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# THE BREEDING BIRD SURVEY 1966





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# THE BREEDING BIRD SURVEY, 1966

By

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#### ABSTRACT

A Breeding Bird Survey of a large section of North America was conducted during June 1966. Cooperators ran a total of 585 Survey routes in 26 eastern States and 4 Canadian Provinces. Future coverage of established routes will enable changes in the abundance of North American breeding birds to be measured.

Routes are selected at random on the basis of one-degree blocks of latitude and longitude. Each  $24\frac{1}{2}$ -mile route, with 3-minute stops spaced one-half mile apart, is driven by automobile. All birds heard or seen at the stops are recorded on special forms and the data are then transferred to machine punch cards.

The average number of birds per route is tabulated by State, along with the total number of each species and the percent of routes and stops upon which they were recorded. Maps are presented showing the range and abundance of selected species. Also, a year-to-year comparison is made of populations of selected species on Maryland routes in 1965 and 1966.

# THE BREEDING BIRD SURVEY, 1966

The Breeding Bird Survey is designed to measure changes in abundance of North American breeding birds by surveying populations on a large number of randomly located roadside transects. In the past two decades we have witnessed a drastic change in land use, agricultural practices and environmental polution. With expanding human populations we can anticipate even greater intensity of land use and alteration of wildlife environments.

Except for a few rare and local species, no adequate method has existed for measuring population changes of non-game species on a continental basis. Even after 30 years of Audubon Breeding Bird Censuses we find that only 15 census areas were covered both in 1964 and 1965. This sample, comprising barely 500 acres, includes only small numbers of any one species, and many important species are not included at all.

#### **METHODS**

The method for the Breeding Bird Survey was developed over a period of 15 years using observations from 7 States and Provinces. It was given an intensive field test in Maryland and Delaware in June 1965. The Survey was expanded in 1966 to include all States east of the Mississippi River as well as the eastern Provinces of Canada.

#### Selection of Routes

Each State and Province was assigned a certain number of routes in each degree block of latitude and longitude, the number depending upon the best estimate of potential coverage. An attempt was made to have uniform density of coverage within a State or Province; but density varied from one State to another. Most States and Provinces were assigned at least 2 routes per degree block and there was a maximum density of 16 routes per block in Maryland and Delaware.

The starting point and direction for each route were determined in advance. In many States and Provinces marked maps were supplied to the observers. In other States only the starting point and direction were supplied and the actual route was mapped by the observer. In the future all observers will be provided with marked maps.

The starting points within each degree block were drawn from a table of random numbers, each number representing minutes of latitude and longitude. After locating the intersection of latitude and longitude on a map a conspicuous landmark on the nearest road was named as the starting point. The direction in which the route was to proceed was determined from the last digit in the minutes of latitude and longitude of the starting points. If both latitude and longitude ended in an even number the route proceeded to the north; if latitude was even and longitude was odd the route went east; if latitude was odd and longitude was even the route proceeded south; and if both latitude and longitude ended in an odd number the route proceeded west.

Numbered Interstate, Federal and State highways were avoided as much as possible in order to reduce interference from traffic. Also, roads that might prove impassable in subsequent years were avoided. With these exceptions, each route proceeded as closely as possible in the prescribed direction unless or until it approached either a State line or a degree block boundary. If this happened, the direction of the route turned clockwise and the route continued until 50 stops were completed.

Although routes were laid out in advance wherever possible, provision was made for deviation from the prescribed route in the event of impassable roads or blockage of old roads by new highways. In order for the routes to be duplicated as closely as possible in the future, each observer was asked to mark his actual stopping points on his map. The maps then were returned to the Migratory Bird Populations Station so that master maps could be prepared for future use.

Figure 1 shows the starting points of the 1966 routes as selected for each State and Province by a random drawing. Only those routes that were covered and reported in time to be used in the present analysis are shown.

#### Observer Contacts

To facilitate the organization of the Survey and the selection of competent cooperators to run the routes, a coordinator was selected for each State. The coordinators selected were generally professional ornithologists or individuals especially active in bird work who would be in a good position to direct the activities of birders throughout the State.

#### Coverage

Coverage was standardized as much as possible. Each observer was instructed to start at exactly one-half hour before local sunrise, making 50 stops along a predetermined route. The stops were one-half mile apart, and the observer watched and listened for exactly three minutes at each stop.

