from D. Blockstein
6/21 (2)

United States Department of the Interior

FISH AND WILDLIFE SERVICE

MIGRATORY BIRD AND HABITAT RESEARCH LABORATORY

THE BREEDING BIRD SURVEY

People have long speculated about the reasons some species of birds were able to increase their numbers significantly, while other species declined in population—many to the point of extinction. Why has the Starling prospered? What happened to the Passenger Pigeon? What is now happening to bluebirds?

Widespread or local weather patterns, habitat destruction, pesticides and many other factors affecting bird populations, as well as normal biological cycles, have always been mysterious, difficult to measure forces, greatly confounding conjecture. The Breeding Bird Survey (BBS), sponsored by the U.S. Fish and Wildlife Service and the Canadian Wildlife Service, is designed to take as much of the mystery as possible out of bird population fluctuations and their possible causes.

In the past three decades we've had drastic change in land use, agricultural practices and environmental pollution. With expanding human populations we can anticipate even greater intensity of land use and alteration of wildlife habitat, making the gathering of baseline population data even more important. These data are crucial if we're to obtain an understanding of what the usual, or normative, bird populations are, as measured uniformly over a period of time. By knowing what is normal, we can infer that which is abnormal, and hence increase our ability to predict the factors mitigating for or against survival of many bird species. With the help of about 1200 volunteer observers this survey has been producing the only index of song bird populations ever attempted throughout North America.

The word survey is appropriate because the BBS attempts to establish a sample index, not a total count of bird populations. No effort is made on a BBS route to count as many birds as possible, as on Christmas Bird Counts or spring Big Days, or even to determine exact breeding populations as in the Audubon Breeding Bird Census. Because of the increased interest in all of these techniques, it is important to refer to each one properly. In any "survey" the valid negative data are as important as the positive. Statistical analysis of the data is possible because strict adherence to the rules provides comparable samples over a large area. Since these results are frequently used in policy making and environmental impact assessments, it is extremely important that the rules be followed closely.

History

In 1965 the Breeding Bird Survey idea was tested along 50 roadside routes in Maryland and 10 in Delaware to determine if the technique was feasible. Based on this pilot effort, the decision was made to sample the U.S. and Canada east of the Mississippi River. In 1966 about 600 routes were run in this area.

Coverage was expanded to include the Great Plains states and provinces in 1967 and the entire continent in 1968. Coverage has slowly grown to a level of approximately 1850 routes per year.

Methods

In order to apply statistical methods of analysis, the data to be analyzed must be gathered in accordance with certain standards. Probably most important of these is that there be no biases in the data. All habitats should be represented in proportion to their occurrence in North America; good birding areas should not be intentionally over-sampled. Random selection of routes before-hand is essential to minimize this and other potential biases. Because any data being gathered are subject to natural variability and sampling error, a large sample size is needed to average out local variations and reduce the effects of sampling error. Other obvious requirements are a consistent sampling method, comparable observer expertise and similar weather conditions. The Breeding Bird Survey was established with all of these goals in mind.

A sampling scheme based on lati-longs (blocks of one degree of latitude and one degree of longitude—about 50 by 70 miles) was devised for the selection of survey routes. Throughout North America the number of routes per lati-long varies according to availability of qualified personnel but is uniform across a state or province. There is one route per lati-long in most of the western states and provinces, two in the central and southern states and four from Tennessee and Virginia northward. There is more intensive coverage in those states or provinces that have a high number of qualified birders. In such areas the sampling density can be increased once all established routes are being run.

The routes were randomly drawn by picking starting points and direction of travel from a table of random numbers. Approximately 2300 routes have been drawn this way and every effort is made to see that as many of them as possible are run each year to ensure a large sample size. The routes are on secondary roads in order to minimize interference from traffic noise and danger to observers. Unfortunately, increased traffic on secondary roads has necessitated relocation of some routes.

Qualified observers are recruited in each state or province by a volunteer coordinator who is usually in contact with a large portion of the birding community. The coordinators receive copies of each year's results for their respective areas and often prepare summaries for publication. These dedicated people, many of whom also run several routes, deserve a great deal of thanks.

Observers are supplied with rules and all necessary forms and maps and are instructed to pick a day in June that is as close as possible to previous runs and that has good weather conditions. Each observer starts exactly ½ hour before local sunrise, counting and recording all birds detected in 3 minutes at the starting point. The counting is repeated at 49 more stops, each ½ mile apart. Only birds counted during the 50 3-minute stops are included in the totals. A route should take from 4 to 4½ hours to complete. It is important to finish in this time-frame because on most mornings bird song decreases rapidly after the first 4 hours.

