

On the Road Again For a Bird Survey that Counts

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The early '60s ushered in an era of revolutionary thinking—civil rights took the forefront, rock 'n' roll seized the stage, and folks like John Coltrane and Andy Warhol reinterpreted everything from jazz to soup cans. In literature, Maurice Sendak described where the wild things were, Harper Lee encouraged us not to kill them, and Rachel Carson revealed how it was too late, we already were. For millions of maturing baby boomers, Carson turned cautionary eyes toward another post-war product that was similarly coming of age—the organochloride pesticide DDT.

As rural campaigns targeting spruce budworms and agricultural pests expanded to include urban mosquitoes and Dutch elm disease, residential areas and college campuses witnessed scores of dead and dying birds; that prompted one concerned mid-westerner to ask if

the continental robin population was in decline. This birder's letter, archaic as handwritten correspondence seems today, was the catalyst for synthesizing the modern foundation of landbird conservation in North America.

The letter was directed to a U.S. Fish and Wildlife Service biologist, Chandler S. Robbins. Robbins lamented in his reply that no one could be sure of the American Robin's continental population trend since there were no scientifically rigorous programs monitoring songbirds at such ambitious scales. This reply sat uneasy with Robbins in the months that followed and, together with the evolving story of the effects of DDT on birds of prey, it served to solidify his conviction that the creation of a continental monitoring program was both vital and of timely need. A couple of attempts had previously been made at this goal—in the early part of the century, both Frank Chapman (1900) and Wells Cooke (1915) aimed to annually census songbirds across the U.S. in hopes of better appraising their abundance and degree of ecological service. The experiences of these two efforts, plus those of three others then in the latter stages of development, would lead Robbins to reinvent the concept of large-scale bird monitoring—making it economical, practical, and statistically appropriate.

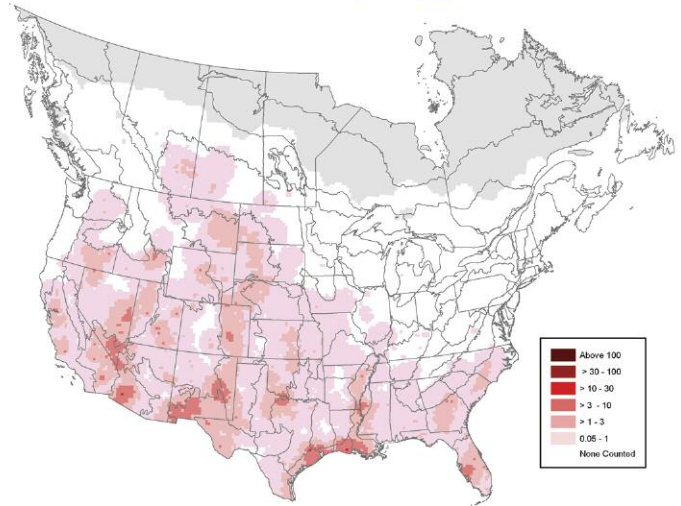
Laying out the Road Map to Success

In 1962 a British colleague of Robbins, Ken Williamson, described to Robbins a bird-monitoring program that was on the brink of launching in the United Kingdom. This program, coined "The Common Bird Census" (O'Connor 1990), was akin to Cooke's earlier North American effort (1915), which by this time had been rejuvenated under the auspices of the National Audubon Society as the Breeding Bird Census (BBC). Both of these programs required observers to define plots of fixed size and then visit those plots eight or more times annually to map breeding