The 1966 Survey was scheduled to be completed during June. Several areas in the north were not surveyed until early July, but satisfactory results were obtained. It was realized, and subsequently supported by this year's Survey, that routes in the southern part of the United States should be covered during late May or early June, as vocalization drops off noticeably during June.

Except for certain experimental routes, each was covered once. This report presents an analysis of data obtained on 585 routes that were successfully run in 1966.



Figure 1. Distribution of 1966 Breeding Bird Survey routes

In order to keep variability resulting from weather conditions to a minimum, observers were requested not to run their routes during rainy or foggy weather or if the wind exceeded twelve miles per hour (Beaufort 3). It takes approximately four hours to cover each route.

#### Recording of Data

Figure 2 is a reproduction of an actual field data sheet showing how the observations were recorded. One sheet was used for the first 10 stops, a separate sheet for the next 10, etc. Each bird seen or heard was marked by placing a tick mark in the appropriate column. All birds seen within one-quarter mile of the stop were counted, along with all birds heard, regardless of distance. The quarter-mile distance is judged as one-half the distance from the preceding stop. No effort was made to

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WRITE-ER. NUTHAICH											HUFOUS-SIDED TOWHEE		1	<u> </u>		<u>u</u>			<u>«</u>	4	
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CAROLINA WREN								-			VESPER SPARROW									1	
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Figure 2. Field sheet for recording Breeding Bird Survey data

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VIDER DUCK								LOGGERNEND SHRIPE	6?2	1	3	2	2	-+	8	7
TURKEY VILLTURE			71		7	2	2	STARLING	493		4	4	4	11	13	5
BLACK VULTURE 326								WH. TE-EYED VIREO	631	6	31	2			11	9
RED-TAILED HAWK 337					7	1	1	YE_ OW-SHA V RED	628	1	1			1	2	2
RED-SHOU DEREO HAW*339			i i					SC. ITARY V-RED	6?9					i		
BROAD-WINGED HAWK 343							·	RED-EYED VIRED	624	3				_/_	_4	4-
OSPREY								WARR, ING V 410 -	676	1						
SPARROW HAWK	11	1	12		12	67	22	PROTHONOTIES WARD.	637	-1-						
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WOODCUCK								BLUE-WINGED WARB-	.641							
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RED-BE' IFD WOPPR. 409	2	1	2	3	2	10	8	HODDED WARE ER	684							
HAIRY WOODFECKEP 393	2					2	2	CANADA WAPFLER	686							
DOWNY WOCOPEC/ER 394	1	3	2		3	10	9	AMERICIN REOSTARI	6000		6				-11	8
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ROUGH-WING SWALLOW-617								CAROINAL	593	7	9	18	21	25	80	38
CLIEF SWALLOWALLAS 612								ROSE-B9 GROSBEA	595				-			
PURPLE MARTINAL SOLUTION	-7					1	7	B'UE GROSBEA-	59°		3	2		/	6_	6
BLUE JAY 477	3	5	7	5	9	29	17	INDIGO BUNIING	598	5	Z	10	5	11	_38_	29
COMMON CROW 488	9	7	7		5	28	15	AMER AN GOLDFINE	сн529		12		-	- 77		72
FISH CROW								RUFOUS-SIDED TOW	1 5031	5	-7-	10	3	7	29	- 4.2
BLACK-CAP CHICKADEE 735						- 0		CRASSHOPPER SPAP	-546					-		
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WHITE-SR. NUTHATCH. 727		· '	<u> </u>		+ '		2	SHARO-TA TED SOA	R 549		1	<u> </u>				
BROWN-HEADED NUT								SEASIDE SFARPON	-550							
HOUSE WREN								VESPER SPARTOW	-540	h						
CAROLINA WREN						1	T	SLATE-COL JUNCO			1				7	
LONG-BIL MARSH WREN725								CHIPPING SPARROW	-560			2-	2	5		15
MOCKINGBIR0	4	9	12	13	14	49	33	FILLD SPARROWAND	JOJ _ 584	14	14_	12				1-1-1
CATS IR 0		_4		Ļ	<u>├</u>		3	SONG STARROW -	- 58+				-			<u>  </u>
BROWN THRASHER		4		ŀĻ	+4		13	COOPER HAM	332			17			-7	7
NUB IN	11	7		4		- 2	6	BENICHS WREN	1. 719	-	17	<u>-</u>	3	7	5	5
HERMIT THRUSH	<u> </u> #_			-4-				LARK SPARRO	W 552			2			2	1
VEERY								DICKCISSEL	-604	3	7		T	4	-9.	<u> </u>
E. BLUEBIAD	2	1		3	3	. 9	8			<u> </u>	<b> </b>					
BLUE-GR GNATCATCHER751	3	2.				_ 5	14	ROCK DOVE	.3131		L	1	L			