Processing and Quality Controls

When the routes are completed, the summary sheets (Fig. 1), field sheets and other data are sent to the Nongame Section of t Migratory Bird and Habitat Research Labo tory in Laurel, MD. Biologists and clerks e the forms very carefully, comparing fi sheets to summary sheets and questioni observers on any discrepancies or unverifi observations of rare species. At this stage code is entered to distinguish routes that, one reason or another, cannot be used statistical analyses, but are still retained their distributional data. All data are tra ferred to magnetic tape and subjected computer edit checks. The observers reta copies of their results to verify against co puter print-outs which are sent to them each route run. After the final corrections a made, three listings are produced, one sort by individual route, one by state a province and one by species. These listin are available to the public and use of t data for appropriate research is encourage

Ecological Stratification

To detect small changes in the populati of a species between years, it is helpful group data for areas where the populatio are fairly similar. These small, usually ec logically similar units can be combined in

U.S. FISH AND WILDLIFE SERVICE
LAUREL, MARYLAND 20811

SUMMARY SHEET, BREEDING BIRD SURVEY

(1)	STATE-PROV.	67
(3)	ROUTE NO.	002
(6)	ROUTE NAME	BIRDVILLE
(16)	COORDINATES	3445-09546
	STRATUM	19 (40)

(91) TOTAL SPECIES: 64 C (39)

ASSISTANT: Myrtle Bullock

(OBSERVER (please print)) Dr. Mr. Mrs. Miss (circle one)

(27) WRENN Phoebe A
Last Name First Name M.I.

USE ONLY NUMBERS—ONE DIGIT PER BLOCK

	Start	Finish
(42) TEMP. (F)	70	78
(46) WIND SPEED	1	1
(48) SKY	2	1

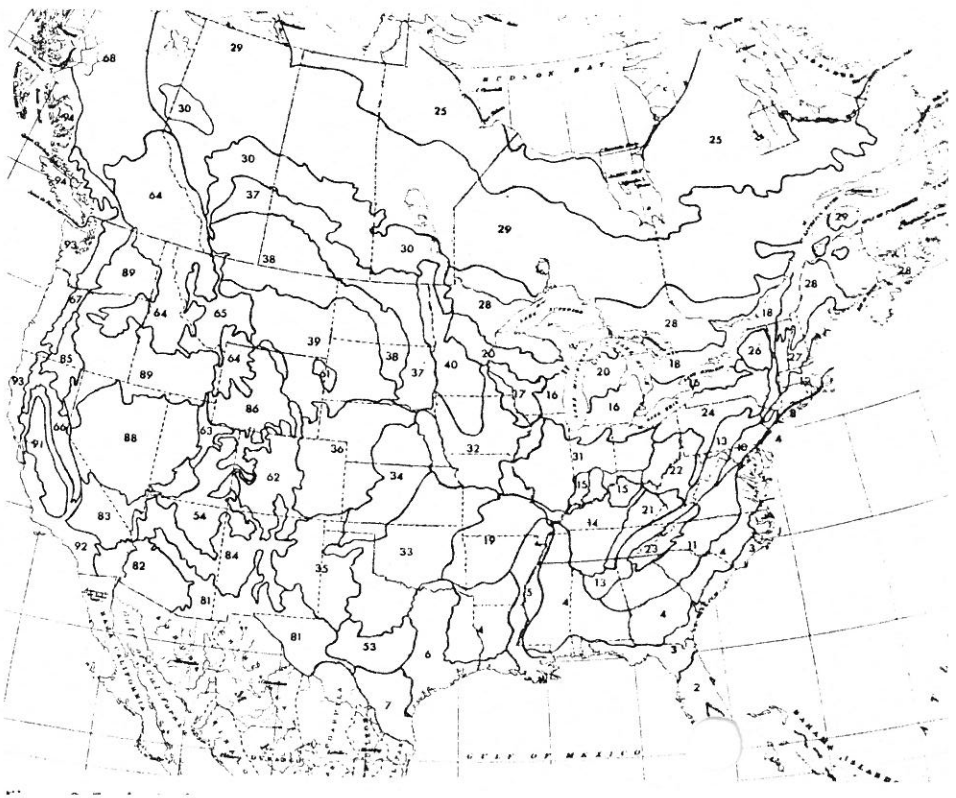
(50) DATE 06 04 78 (Month Day Year)