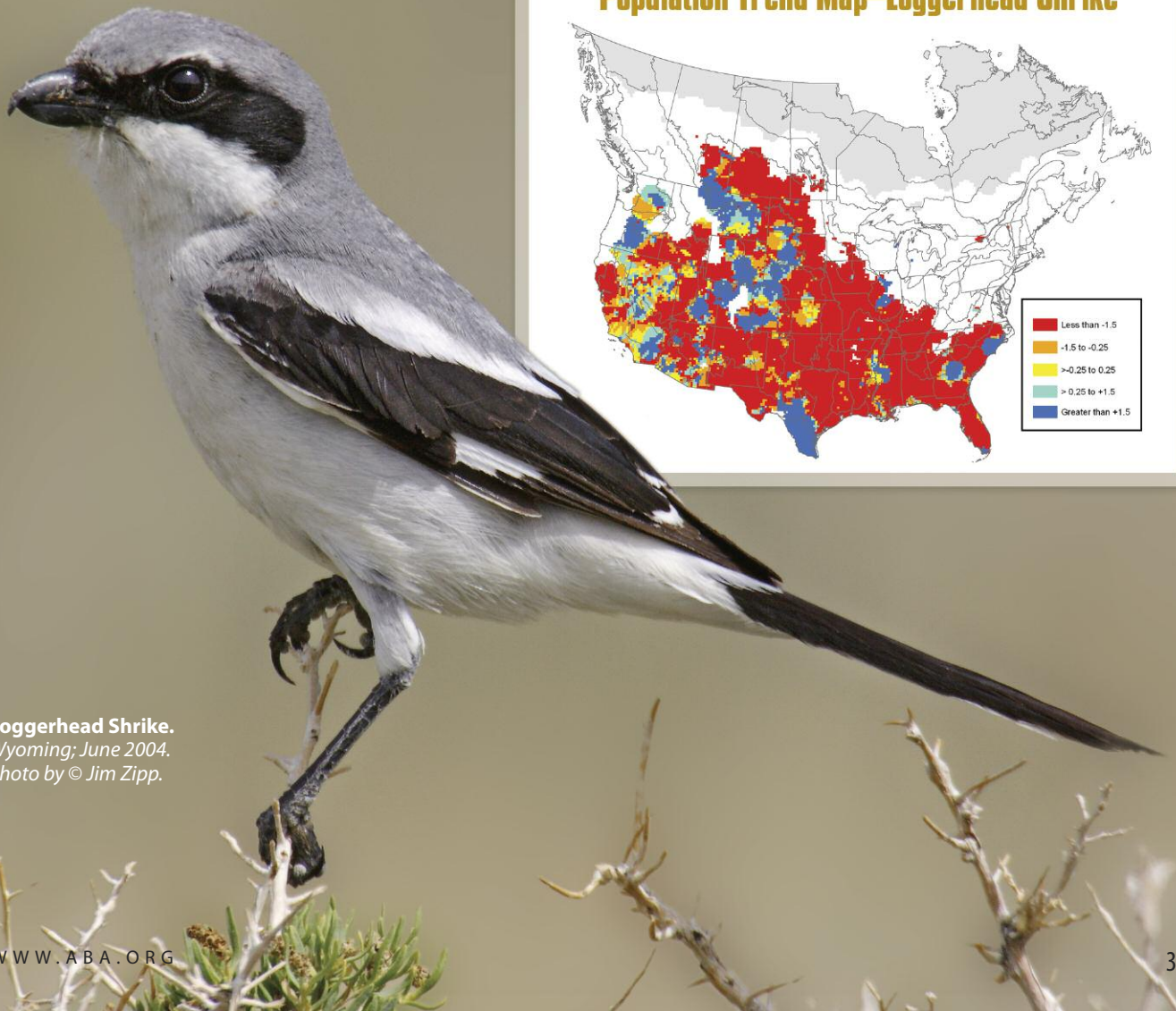
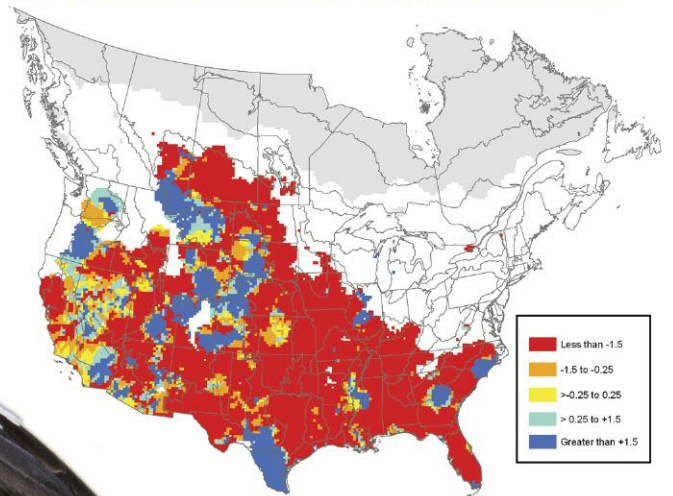
As the top map shows, Breeding Bird Survey (BBS) data provide a continent-wide picture of the relative abundance of the **Loggerhead Shrike**. Darker areas indicate populations of higher abundance. This map and others depicting different species and different analytical methods are available at the BBS website <www.pwrc.usgs.gov/bbs>. *Figure courtesy of © the Breeding Bird Survey.*

Changes in the pattern of abundance over time (bottom map) reveal areas of **Loggerhead Shrike** population loss (red) and increase (blue). Despite an overall population loss of nearly 80% across the U.S. and Canada since 1966, Loggerhead Shrike populations in Colorado, Montana, and Oregon have remained stable or even slightly increased. *Figure courtesy of © the Breeding Bird Survey.*