Figure 3. Summary sheet for recording individual Survey routes

separate birds seen from birds heard, and birds seen in flight were combined with birds seen perched, singing, feeding, etc. Only those birds observed during the 3-minute period were entered on the field sheet. No birds seen while driving from one stop to the next were included unless they were also observed during one of the 3-minute listening periods.

At the conclusion of the 50 stops the data are transferred to a summary sheet (figure 3). The first five columns contain the totals from each of the five field sheets. The next column contains the total number of each species observed on the route. The last column shows the number of stops (out of a possible 50) at which each species was recorded.

#### Analysis of Data

Completed Survey sheets were submitted by the cooperators through the State coordinators or directly to the Migratory Bird Populations Station. An attempt was made to check the summary sheets for accuracy prior to processing; however, responsibility for the accuracy of the transferral of data from field sheets to summary sheets fell upon the individual cooperators. As an additional accuracy check, machine listings were provided for each cooperator with the request that all figures be rechecked.

Since the 1966 reports contained more than one-half million birds, it was essential that the data be transferred to punch cards for machine data processing. One card was prepared for each species recorded on each route; cards were punched directly from the summary sheets. Each card contains information on the route number, State, starting locality, observer, date, species, the number of individuals recorded on each of the five field sheets, the total individuals and the number of stops at which the species was recorded. Each card also contains a code for the life area within which the route was taken. Most States were subdivided into several life areas so that the variance would be computed separately for each major area within a State. The stratification was based on the map of life areas published by Aldrich (1963).

This stratification makes it possible to obtain weighted means and weighted variance, either by individual States, groups of States, or all of the eastern United States and eastern Canada combined. This, in turn, permits us to estimate the number of routes that would be needed to detect a change of a given percentage in the population of any breeding species.

#### Sources of Bias

Several observers expressed the concern that a single coverage of a 50-stop route would not adequately represent the bird population of their area. In Maryland and Delaware, members of the Maryland Ornithological Society and the Delmarva Ornithological Society are assisting with bias studies to determine the representativeness of a single trip, the effects of weather conditions, of date, and the bias inherent in varying ability of different observers.

#### Observer Bias

The observer bias is believed to be the greatest bias in the Survey, and for this reason, a special effort is being made to appraise it. Observers in Maryland and Delaware have been requested to cover a prescribed check route in addition to their regular routes. All of the check routes were covered by the same Bureau employee so that a correction factor could be computed for each species for each observer. Some of the results of these studies are discussed here.

Studies of observer bias indicate that if correction factors are used to compensate for differences in personnel, these must be computed separately for each species. A correction factor based solely upon the ratio of counts made by two observers covering the same route once each is not adequate, especially if they should run it on different days. A correction factor computed from the average of two trips over the same route by each observer is more dependable. In 1967, comparisons will be made of three coverages by Maryland and Delaware observers.

It is, of course, impossible for any observer to record all the birds that are within range of his 50 stops. In fact, it is unlikely that any observer recorded all of the birds at any of his stops. However, since the routes were picked at random, each is to a degree representative of the area in which it is located. The greater the density of routes the more adequately an area is represented. If the same route is covered ten times an average of the ten observations would, of course, come closer to being representative of the population than would a single coverage. On the other hand, ten separate samples within the same general area would be more representative of that area than would ten coverages of exactly the same route.

This can be illustrated by two examples. Figure 4 shows the results of coverage of a single Maryland route by ten observers in 1965 and again by the same ten observers in 1966. The totals each year are similar and there were an equal number of increases and decreases. The means and the 95 percent confidence limits indicated at the right of figure 4 show that there was no significant change in the population of Indigo Buntings on this route from 1965 to 1966.

