advised to read the entire metadata record for details regarding those files.

1) BBS data. Data from the BBS provide an index of population abundance, not a complete inventory of birds that reside at a stop or on a route. Only birds detected by sight or sound by the observer during the 3-minute point count period are reported. Birds are identified to species or appropriate BBS taxa group and enumerated. The probability of detecting birds is influenced by weather, habitat, bird activity levels, time of day, ambient noise, human abilities, etc. The scientifically rigorous, highly standardized BBS methodology was designed to control many of these factors. Nevertheless, the use of mathematical models that account for first-time observer affects, differences between observers, sample density, and minor protocol changes have been shown to play an important role in mitigating bias when analyzing BBS data. The following articles describe these practices and provide a general overview of the analysis of BBS data:

Faanes, C. A. and D. Bystrak. 1981. The role of observer bias in the North American Breeding Bird Survey. Pages 353-359 in C. John Ralph and J. Michael Scott Estimating Numbers of Terrestrial Birds. *Studies in Avian Biology* 6., 630 pp. http://sora.unm.edu/node/49.

Kendall, W. L., B. G. Peterjohn, and J. R. Sauer. 1996. First-time observer effects in the North American Breeding Bird Survey. *The Auk* 113(4):823-829. http://sora.unm.edu/node/25734.

Link, W. A. and J. R. Sauer. 1997. Estimation of population trajectories from count data. *Biometrics* 53(2):488-497. DOI: 10.2307/2533952 https://www.jstor.org/stable/2533952.

Sauer, J. R., W. A. Link, and J. A. Royle. 2004. Estimating population trends with a linear model: technical comments. *The Condor* 106(2):435-440. http://www.bioone.org/perlserv/?request=get-abstract&doi=10.1650/7431.

Sauer, J. R. and W. A. Link. 2011. Analysis of the North American Breeding Bird Survey using hierarchical models. *The Auk* 128(1):87-98. DOI: 10.1525/auk.2010.09220 https://www.jstor.org/stable/10.1525/auk.2010.09220.

Sauer et al. 2019. Consistency counts: Modeling the effects of a change in protocol on Breeding Bird Survey counts. *The Condor*, Volume 121, Issue 2, 1 May 2019, duz009. https://doi.org/10.1093/condor/duz009.

2) Breeding bird species. Breeding birds are representatives of the regional breeding population as defined by having been detected within the known geographical breeding distribution of the species and within the accepted breeding season timeframe for the region where detected. No attempt is made to

distinguish between paired and unpaired individuals. Dependent young are not recorded during BBS surveys. Non-breeding birds (i.e., migrants, vagrants, and non-established species) are infrequently encountered during BBS surveys. Information about these birds has not been consistently reported or collected for most of the survey's history due to the survey's focus on breeding species. Steps were taken in 1999 to begin preserving this information when reported. Termed "Migrant" data for convenience, this information set contains all data not fitting into the "Breeding" category, regardless of data quality.

3) Sample size and density. The BBS was initiated in 1966 and has since increased in geographic scope and number of routes (the fundamental sampling unit), so the sample density has varied across time and space. There were initially about 500 routes sampled in the area encompassing the United States east of the Mississippi River, Quebec, and the maritime provinces of Canada. In 1967, the BBS expanded to the central United States, with a few routes in Ontario and Manitoba. By 1968 approximately 1,200 routes were established and being sampled across the contiguous United States and southern half of all Canadian provinces. Alaska had 2-3 routes sampled up until the 1980s. Today, approximately 5,000 active routes exist survey-wide. Each year roughly 3,000 routes have been sampled since the mid-1990s. The same ~3,000 routes are not necessarily sampled each year due to a variety of reasons, including: poor weather conditions, safety concerns, participant availability (e.g., illness), etc. Many patterns occur in geographic coverage of the BBS. Some patterns occur because of logistics. BBS routes near human population centers are often consistently surveyed but more remote routes tend to be less frequently surveyed, which causes regional variation in the efficiency of the survey (Robbins et al. 1986). Although all States and Provinces vary in coverage over time, some consistent regional patterns occur in BBS coverage. For example, the northeast and southeast generally having higher route densities than most western and midwestern regions. Maryland has approximately 14 routes per degree block, Alabama and Georgia have about 6 routes per degree block, and Nevada and Utah have about 2 routes per degree block. Also noteworthy is Canada, where routes are largely restricted to the southern half of provinces and territories. The following articles provide further insight into the topic:

Lawler, J. J., and R. J. O'Connor. 2004. How well do consistently monitored Breeding Bird Survey routes represent the environments of the conterminous United States? *The Condor* 106:801-814.