Relative Abundance Map—Loggerhead Shrike



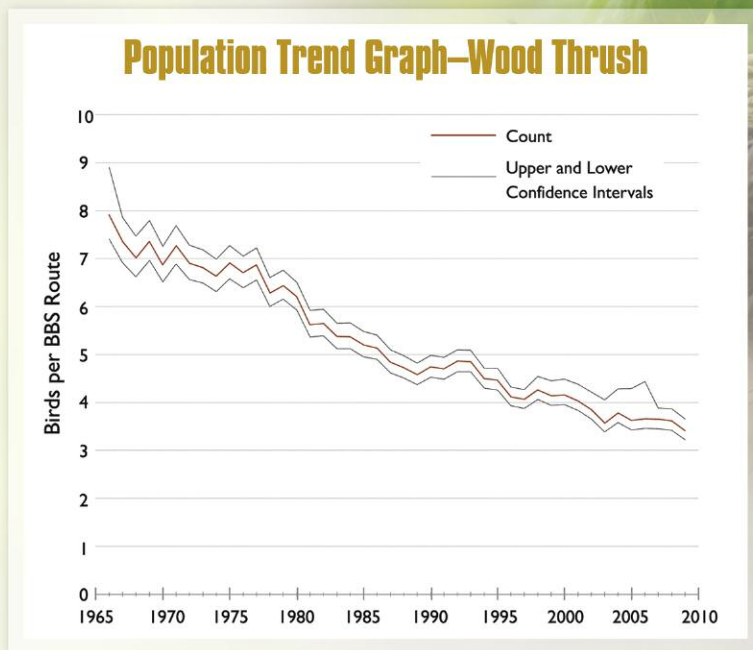
Population Trend Map—Loggerhead Shrike



Loggerhead Shrike.
Wyoming; June 2004.
Photo by © Jim Zipp.

Wood Thrush. *New Haven County, Connecticut; May 2003. Photo by © Jim Zipp.*

BBS routes are distributed to allow species to be monitored across multiple geographic scales spanning from a single state's physiographic province up to the entire continental population. This graph depicts the record of population change at the largest combined scale for the **Wood Thrush**, illustrating an almost 50% decline in the overall continental population since 1966. *Data courtesy of © the Breeding Bird Survey; figure by Kei Sochi.*



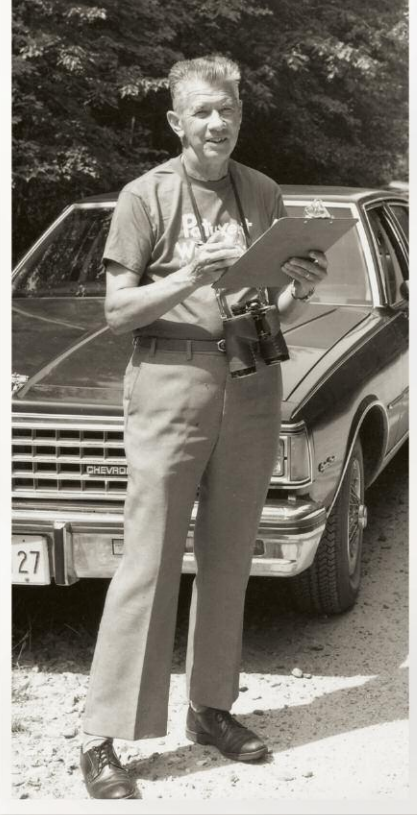
territories. Although the idea of obtaining total counts from sample locations seemed desirable, judging by his experience as a BBC compiler and the fact that fewer than 20 plots had been continually sampled up to that time in the early 1960s, Robbins deemed a mapping approach too time intensive to meet with large-scale success in North America.

Robbins recognized that a point count sampling strategy offered a significant advantage over a territory mapping framework because it allowed fewer observers to cover a far greater area in much less time. In addition, Robbins was familiar with the affinity that Americans had for the automobile, and he had noticed that Americans were much less accustomed to walking the distances that Europeans typically covered on foot. He believed that a series of point counts along roadside routes could provide an ideal arrangement—that is, if associated logistical considerations could be resolved. This was familiar ground for Robbins. He and his colleagues had already worked through a number of related issues in the 1950s when assisting in the development of the U.S. Fish and Wildlife Service's Mourning

Dove Call Count Survey (CCS).

The CCS is a roadside survey with routes consisting of 20 points, spaced one mile apart, where observers count all doves heard or seen in three-minute periods, once annually (Dolton 1993). Although the CCS indicated to Robbins that the concept generally worked, nearly all of the CCS observers were conservation agency professionals. This was at a time before the advent of federal and state government non-game biologist positions, and Robbins had decided that any new monitoring program would have to be done by a volunteer workforce. Participation in Christmas Bird Counts and regional ornithological society membership rolls suggested that a sufficiently large pool of skilled amateurs was available. The evidence for the feasibility of using volunteers for his sampling scheme would come from a more familial source. In the summer of 1961, Sam Robbins, Chandler Robbins' brother, successfully implemented an all-volunteer "Summer Bird Count" in Wisconsin that included roadside routes with varying numbers of five-minute point counts spaced a quarter mile apart (Robbins 1961).