(56) TIME 0535 (Start) 0950 (Finish) (57)

Species	AOU	Page Totals 1	2	3	4	5	Total Indiv.	Stops per Spec.
GREAT BLUE HERON	1[illegible]			1	1		2	2
GREEN HERON	2[illegible]		1				1	1
LITTLE BLUE HERON	2[illegible]		1		1		2	2
CATTLE EGRET	2[illegible]							
CANADA GOOSE	1[illegible]							
MALLARD	1[illegible]							
BLUE-WINGED TEAL	1[illegible]							
WOOD DUCK	1[illegible]							
TURKEY VULTURE	[illegible]				7		7	1
BLACK VULTURE	[illegible]							
SHARP-SHINNED HAWK	[illegible]							
COOPER'S HAWK	[illegible]							
RED-TAILED HAWK	[illegible]							
RED-SHOULDERED HAWK	[illegible]				2		2	2
BROAD-WINGED HAWK	[illegible]							

Species	AOU	Page Totals 1	2	3	4	5	Total Indiv.	Stops per Spec.
WOOD THRUSH	758					1	1	1
VEERY	756							
E. BLUEBIRD	766		1	2	2		5	5
BL-GR. GNATCATCHER	751	3	2	6	7	6	24	20
CEDAR WAXWING	619							
LOGGERHEAD SHRIKE	622							
STARLING	493				4		4	1
WHITE-EYED VIREO	631		3	2	2	4	11	9
BELL'S VIREO	633			1			1	1
YELLOW-THR. VIREO	628							
RED-EYED VIREO	624					3	3	2
WARBLING VIREO	627							
BLK-&-WHT WARBLER	636					2	2	2
PROTHONOTARY WARB	637							
WORM-EATING WARB	639							

Figure 1. Portion of properly completed Breeding Bird Survey Summary Sheet.



regions such as coastal plain, piedmont, and mountain, which in turn can be combined to obtain figures for a continental population index. Better measurement of change can be obtained by the use of ecological regions than by combining data on a state or province basis, because many species vary greatly in abundance in different parts of the same state or Province

Although it is difficult to subdivide the continent into ecological regions whose boundaries precisely define the distribution or abundance of a large number of bird species, an initial attempt has been made. The stratification plan used for the BBS analyses is shown in Figure 2. This plan is based on several published sources and seems to be an effective ecological stratification. It should be considered by anyone working with bird studies covering large areas of North America.

What Does The BBS Tell Us?

Access to a computer facility is extremely important to an effort as large as the Breeding Bird Survey. Not only does it permit the handling of an otherwise unwieldy amount of data, but it also permits the data to be examined in a wide variety of ways. Because each species of bird differs in detectability and preference for roadside habitat, it is not possible to compare BBS data between or among species. However, the main purpose of the BBS is to detect changes in populations of all bird species encountered along the routes by establishing a yearly index which can be used to determine trends. It is hoped that, by detecting trends, we can determine if, and to what degree, a species is declining, and management techniques can be employed before it becomes threatened or endangered.

Because changes in bird populations are almost always gradual, the change from one year to the next is rarely significant. By analyzing population changes over a period of years, it is possible to determine if any gradual trend is statistically significant. Analysis of the BBS data has shown that most species experience population fluctuations from year to year. However, these ups and downs do not indicate a long-term trend. On the other hand, many species appear to be increasing or declining at a significant rate when a decade or more of data are examined. Not only does BBS data tell us how these dynamic populations are changing, but it also serves as a baseline for the more stable species in case a sudden change occurs. Although the population appears lower for Eastern Bluebirds than it was 30 years ago, the BBS shows it to be remarkably stable despite some severe weather set-backs and competition for nesting sites from introduced species. Figure 3 shows that the bluebird displays the up and down pattern of a species well capable of recovering from periodic population decreases. The last two years give the impression of an overall downward trend, but the highly significant decrease in 1977 and the less severe one in 1978 can be attributed to two harsh winters in the East. Significant changes that do take place between any two successive years are almost always a result of abnormal weather.

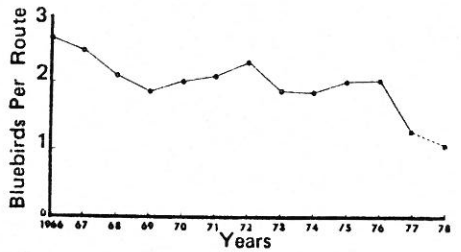


Figure 3. Population Index of Eastern Bluebird for North America east of the Mississippi River from BBS data.