Consider now the Blue Jay sightings for the same ten observers on the same Maryland route, as shown in figure 5. Nine of the ten observers recorded a decrease in Blue Jays and, as we see from the mean numbers of Blue Jays and the 95 percent confidence limits, there was a significant decrease in the Blue Jay population along this route. However, it happened that other routes in the same part of the State did not show a decrease. Neither was there a decrease for the State as a whole; so, although the decrease on this particular route was well substantiated, this intensive coverage gave a false picture of the actual change in population in that part of Maryland.

7



Figure 4. Comparison of Indigo Bunting population on Maryland Route P-1 as recorded by 10 observers, 1965 and 1966.



Figure 5. Comparison of Blue Jay population on Maryland Route P-1 as recorded by 10 observers, 1965 and 1966.

#### Seasonal Changes

For some species there may be considerable bias if counts are not taken at about the same date each season. This can be shown by an extreme example, the Downy Woodpecker. Figure 6 shows a summary of Downy Woodpecker counts obtained on 34 trips (1965-66) over the same Maryland route. These counts are combined by 10-day periods and a mean for each period is shown on the graph. The increase in numbers of woodpeckers recorded as the season progresses is quite striking, since we are sampling not only the adult population but an increasing number of young birds. Furthermore, the adults are very quiet shortly before the young leave the nest. However, for the first few weeks after the young leave the nest, both adults





and young become increasingly noisy. As long as we are aware of the bias caused by date of coverage, we can correct for this in the analysis.

#### Time of Day

It is a well-known fact that many species are more conspicuous in the early morning than later in the day. This matter received careful study and the recommended number of stops was determined partly on the basis of the optimum period for observing birds. It is quite obvious that species such as owls, goatsuckers, and pheasants are recorded in greatest numbers before or at dawn. Other species do not reach their peak of activity until after sunrise. There is no time of day when all species are at a peak of activity, so any observation period is of necessity a compromise if one is attempting to obtain information on all species simultaneously.

Some observers felt that 50 stops were too many and that there was a substantial decrease in singing at the last 10 stops. One of the purposes for entering the data on the punch cards by 10-stop periods was to permit easy analysis of any change in activity as the morning progressed. The graph at the top of figure 7 shows how the percentage of total birds recorded changed, from one 10-stop period to the next. Note that the observations for all species combined reached a peak in the second period and that there was a relatively slight, although steady, decline through the remaining periods.

Feeling that those birds that are detected almost entirely by sound might show a greater decline than was observed for all species combined, a separate analysis was made for the wood warbler family, Parulidae. The graph at the center of figure 7 demonstrates almost exactly the same slight decrease as shown for all species combined.

Although the average number of birds per stop would have been higher with a smaller number of stops, the total data gathered was enhanced considerably by including the full 50 stops. As long as the variability is not affected greatly by the additional stops, it seems desirable to continue with full 50-stop coverage.

In contrast to the small change in conspicuousness of wood warblers, and of all birds combined, there was a marked decline in all of the thrushes as the morning progressed. This is illustrated by the Wood Thrush data at the bottom of figure 7. As long as samples are large enough to demonstrate the normal decrease in activity as the morning progresses, this decline in conspicuousness does not in any sense invalidate the reliability of the Survey. A conspicuousness factor for each 10-stop period could be computed from figure 7 if one wished to compensate for the decrease in singing and estimate the relative numbers of birds present but not recorded. Actually, the Breeding Bird Survey does not pretend to measure the number of birds present in an area, but provides an index of abundance that can be used for detecting changes from year to year. It samples most effectively those species that are most readily seen and most frequently heard.



Figure 7. Effect of time of day

#### Weather

Study of the Survey data has shown that wind speed, temperature and cloud cover all have an effect on the number of birds recorded. By discouraging coverage on windy (over 12 m.p.h.), foggy, or rainy days, the weather bias can be kept within reasonable bounds. Even so, statistical analyses will be run to determine whether correction factors are needed to compensate for the more subtle differences in weather conditions.

#### Distribution of Survey Data

Duplicate copies of the individual Survey route listings were supplied to each State coordinator. In addition, various tabulations were supplied to the State coordinators and to the regional editors of Audubon Field Notes.