Chandler S. Robbins was central to getting the BBS up and running in the mid-1960s, and he continues to be an important and influential figure in the fifth decade of the BBS. *Patuxent Wildlife Research Center, Maryland; August 1986. Photo by © Barbara Dowell.*

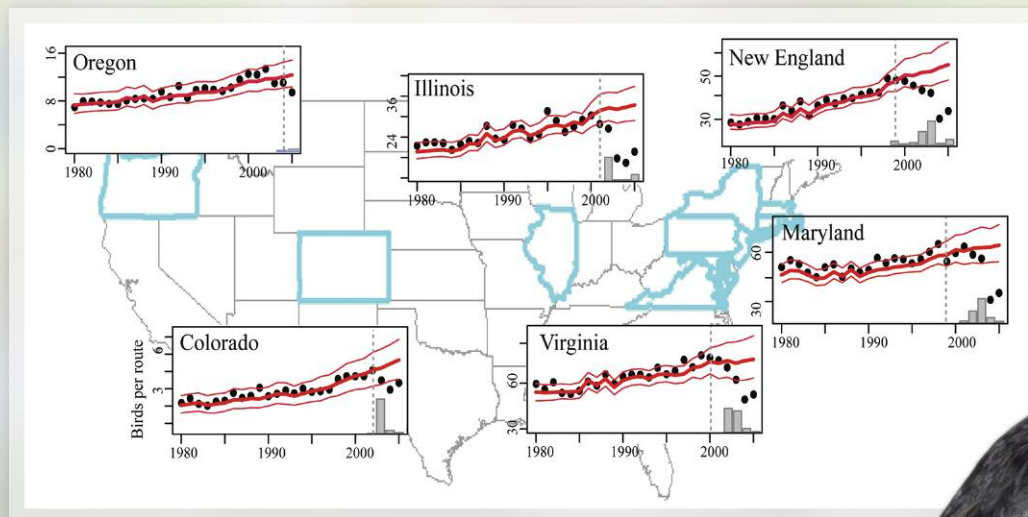


Now convinced that a volunteer bird survey based on roadside point counts could be efficient, practical, and logistically feasible, Robbins focused on how best to distribute routes to effectively measure population trends from large geographic areas. One thing that concerned Robbins about the early CCS and Wisconsin efforts was that observers were given free rein to create routes. This practice is not appropriate for monitoring programs because observers typically establish routes near habitats they believe are best suited for birds and birding. As these areas

are also afforded protection as local, state, or federal parklands, they do not necessarily represent the landscape as a whole. Instead, less-attractive habitats—those experiencing greater human-caused disturbance or more vulnerable to it—are usually where landscape-level population changes are actually occurring.

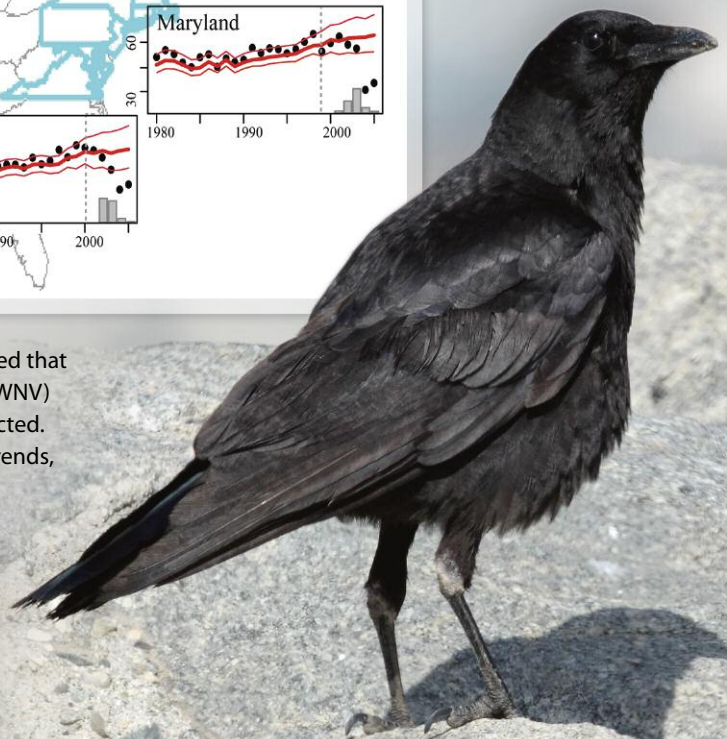
Robbins believed it was essential that all habitats be sampled in proportion to their actual occurrence in the landscape. He envisioned a program based on randomly selected pre-established routes as the best way to accomplish this goal. Armed with U.S. Geological Survey (USGS) topographic maps and a random number table, Robbins partitioned states into blocks of one degree of latitude and longitude and then randomly selected a uniform number of route start-points for each block. Each of these start-points was positioned on the nearest secondary or tertiary road. The direction of the route also was determined randomly.

