Why and How eBird Wants Your Numbers

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eBird collects and maintains data about bird distribution (https://ebird.org/, Sullivan et al. 2009). Birders contribute to citizen science by making bird observations and submitting lists of those observations to eBird. Those reported observations become data that are available to others. Some of the submitted information is immediately useful, but some is not complete enough to be as useful as it could be. We believe that most birders are eager to increase the usefulness of their data, which can be achieved by investing only a little extra effort. This paper describes why birders should report data and how to improve the usefulness of that data.

Birders' data are more useful if they are submitted in the manner that eBird requests. In its *Help* section eBird offers in-depth instructions on how to count birds, how to report counts, and why they want them. At the 2018 Central Valley Bird Symposium, Joe Morlan introduced, and Kimball Garrett expanded upon how we can contribute more efficiently and effectively to the eBird data base. Following eBird's guidelines is a starting point.

Many birders keep many types of bird lists and participate in many types of counts. Why not put those data to use? By submitting the data to eBird, researchers can use birders' data to identify shifting trends in populations, timing of migration and breeding, and locations of habitat that may be critical or limiting (Sullivan et al. 2009). Birders' lists can be distinguished as those useful only by the observer personally and those useful to researchers.

Qualitative data, in eBird as well as other venues such as Breeding Bird Atlases, become increasingly useful over time. With the passage of time, qualitative data become the baseline to be compared with new information, and thus become quantitative data. For example, changes in the number of geographic blocks with confirmed species occurrence can be used to calculate a rate of change in species' breeding ranges. The value of the original qualitative data may only become apparent over time, for example when the second edition of the Atlas is published.

WHY WE SHOULD QUANTIFY OUR OBSERVATIONS

Birders make observations. That is a first step. While we are doing that anyway, why not make the observations more useful? eBird was set up for

this purpose. By making a separate eBird list for each visit to each location, and for each type of habitat visited each day, birders can help provide data for a wide variety of uses and users. Local observations can be used to develop a local species list (i.e., qualitative data) and assess relative abundances (i.e., quantitative data). By collecting and then combining the data from millions of visits all over the country into a large database, eBird has become a valuable resource for researchers studying all scales of bird distribution, abundance, and movements, whether local, regional, state, national, or continental.

eBird wants our numbers. When we submit numbers to eBird, those numerical data allow researchers to assess rates of change in populations and even how fast those rates are changing. Without numbers, researchers are unable to evaluate or compare information. Without numbers we may not know that problems are occurring in bird communities and may not sense the urgency to apply corrective actions that may be needed.

Why add numbers to the lists? To quote William Thomson, aka 1st Baron, or Lord Kelvin, from a 3 May 1883 lecture to the Institution of Civil Engineers: *"When you can measure what you are speaking about, and can express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind…".*

HOW TO MAKE YOUR NUMBERS COUNT FOR MORE

Birders collect different types of data using different methodologies. The methodology chosen determines not just the type of data collected but also how those data can be used. Observers control their choice of methodologies and how rigorously they apply them. If the procedures are similar in multiple studies it becomes possible to combine or compare data, even from distinctly different sources.

The first step in creating useful data is to ensure consistent and compatible collection methodologies. Clearly explained and publicly available data collection methods are helpful when any individual or agency wishes to utilize a data set. If all the data conform to eBird's standard methodologies, then the data can be merged into larger, and therefore more valuable, data sets.

One of the most important data parameters is the amount of effort used to acquire the data—generally described as the unit of effort (U/E). The establishment of party hours as the U/E for Christmas Bird Counts (CBCs) and duration of observation for the U/E for eBird allows the comparison of birds seen at different times by different parties. For example, survey party hours are recorded for CBCs. With data expressed as birds/party hr., the numbers seen are "normalized" (i.e., made comparable) even for CBC data acquired in

circles with highly variable levels of participation. Without this normalization, eBird and CBC data would be just bird numbers that are incompatible for comparison. eBird has gone further in the effort to normalize the data. eBird wants birders to break the number of birds down into separate counts for each habitat type visited so that the unit of time or distance refers to a single location and a single habitat. In most cases, this is not enough information to determine density (i.e., birds per unit of space). Birds per unit of effort is not the same as density (birds per unit area).

By including the extent of the area observed, density can be calculated as animals per unit of 2-dimensional surface (i.e., birds per acre). Standardized abundance also can be calculated in one dimension. Examples of depiction of birds per one-dimension unit include Red-shouldered Hawks (*Buteo lineatus)* per mile of riparian habitat or Red-tailed Hawks (*B. jamaicensis*) per mile of powerline.