#### RESULTS

#### Population Status

Table 1 summarizes the totals reported for each species. It must be stressed that these figures do not represent abundance of one species in relation to other species; the species most readily observed on roadside counts will be found in greater numbers in relation to their true abundance than will inconspicuous species, species that are difficult to identify, or species found in habitats such as marsh or swampland that are not sampled by roadside observations to the same degree as is farmland.

The three figures given after each species in the table are the total individuals recorded, the percentage of routes on which the species was recorded, and the percentage of stops (of 29,250) at which each species was observed.

No species was recorded on all routes. The Red-winged Blackbird and Common Crow came closest, with one or more individuals on 99 percent of all routes. These were closely followed by the Starling (97 percent) and the Common Grackle (98 percent).

At the bottom of table 1 are a few species that were not breeding birds in the area from which they were reported. These were non-breeding stragglers or late migrants, principally shorebirds, that were observed along the routes but are not properly part of the survey. Other species that were reported in States where they do not breed are indicated by parentheses. One of the principles of random sampling is that nothing be left up to the individual judgment of observers. Consequently, it was requested that all birds identified be reported. It is quite appropriate for the observer to add notations regarding the status of any birds he does not believe to be breeding in the area sampled, but the observer

		Percent	Percent			Percent	Percent
Species	Total	Routes	Stops	Species	Total	Routes	Stops
Common Loon	36	3.25	.109	Marsh Hawk	29	3.59	.092
Pied-billed Grebe	26	2.22	.085	Osprey	29	2.91	.096
Brown Pelican	23	.68	.044	Pigeon Hawk	1	.12	.003
Double-cr.Cormorant	138	2.05	.123	Sparrow Hawk	313	24.27	.868
Anhinga	20	2.05	.068	Spruce Grouse	1	.12	.003
Gt. White Heron	7	.17	.023	Ruffed Grouse	39	4.44	.126
Gt. Blue Heron	264	15.04	.670	Bobwhite	14,623	67.01	28.789
Green Heron	429	32.48	1.220	Ring-necked Pheasant	1358	23.42	3.309
Little Blue Heron	355	8.89	540	Grav Partridge	4	. 34	.007
Cattle Egret	1014	6.50	.724	Turkey	12	1.03	.024