Birders have always known of the tendency of populations to vary from place to place and from year to year, but Robbins'



American Crow. *Los Angeles County, California; May 2009. Photo by © Brian E. Small.*

In 2003 the Centers for Disease Control and Prevention reported that **American Crow** carcasses tested positive for West Nile Virus (WNV) more often than any of the 225 other species found to be infected. The impact of this mortality was reflected in BBS population trends, and LaDeau et al. (2007) demonstrate how focused research programs outside of the BBS put those data to good use. In this figure, vertical dotted lines denote the first appearance of WNV in each region, dots represent BBS counts, and solid lines depict expected population counts based on pre-WNV data. *Figure reproduced with permission of © S. L. LaDeau and coauthors.*



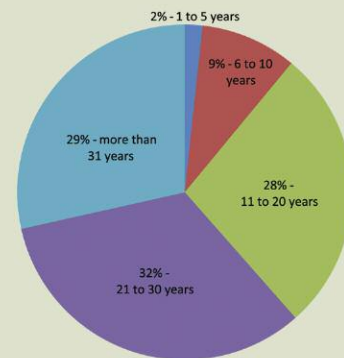
BREEDING BIRD SURVEY

BBS participants are highly experienced and motivated birders. These pie charts show the experience levels (upper), intensity levels (middle), and professional background (lower) of BBS participants. *Data courtesy of © the Breeding Bird Survey; figures by Kei Sochi.*

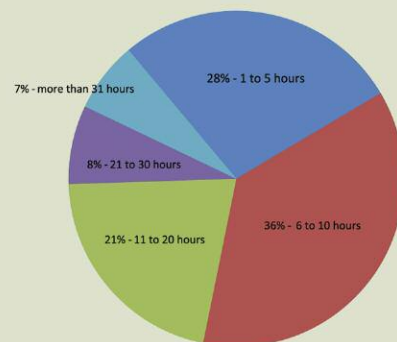
single greatest advance in North American bird monitoring may have been his stubborn insistence on removing as much spatial and temporal variation from those bird population assessments as possible. He was well aware that, at very large scales, even seemingly subtle differences in the ways observers collect data and in their abilities in the field can yield data so variable as to mask all but the most pronounced of population changes. To reduce “measurement error” and ensure that all survey participants have equal opportunity to see or hear the same proportions of individuals, Robbins insisted on strict adherence to a standardized methodology. This included well-defined observer quality standards and sampling protocols established through an intensive series of experimental counts performed across the continent by Robbins and his colleagues.

Birders Take it to the Streets

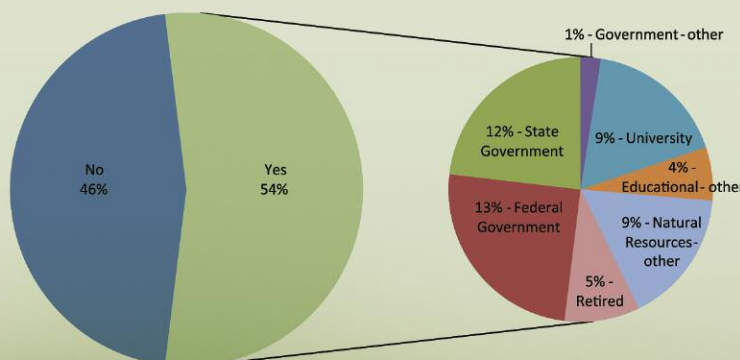
The first Breeding Bird Survey (BBS) participants surveyed routes in 1965 as part of a pilot effort organized by Robbins in Maryland and Jack Linehan in Delaware. The initial crack team of birders volunteered a weekend’s time to learn to execute the procedures to a tee. The pilot field season met with overwhelming success, as 50 routes were completed in Maryland and ten in Delaware. Robbins saw to it that word of the survey’s success traveled far and fast as he lined up state coordinators for the upcoming year. The BBS officially launched in 1966 with nearly 600 routes covered in the U.S. east of the Mississippi, including, thanks to Tony Erskine’s coordination, southeastern Canada as well. By 1967, the growing army of survey coordinators and observers had swelled to include the Great Plains states and Prairie provinces. Coverage expanded to include all of the continental U.S. and Canadian provinces by 1968, with roughly 1,850 routes distributed north of Mexico.



Number of Years Birding



Hours Birding per Week



Are They Professionals?

Scarcely encountered prior to the mid-1800s, the **Chestnut-sided Warbler** underwent a century of population expansion across a geographic scale seemingly immeasurable at the time, but now annually monitored by the BBS. *Chippewa County, Michigan; May 2007. Photo by © Brian E. Small.*



Since its inception nearly 45 years ago, the BBS has become the primary source of long-term, large-scale population data for more than 400 of North America's breeding bird species. The program continues its fruitful legacy in the U.S. and Canada under the joint coordination of staff from the USGS Patuxent Wildlife Research Center in Maryland and the Canadian Wildlife Service (CWS). No other single resource provides as much scientifically defensible data regarding the continent's bird populations as the BBS.

Analysis of BBS trends in the late 1980s revealed widespread declines of neotropical migrant birds in eastern woodlands, sending a shockwave through the bird management and conservation communities. These findings precipitated the formation of North America's most comprehensive bird conservation organization, Partners in Flight. Additional conservation initiatives and monitoring efforts sprung forth as decades of amassed data highlighted the specialized needs of birds like colonial waterbirds and secretive marsh birds, and the necessity for tailored monitoring programs to accommodate them.