When the controlling factors of a bird's population are suspected, the BBS data can be used to show if a correlation exists. One of the strongest correlations in the bird world is that between winter weather and Carolina Wrens. Figure 4 shows the BBS population index of Carolina Wren east of the Mississippi River for a 12-year period plotted with the average winter (December, January, February) temperatures for Washington, D.C. for the same period. When the winter temperatures were near normal, the wren population increased only slowly, but when the winter temperatures stayed well above normal for 5 years, the population grew rapidly. This was expressed not only by larger populations in the central states, but also by considerable northward expansion of the range. The winter of 1976-77 was very severe in the East, with temperatures well below normal, resulting in extended snow and ice cover. These conditions cut short the wren's rapid increase, and, in fact caused a drastic drop in population reflected on the 1977 BBS.

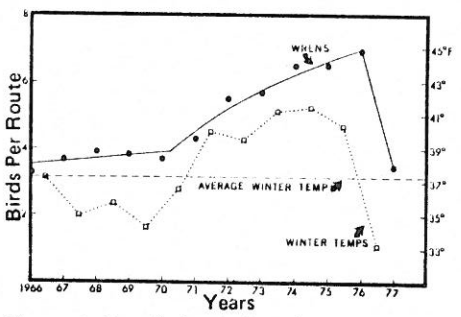
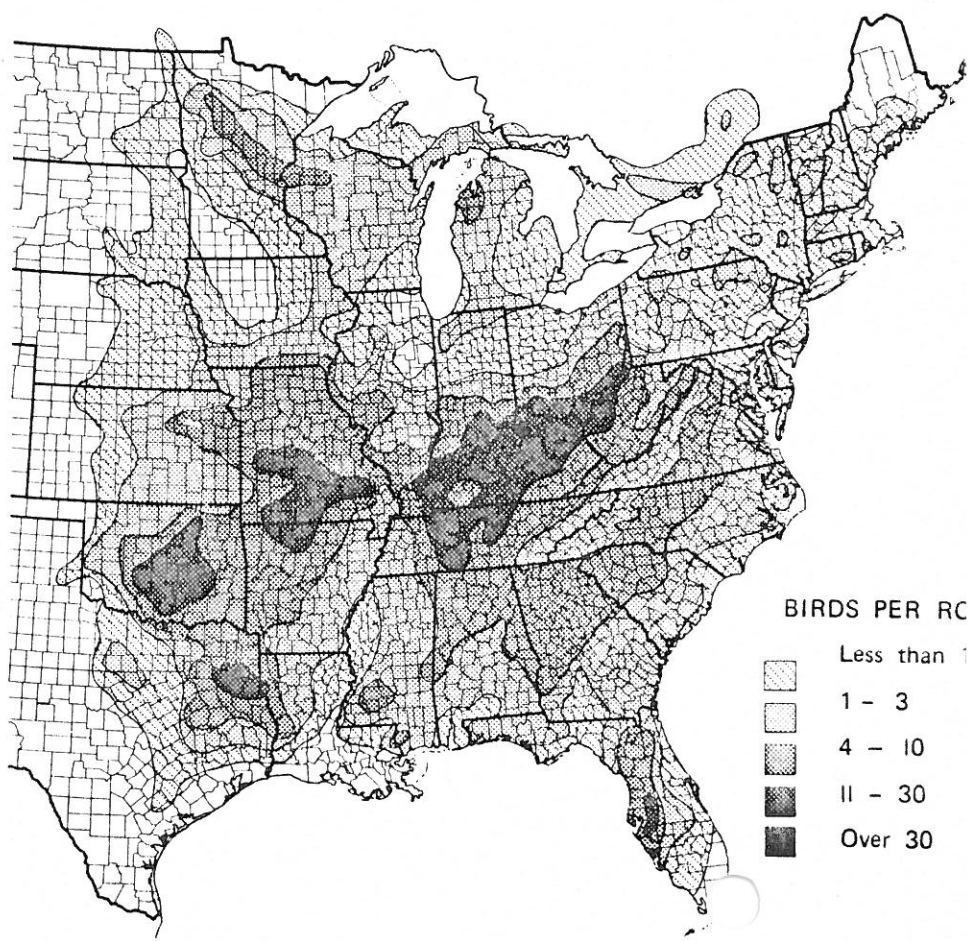


Figure 4. Population Index of Carolina Wren for states east of the Mississippi River from BBS data plotted against winter temperatures for Washington, D.C.