Reddish Egret	2021	34	.010	Sandhill Crane	12	.86	.031
Common Egret	750	8.03	.574	Limpkin	17	.68	.048
Snow Egret	245	2 74	.112	King Rail	6	.68	.017
Louisiana Heron	125	2 05	104	Clapper Bail	8	1.03	.021
Blk-or Night Heron	52	2.07	085	Virginia Bail	6	1.03	.021
Vellow-on Night Heron	30	2.30	.009	Sora	13	1.54	.038
Teact Bittom	ےر 7	2•J7 85	.020	Pumle Callinule	2 7 J	зр т•)+	.007
Am Bittom	).)	2.10	<u>י</u> ער.	Common Gallinule	24	1 88	.001
Mand Thig	), 1	4.10	• 141	American Coot	<del>4</del>	68	.020
Glosgy This	41 25	.00	.020	Wilson's Ployer	2	-00 -3h	007
Unite This	) 557	1.20 0.7h	.050	Willdoor	1320	57 00	3 265
White Crop		∠• [4 2)	· 229	Am Woodcook	2020	21.02	055
Mute Swan	)7 25	• 54	.034	Common Snipe	171	8 21	523
Valland	718	.05	.050	Unland Ployon	155	7 60	- 220
Mallard	102	9•91 E 81	• 491	Spotted Sandnipon	82	1.09	- 75T
Black Duck	223	2.01	• 14 (	Soliter Sandpiper	00	9.00	.245
Mottled Suck	<u> </u>	1.03	.044	Willot	81	- IC 0 56	150
Pintall		.00	.014	WILLED	11	2.00	.1)4
Green-winged Teal	12	•51 2 bo	.010	Black-necked Still	11	• ) I	.10.
Blue-winged Teal	60	3.42	.000	Wilson's Phalarope	5	• 34	.010
Am. Widgeon	1	.17	.003	Gt.Black-backed Gull	130	2.05	.140
Wood Duck	117	10.00	.215	Herring Gull	1300	1.01	•921
Ring-necked Duck	j(	.68	.014	Ring-billed Gull	331	2.91	.144
Lesser Scaup	4	• 34	.010	Laughing Gull	990	3.42	•513
Common Goldeneye	7	.17	•00'	Gull-billed Tern	ځ	• 34	.014
Common Eider	3	.17	.003	Forster's Tern	25	1.03	.024
Common Scoter	1	.17	.003	Common Tern	18.	3.08	.202
Hooded Merganser	3	.51	.010	Arctic Tern	- 2	• 17	.003
Common Merganser	18	1.88	.044	Least Tern	148	1.37	.129
Red-breasted Merganser	r 1	.17	.003	Royal Tern	53	.86	.047
Turkey Vulture	792	28.72	1.411	Caspian Tern	1	.17	.003
Black Vulture	213	8.03	.280	Black Tern	120	2.91	.129
Swallow-tailed Kite	14	• 34	.014	Black Skimmer	13	.85	.02.(
Mississippi Kite	6	.86	.021	White-crowned Pigeon	10	.17	•239
Sharp-shinned Hawk	11	1.88	.038	Rock Dove	5642	52.14	3.938
Cooper's Hawk	25	3.59	.079	Mourning Dove	12,431	85.47	23.022
Red-tailed Hawk	133	16.58	.420	Ground Dove	251	4.96	•568
Red-shouldered Hawk	163	10.09	.482	Yellow-billed Cuckoo	1801	50.60	5.241
Broad-winged Hawk	56	7.52	.171	Black-billed Cuckoo	188	16.75	.602
Rough-legged Hawk	1	.12	.003	Barn Owl	2	• 34	.007
Golden Eagle	1	.12	.003	Screech Owl	13	1.54	.034
Bald Eagle	2	.12	.007	Great Horned Owl	19	2.39	.062