Through continued incorporation of emerging computing technologies, geographic information systems, and innovative modeling techniques, analysts at the Patuxent Wildlife Research Center's quantitative population ecology division have made revolutionary advances in the complex and challenging arena of trend analysis. The most common analyses performed on BBS data assess geographic patterns of relative abundance, population trends, and geographic patterns in trends. The raw data behind these analyses, as well as analytical results and graphical depictions, are available on the BBS website; see figures, pp. 33–34, for examples.

Although the BBS was designed to provide a continent-wide perspective of population changes, peer-reviewed articles appear regularly in scientific journals illustrating myriad ways that BBS data are applied to questions far beyond the originally intended purpose of estimating population trends; see our online bibliography with more than 400 entries <tinyurl.com/2gxmwx>. Such questions have encompassed a range of topics in ecology, evolutionary, and conservation biology, from predator-prey dynamics to climate change, range expansions to invasive species, and niche modeling to epidemiology. Whereas BBS data alone do not indicate the cause of population change or of associations with environmental factors, they readily allow for the generation of hypotheses that can be tested by research programs employing more specifically appropriate techniques; see figure, p. 35. New and creative uses of BBS data continue to appear regularly, and the consistent use of BBS data in prominent watershed reports like the U.S. Department of the Interior's *State of the Birds* report <tinyurl.com/268kr32> attests to the continued relevance of BBS data in informing bird conservation planning.



Populations at the northern tip of the breeding range of the **Prairie Warbler** are experiencing population growth, while those throughout the rest of the range are experiencing significant population declines similar to those seen in much of the rest of the shrubland bird suite. *Muskingum County, Ohio; May 2007. Photo by © Brian E. Small.*

Many factors have contributed to the success of the BBS, but none has been more important than the participants who collect these data. Each year roughly 2,000 people perform surveys on more than 3,000 BBS routes. This predominantly volunteer workforce represents an elite and highly skilled cadre of birders whose experience rivals and often surpasses that of trained resource professionals; see figures, p. 36. Assisting them are an additional 1,000 or so volunteers who take on the burden of such tasks as driving, collecting GPS coordinates, and recording tallies and stop descriptions in the field. An astounding 225,000 miles and 22,500+ hours are logged annually by the survey's dedicated workforce, earning the BBS a well-deserved reputation as the model for efficient large-scale wildlife monitoring.

Outstanding even among this group, but certainly not wildly atypical, is David Holmes of Maryland. Holmes started as a volunteer observer in 1968, just barely missing the inaugural year by a couple of field seasons. His record of participation typifies the spirit of service that has become a hallmark of the BBS observer flock—431 completed surveys as of 2009, at times conducting as many as 15 surveys per season! Observers like Holmes are recruited today in much the same way as when the survey began. A network of committed state coordinators, expert birders who keep a finger on the pulse of their state's

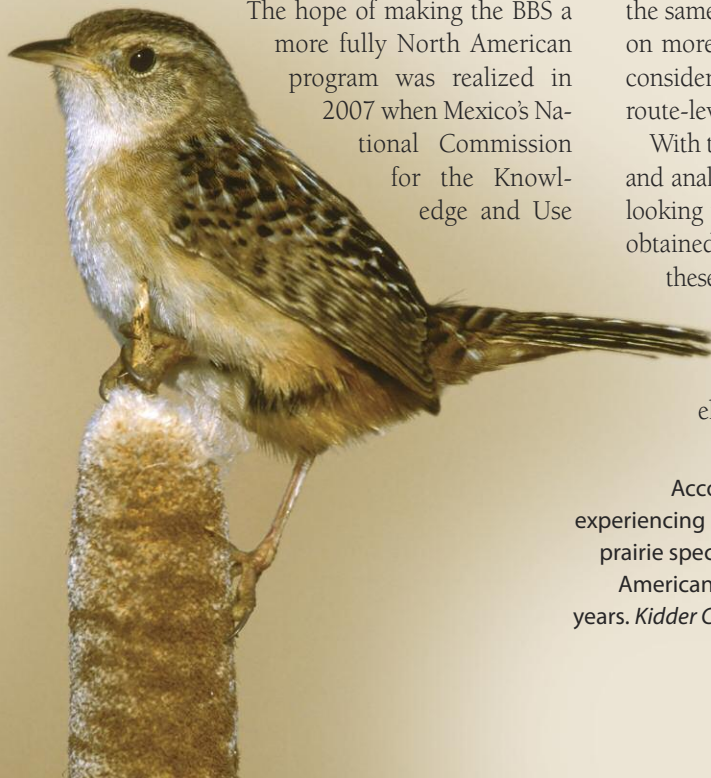
birding community, search for talented birders who possess the sound and sight identification abilities needed to fulfill the area's vacant routes. A much greater proportion of observers preemptively contact their state coordinator to volunteer these days, and that's encouraged, but the scientific rigor of the BBS protocol requires coordinators to select only skilled observers able to generate a consistently high quality of data.