Robbins, C.S., D.A. Bystrak, and P.H. Geissler. 1986. The Breeding Bird Survey: its first fifteen years, 1965-1979. USDOI, Fish and Wildlife Service resource publication 157. Washington, D.C.

4) Representativeness of sampling. Routes are the fundamental unit of BBS sampling and they are established using a stratified random process, constrained to roadsides except for a handful of water routes primarily in Alaska. This sampling frame has been the subject of questions regarding the influence of roadside bias. There are three primary concerns:

- Habitats along roads may not be representative of habitats in the landscape due to, for example, increased disturbance along roads or placement of roads
- Counts may not be representative for some species due to differential attraction to, or avoidance of, roadside habitats
- Counts along roads through time may not be representative due to differing rates of habitat change on roads versus off roads.

Habitat representation has been fairly well examined in the literature (Bart et al. 1995; Keller and Scallan 1999; Neimuth et al. 2007) with the most comprehensive studies to date (Veech et al. 2012, 2017) finding that for most of the 15 National Land Cover Database (NLCD) land cover types examined, the

habitats within 400m of BBS routes are similar to habitats within 10,000m. Notable exceptions included a slight under-representation of open water habitat and a slight over-representation of developed open space near routes. Nevertheless, differences in local habitat quality or roadside attraction/avoidance effects may influence species abundance on roadside counts (Wellicome et al. 2014). The following articles have informed the discussion of these topics:

Bart, J., M. Hofschen, and B. G. Peterjohn. 1995. Reliability of the Breeding Bird Survey: Effects of restricting surveys to roads. *The Auk* 112:758-761.

Keller, C. M. E., and J. T. Scallan. 1999. Potential roadside biases due to habitat changes along breeding bird survey routes. *The Condor* 101:50-57.

Niemuth, N. D., A. L. Dahl, M. E. Estey, and C. R. Loesch. 2007. Representation of landcover along Breeding Bird Survey routes in the Northern Plains. *Journal of Wildlife Management* 71:2258-2265.

Veech, J. A., M. F. Small, and J. T. Baccus. 2012. Representativeness of Land Cover Composition along Routes of the North American Breeding Bird Survey. *The Auk* 129(2):259-267, (1 April 2012). https://doi.org/10.1525/auk.2012.11242.

Wellicome, T. I., K. J. Kardynal, R. J. Franken, and C. S. Gillies. 2014. Off-road sampling reveals a different grassland bird community than roadside sampling: implications for survey design and estimates to guide conservation. *Avian Conservation and Ecology* 9(1): 4. http://dx.doi.org/10.5751/ACE-00624-090104

Veech, J. A., K. L. Pardieck, and D. J. Ziolkowski, Jr. 2017. How well do route survey areas represent landscapes at larger spatial extents? An analysis of land cover composition along Breeding Bird Survey routes. *The Condor*, Volume 119, Issue 3, 1 August 2017, Pages 607–615, https://doi.org/10.1650/CONDOR-17-15.1

5) Data quality indicator. The BBS provides a "RunType" code to help data users quickly determine which data meet the BBS program's analysis quality criteria. Qualifying data receive a **RunType code = 1**. This requires both of the following:

- the data were collected under acceptable BBS date, time, and weather conditions and have met all route completion criteria (QualityCurrentID = 1)
- sampling had occurred on a randomly established route (i.e., RouteTypeDetailID = 1) using the official BBS sampling protocol (RPID = 101)

Data that do not qualify receive a **RunType code = 0**, indicating that one or more of the aforementioned requirements was not met. This occurs from one of 3 scenarios, or in combination when:

- the sample event exceeded acceptable BBS date, time, and/or weather conditions and/or did not meet all route completion criteria (QualityCurrentID = 0)
- a non-randomly established route was sampled (i.e., RouteTypeDetailID is not 1), and/or the official BBS sampling protocol was not used (RPID is not 101).

See the file RunType.pdf file for more information.