# Table 1. Total individuals and frequency of detection, by species (Continued)

		Percent	Percent			Percent	Percent
Species	Total	Routes	Stops	Species	Total	Routes	Stops.
Burrowing Owl	29	.17	.020	Mockingbird	10,010	59.15	21.234
Barred Owl	47	6.15	.137	Catbird	4405	82.74	11.647
Chuck-will's-widow	323	15.90	.721	Brown Thrasher	2677	81.37	7.405
Whip-poor-will	209	14.36	.478	Robin	20,661	87.01	36.585
Common Nighthawk	439	15.90	•954	Wood Thrush	5795	73.85	13.326
Chimnev Swift	6432	83.93	8.793	Hermit Thrush	462	13.68	1.279
Ruby-thr.Hummingbird	200	22.05	.612	Swainson's Thrush	567	7.86	1.415
Belted Kingfisher	290	30.94	.879	Gray-cheeked Thrush	2	.17	.007
Yel-shafted Flicker	3386	91.45	9.928	Veerv	1552	23.93	4.048
Pileated Woodpecker	374	28.03	1.193	Eastern Bluebird	2365	61.03	5.189
Red-bellied Woodpecker	2361	53,33	6.629	Blue-gray Gnatcatcher	761	33.85	2.014
Red-headed Woodpecker	750	29.23	2.079	Golden-crowned Kingle	. 24	1.54	.051
Yel-bellied Sapsucker	389	11.11	1,100	Ruby-crowned Kinglet	548	5.98	1,590
Hairy Woodpacker	280	28 72	.879	Codar Waywing	1110	28.03	1 785
Dormy Woodpecker	1281	67 01	3,935	Loggerhead Shrike	780	25.08	2 051
Ped accladed Weedbacks	m 7	68	014	Stenling	107	05 72	20.258
Red-Cockaded Woodpecke	- 087h	81 20	7 576	White and Wiree	1688	22.13	1 561
Case Vin abiad	2014	17	051	Pollig Vinco	20001	40.00	4. 004
Gray Kingbird	- 26	• - 1		Nelles the Vines	EOG	22.16	1 600
Gt. Crested Flycatcher	1 2000	[<•33 E7 78	2.002	Yellow-unr. Vireo	220	55.10	1.000
Eastern Phoebe	134 ( 	21.10	2•773 184	Solitary Vireo	01	0.15	.200
Yel-bellied Flycatcher	24	3.42	.104	BIK-Whiskered Vireo	14	• 34	.034
Acadian Flycatcher	(22	30.06	2.130	Red-eyed Vireo	5097	01.20	14. (21
Traill's Flycatcher	(24	22.91	5.110	Philadelphia Vireo		•51	.017
Least Flycatcher	1099	25.04	3.091	Warbling Vireo	649	20.55	1.959
E. Wood Pewee	2624	70.29	7.039	Black-&-white Warble:	r 509	28.30	1.559
Olive-sided Flycatcher	• 68	5.01	•232	Prothonotary Warbler	Τ.(Τ	12.14	.444
Horned Lark	1684	36.24	3.121	Swainson's Warbler	3	• 34	.00'
Tree Swallow	1712	29.06	2.834	Worm-eating Warbler	68	6.67	.218
Bank Swallow	1806	T8.63	.824	Golden-winged Warble:	r 82	4.62	.243
Rough-winged Swallow	560	26.50	.800	Blue winged Warbler	122	8.89	• 369
Barn Swallow	9143	82.22	12.643	Tennessee Warbler	106	3.59	• 325
Cliff Swallow	886	14.70	.827	Nashville Warbler	255	9.40	.800
Purple Martin	3769	56 <b>.</b> 58	4.010	Parula Warbler	470	20.85	1.299
Gray Jay	34	2.05	.072	Yellow Warbler	1893	47.86	5.562
Blue Jay	8762	94.53	18.851	Magnolia Warbler	537	9.40	1.419
Scrub Jay	11	.17	.270	Cape May Warbler	4	51	.014
Common Raven	359	9.40	•725	Blk-throated Blue Wa	rb. 68	5.98	.202
Common Crow 1	.6,657	98.12	30.147	Myrtle Warbler	149	7.35	.472
Fish Crow	720	12.99	1.197	Blk-thr. Green Warble	er 319	13.85	•923
Black-capped Chickadee	e 813	30.26	2.150	Cerulean Warbler	135	8.38	• 390
Carolina Chickadee	1655	43.42	3.614	Blackburnian Warbler	- 29	7.69	• 324
Boreal Chickadee	<b>5</b> 6	2.91	.168	Yellow-thr. Warbler	161	9.57	-458
Tufted Titmouse	3583	63.42	9.781	Chestnut-sided Warble	er 1054	21.88	3.135
White-br. Nuthatch	399	29.74	1.207	Bay-breasted Warbler	71	2.56	•225
Red-breasted Nuthatch	34	3.93	.113	Blackpoll Warbler	21	1.03	.062
Brown-headed Nuthatch	187	8.55	.366	Pine Warbler	498	20.00	1.330
Brown Creeper	14	2.05	.044	Prairie Warbler	1114	29 <b>.57</b>	2.875
House Wren	2335	52.48	6.663	Palm Warbler	24	. •51	.014
Winter Wren	172	7.18	.550	Ovenbird	2086	42.91	5.624
Bewick's Wren	120	6.84	• 359	Northern Waterthrush	113	6.67	• 335
Carolina Wren	2547	48.03	6.923	Louisiana Waterthrus	h 111	9.91	.331
Long-billed Marsh Wrer	108	3.93	.157	Kentucky Warbler	473	23.93	1.432
Short-billed Marsh Wre	en 150	4.62	.328	Mourning Warbler	112	5.13	•379