The original methods and design of the survey have remained largely unchanged since its beginning (see sidebar, p. 40), but the program's day-to-day operations have evolved considerably over the years. Long past are the days of collecting data on generic survey forms, totaling up ten-stop summaries, and then entering those data into a computer via punch cards! Current observers receive a packet of survey materials each spring that includes a route-specific species list, a route map, and other materials. Database upgrades made over the past couple of years now provide observers the ability to conveniently enter and retrieve their data online. Investigators seeking the publicly available raw data or annual trend analysis results have also benefited from the survey's increased online accessibility.

The Road Ahead

What does the future hold for the BBS? In addition to continuing improvements in data management, quality control, and data presentation, the BBS looks forward to three areas of near-term growth—geographic expansion in Mexico, improvements in population estimation procedures, and better integration of geospatial information with population data. For more than 100 species that breed in both the U.S. and the poorly surveyed areas of northern Mexico, a lack of information from the Mexican side has historically been a significant impediment to developing the full population picture.

The hope of making the BBS a more fully North American program was realized in 2007 when Mexico's National Commission for the Knowledge and Use



of Biodiversity (CONABIO) partnered with the USGS and CWS to expand the BBS into Mexico. In the past several years, hundreds of new routes have been established across the northern tier of Mexican states, putting the BBS closer to its goal of elucidating the conservation picture for cross-border species and providing the Mexican government with a sampling framework for tracking their resident bird populations. CONABIO biologists Humberto Berlanga and Vicente Rodriguez, along with USGS, CWS, and USFWS staff, plan extended training and recruitment events to build capacity and to support southward expansion throughout Mexico.

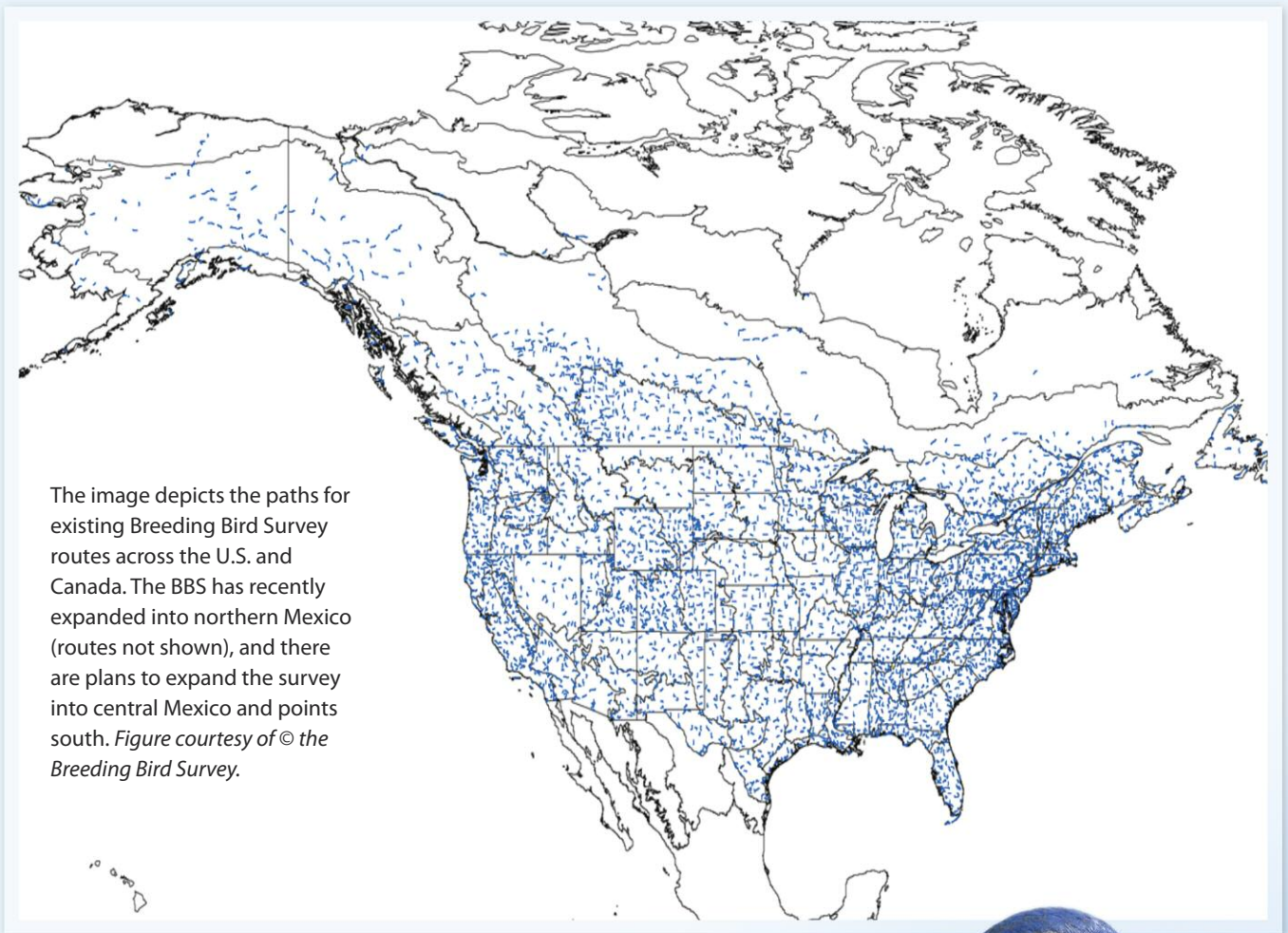
Concerns about the statistical shortcomings of many point count methods have been around for a long time. The BBS approach, true to its namesake and in contrast to a census, surveys relative abundance in lieu of enumerating the entire population; it is a given that all observers miss some birds during counting. To reduce uncertainty in the counting process, the BBS has initiated efforts to estimate the fraction of the population that was not counted; this estimate is based on the relative *detectability* of different bird species. Because these measures are not obtained through existing BBS protocols, work has begun to evaluate procedures to augment the existing survey methods. The promise of this work is that eventually analysts may be able to estimate abundance from BBS data. Instead of simply reporting a percent population change per so many years, in the future we might be able to estimate the number of individuals the overall population gained or lost.