Few attempts have been made to map the distribution of North American birds precisely. This is regretable, because such maps would have many uses, not only to birders but to biogeographers, taxonomists and population biologists. With the BBS data and the versatility of the computer, not only can most of the range of a species be mapped but, by using long-term averages the relative breeding densities also can be deduced. A good example of the potential management use of these maps is the Eastern Bluebird map (Fig. 5), which shows areas within the normal breeding range that have very low populations, such as the area from Wisconsin through Ohio. This scarcity of bluebirds is related in part to a lack of good habitat and nesting sites in this area but possibly also to nest site competition from the great density of House Sparrows and Starlings in the same area. Perhaps a concentration of well-monitored nestboxes



in these areas would be more beneficial than in others.

Birds are constantly appearing outside their normal ranges, and in many cases these are preludes to legitimate range expansions. The BBS is an excellent tool to keep track of both the increases in numbers and the current ranges of expanding species. The two most conspicuous recent additions to North American birdlife are the Cattle Egret and, in the East, the House Finch. Both are increasing and spreading rapidly. The BBS will provide a fairly precise measure of the increases of both species. As dramatic as either of these, though probably less well known, is the southward spread of the Barn Swallow breeding range (Fig. 6), which between 1966 and 1973 progressed about 150 miles south. This expansion is continuing and will probably result in Barn Swallows breeding over the entire Southeast.

Population changes within a smaller area, such as a state or group of states or eco-region can be determined and compared to trends for larger areas. Comments from bluebird enthusiasts in the Midwest that populations were down drastically after the winter of 1977-78 were supported by the BBS. States and provinces showing a 50% or greater drop in 1978 (Table 1) form a core where bluebirds apparently suffered more in the second of two hard winters, despite the fact that the entire eastern population dropped more the first winter (Fig. 3). Not only did the remainder of the range remain stable the second winter, but some states even showed increases.

Figure 6. Invasion of southeastern states by nesting Barn Swallows. BBS data show southern limits of breeding range in 1966 and in 1973.

Table 1. Eastern Bluebird totals for several midwestern states and Ontario using only BBS routes run all four years.

	1975	1976	1977	1978
Illinois	98	117	31	1
Indiana	35	41	15	4
Kentucky	289	210	116	45
Michigan	25	37	13	4
Ohio	134	123	64	35
Ontario	11	13	3	0
Tennessee	281	286	190	73
	873	827	432	162

Populations of many species cannot be subjected to most forms of analysis because of small numbers or limited BBS coverage over the range of the species. For example, the sparse coverage over much of the West makes it difficult to analyze species such as Mountain and Western Bluebirds, whose entire range is in the West. It is hoped that a gradual increase in coverage of western birds will contribute a sufficient amount of reliable baseline data to allow obervation of long-term trends.

An interesting side-line of the BBS is the contribution it has made to distributional records by getting a large number of birders out in areas not otherwise visited, especially in June, when most birding seems to cease. At this time, BBS surveyors have accounted for many unusual records within states. At least three "State firsts" have been recorded: a Gray Kingbird in Maryland, a Great-tailed Grackle in Arkansas and a Cassin's Sparrow in South Dakota.

Help is Needed

BBS coverage is poorest in the least populated parts of North America; Nevada, Utah, Idaho, Wyoming and parts of adjacent states are and probably always will be most desperately in need of increased coverage. There are also many smaller areas of sparse coverage throughout the continent, and replacements are continually needed for observers that drop out for one reason or another. Research projects and summer vacations often put qualified observers in areas where help is needed during June. It is desirable, of course, that each route be run for several years, but even one year is better than none.

Routes can be run by anyone satisfying the necessary qualifications. Observers should, of course, have a full knowledge of bird identification and distribution in their area. Knowledge of bird songs and calls is the most crucial factor as the short time spent at each stop means that most birds recorded on the BBS are heard and not seen. Severe hearing deficiencies brought on by advanced age or medical problems can render the results of a route unusable. As mentioned earlier, valid negative data are an important part of the BBS, thus zeros generated by an observer's lack of knowledge or inability to hear can seriously affect the results.

Generally, state and provincial coordinators find qualified people and refer them to the BBS office. A qualified person can also contact the BBS office directly to find out if a route is available within a reasonable distance. A person of uncertain ability may want to ask about routes already being run nearby on which it is possible to accompany the observer. Interested persons in either category are encouraged to write to the Nongame Section, Migratory Bird and Habitat Research Laboratory, Laurel, Maryland 20811.

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