DIFFERENT LEVELS OF COUNT ACCURACY FOR DIFFERENT PURPOSES

Guesses are easy to perform but highly inaccurate. Informed opinions require more knowledge or effort and are better than guesses. An *index* is a number that was acquired using a standard procedure that describes abundance in a relative way (number per area surveyed or per unit of time). An index takes more time to acquire but provides better information. It doesn't provide absolute information on population size but can be used to compare different sites or abundance over time. After an index has been calibrated by comparison to a known total population, the index estimate can then be used to estimate changes or trends in a population at different times or places.

A *census* attempts to provide an accurate count of a population. Censuses provide accurate population information and, when warranted, can be worth the increased cost to acquire. Acquiring a complete population census, however, is not always feasible due to imperfect detectability, movement of birds during surveys, and a myriad of other reasons. If we can improve accuracy, our numbers will be more meaningful. By shifting from indices towards censuses, these more rigorous counting methods provide data that are more useful to more researchers and closer to what eBird is seeking. The resulting better data can be used for more purposes.

The documentation of an isolated observation such as a rare bird sighting is important, especially when we realize how hard it is to determine that something is absent. Presence can sometimes be proven through observation, but proving the absence is near impossible. Who among us has never missed finding a bird that was seen both before and after we missed it? Finding the thin line between where a species is present and where it is absent defines the limits of its range. Without diminishing the importance of qualitative

information (presence detected or not), it is more valuable to shift to the concept of considering density or frequency continuum. Density decreases from abundant, through barely detectable, to not detected due to very low density, and then finally to non-detection due to absence. Quantifying effort in eBird by reporting count duration or distance allows better differentiation of areas of abundance, rarity, and absence. This seems to be how many birders view the role of eBird.

A single correctly identified observation documents that a bird was at a location. Such single observations are qualitative data but have little or no analytical use. Only through repetition can such qualitative observations become useful for quantitative analysis. Repetitive qualitative observations of the same type using standard methodologies can indicate a trend in numbers either in the same location over time or in different geographic locations. As such observations start to enter the realm of quantitative data with replications, the data may be used as an index to the population size. As mentioned above, an index only indirectly helps us understand if the population is changing.

Acquiring actual population data requires a higher level of data accuracy. One approach to determining population estimates is to conduct a survey. Density-based surveys count the numbers of birds in defined sample areas to estimate density (#/unit area). If the sample areas are representative, often by selecting them at random from within the larger study area, the average population density can be calculated. Multiplying the average sample density of the population by the study area (size of the area within which sampling occurs) gives an estimate for the size of the population. Sampling can be *stratified* by separately sampling different types of land cover (i.e., habitat types) and combining the totals from each.

A census is an actual count of all individuals in a population. If it can be possible to accomplish, it is the most accurate measure. Many populations are not amenable to an actual census due to less than perfect detectability for many reasons (cryptic coloration, secretive behavior, visual obstruction due to vegetation or water, etc.).

DIFFERENT PARAMETERS THAT CAN BE QUANTIFIED

Better data is more useful. There is more cost involved, and sometimes the increase in cost is not worth the benefit. It may be cost effective to create larger data sets by combining survey results collected for separate reasons but with similar standardized procedures that are compatible.

Larger data sets can improve both precision and accuracy of population estimates or indices. That is why eBird is adding to their data daily and National Audubon is adding data to their CBC database each year. Now

anyone can examine the data to assess trends or annual rates of change in the number of birds seen at various locations on eBird or on CBCs. eBird is using its database to compare changes over space and over time. With very little extra effort the value of several data parameters can be increased. We can collect more quantitative information, combine data sets, and compare or contrast data sets.

A few parameters that could be quantified by researchers from your eBird data (depending on the information you put in) include:

1. Number of species/area or species/time unit (i.e., diversity)
2. Density of individuals/area or individuals/time unit.
3. Rates of change (change over time) in terms of diversity, density, reproductive success or recruitment (by comparing changes before and after the breeding season), mortality (by comparing changes in abundance over a year), or even habitat availability (if noted repeatedly).

There are many other statistical terms, in addition to parameters, or metrics. For definitions see the statistics portion khanacademy.org (https://www.khanacademy.org).

To quote eBird (http://help.eBird.org/customer/en/portal/articles/1006732) "Let's go count some birds."

LITERATURE CITED

Sullivan, B.L., C.L. Wood, M.J. Iliff, R.E. Bonney, D. Fink, and S. Kelling. 2009. eBird: a citizen-based bird observation network in the biological sciences. Biological Conservation 142: 2282-2292.