Associating actual numbers of birds with population changes due to habitat alteration will greatly enhance our ability to manage the landscape for birds. Many BBS data users need better geographic information from the survey to accomplish this. Although it has always been important for observers to stop at the same location, we lack geospatial coordinates for the stops on more than 90% of routes. Such data were previously not considered critical because the BBS was originally intended for route-level analysis.

With the advent of modern geographical information systems and analytical techniques, however, data users are increasingly looking to relate BBS stop count data to habitat measurements obtained via satellite imagery. Improving the bridge between these data is critical to advancing our understanding of landscape-level research topics such as climate change.

BBS biologists and other USGS scientists have begun working on a series of new tools and analytical models that will allow examination of BBS data in novel and

According to BBS analyses, 60% of grassland bird species are experiencing negative population trends. The **Sedge Wren**, a tallgrass prairie specialist, is an exception to this pattern, however; the North American population of this species has been increasing in recent years. *Kidder County, North Dakota; June 2002. Photo by © Brian E. Small.*



The image depicts the paths for existing Breeding Bird Survey routes across the U.S. and Canada. The BBS has recently expanded into northern Mexico (routes not shown), and there are plans to expand the survey into central Mexico and points south. *Figure courtesy of © the Breeding Bird Survey.*

informative ways, such as estimating trends for specific habitats and unique regions, as well as paving the way for future climate change research.

A Note to Past, Present, and Future Observers

As every past and current member of the BBS staff will readily affirm, the most gratifying aspect of being in the BBS program is the privilege of working with talented and dedicated birders. Throughout his long association with the BBS, Robbins has made a point of crediting those whose ideas and contributions have been crucial to the development and success of the survey. That feeling of appreciation has become an institutional legacy. Every observer and state coordinator, whether running one route or many, has made the BBS the important bird conservation tool that it is today. With great pleasure, we thank all current and past BBS participants for their unselfish donation of time and expertise to the program! We encourage all volunteers who would like to make a greater contribution to North America bird conservation to join the BBS flock by contacting their state coordinators or the national BBS office <www.pwrc.usgs.gov/bbs>.

BBS data for the **Western Bluebird** indicate that populations in the ponderosa woodland region of Colorado and Utah have seen growth over the past two decades, while more abundant populations in New Mexico and Arizona have experienced declines. *Socorro County, New Mexico; December 2007. Photo by © Brian E. Small.*



Breeding Bird Survey Methods

The survey's network of state coordinators works to identify and recruit observers who can identify all breeding birds in their area by sound and sight. Prior to the start of each season, participants receive a packet containing a route map, data collection sheets, and instructions detailing the following standardized methods:

- The survey begins one-half hour before local sunrise.
- Survey stops are located no closer than a half mile apart along routes and remain in the same location from year to year to maintain consistency.
- The observer visits each of a route's 50 stops in sequence and, during the three-minute stationary count period, counts all birds heard or seen within a quarter mile. Birds seen before or after the three-minute count period, or while traveling between stops, are not counted.
- Only a single observer collects the data, although assistants may serve as data recorders and drivers.
- Pishing, tape playbacks, and other methods of coaxing responses from birds are not allowed.
- Each survey is conducted once annually during the peak of the breeding season; most surveys are conducted during June, although surveys in desert areas and some southern states are conducted during May. Observers try to conduct the surveys as near as possible to previous survey dates.
- Each survey is normally completed in 4–4.5 hours, not including driving time to and from the route.
- Surveys are conducted only during suitable weather conditions; precipitation and high winds are avoided because these conditions reduce the likelihood of detecting birds along the route.

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