# Table 1. Total individuals and frequency of detection, by species (Continued)

		Percent	Percent			Percent	Percent
Species	Total	Routes	Stops	Species	Total	Routes	Stops
Yellowthroat	7103	89.57	19,224	Dickcissel	1860	19.82	3.262
Yellow-br. Chat	4342	52.14	11.084	Evening Grosbeak	143	2.56	209
Hooded Warbler	310	15.90	.885	Purple Finch	516	18.12	1.368
Wilson's Warbler	23	1.20	.075	House Finch	24	.51	. Ol+l+
Canada Warbler	184	8.03	.561	Pine Grosbeak	11	.85	.031
American Redstart	1252	35.56	3.607	Pine Siskin	62	2.74	.126
House Sparrow	48,238	93.16	25.665	Am. Goldfinch	5529	77.61	10.725
Bobolink	2563	33.50	4.715	White-winged Crossbil	1 4	.17	.010
E. Meadowlark	13,493	87.52	23.282	Rufous-sided Towhee	7478	81.37	17.340
W. Meadowlark	1730	10.94	3.142	Savannah Sparrow	2708	27.01	5.224
Yel-headed Blackbird	18	.68	.034	Grasshopper Sparrow	1793	40.51	4.301
Red-winged Blackbird	46,612	98.12	34.397	Henslow's Sparrow	84	6.15	.215
Orchard Oriole	1702	38.80	4.455	Sharp-tailed Sparrow	35	.85	.061
Spotted-breasted Orio	ole l	.17	.003	Seaside Sparrow	26	1.03	.041
Baltimore Oriole	1354	48.72	3.918	Vesper Sparrow	1657	33.16	4.154
Rusty Blackbird	23	2.56	.072	Lark Sparrow	36	1.88	.072
Brewer's Blackbird	119	2.56	.164	Bachman's Sparrow	156	4.79	.321
Boat-tailed Grackle	617	3.25	.632	Slate-colored Junco	615	10.77	1.720
Common Grackle	49,750	97.26	33.108	Chipping Sparrow	6018	83.07	14.756
Brown-headed Cowbird	5852	86.32	10.940	Clay-colored Sparrow	116	3.42	.301
Scarlet Tanager	1083	41.20	3.303	Field Sparrow	7488	77.26	17.737
Summer Tanager	1097	32.65	3.214	White-throated Sparro	w 2364	17.61	5.487
Cardinal	12,749	77.78	27.005	Fox Sparrow	. 4	.17	.014
Rose-breasted Grosbea	<b>a</b> k 718	24.10	2.116	Lincoln's Sparrow	43	1.71	.133
Blue Grosbeak	923	25.30	2.492	Swamp Sparrow	258	13.85	.649
Indigo Bunting	10,462	84.62	24.130	Song Sparrow	10,610	73.85	24.844
Painted Bunting	59	1.88	.150				

Transients and non-breeding stragglers recorded on Survey: Magnificent Frigatebird, Whistling Swan, Common Scoter, Rough-legged Hawk, Semipalmated Plover, Black-bellied Plover, Ruddy Turnstone, Greater Yellowlegs, Lesser Yellowlegs, Knot, Dunlin, Short-billed Dowitcher, Semipalmated Sandpiper, Western Sandpiper, Sanderling.

cannot be expected to separate all breeding birds from non-breeding birds; if observers were asked to do this, it certainly would not be done uni-formly on all routes.

This does not mean that all birds reported are accepted as breeding records--which many certainly are not--but it does permit the uniform treatment of obvious transients, non-breeding gulls and terns, summering non-nesting shorebirds, and others.

Table 2 summarizes the average number of birds reported per route in each State and Province. The States are arranged geographically, from Mississippi and Alabama north to Wisconsin and Michigan and then from Florida north to the Provinces of New Brunswick and Quebec. This arrangement should facilitate comparison of abundance from one State or Province to another. All averages are rounded to the nearest whole number. A plus sign (+) indicates an average of less than one-half bird per 50-stop route. Table 2. Average number of birds per 50-stop route, by States and Provinces

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Table 2. Average number of birds per 50-stop route, by States and Provinces (Continued)

Species	AOU N	Ais A	la Te	ų M	(y Il	1 Inč	1 Ohi	Wis	Mic	Fla	Ga	SC	NC	Va D	el l	Md WV	B.N.	ч Г	RI	Con	Mas	М	۲ţ	H	Me	IS PE	E H	Que
Swallow-tailed Kite	327									- ·																		
Mississippi Kite	329	+	÷		+		+	,		+							+		+				+	+				
Const's Hand	1000	+	+	+	- +	-	+ 	+	+	+	+	+	+			+	+		+									
Red-tailed Hawk	337		+	+	÷	ר ה	+	+	+	+	+	+	+	+	1	+		+	+	Ч		+	+	+		+		
Red-shouldered Hawk	339	+	+	+	+	+	+	+		5	+	.Τ	+				+		+			+	+	+				
Broad-winged Hawk	343		+	+		,	+	+					+	+	+	+	+		+	_,		+	ŧ	+				
Golden Eagle	349																					+						
Bald Eagle	352															+			4						÷			
Marsh Hawk	122			+			+		•	-			-		r	-		+							-	-		
Osprey	364									+			t			+										-1	•	L .
Pigeon Hawk	357	-	-		-	C	-	-	~	-	4		4	4	4	ч	-+		-+	~	~	~	+	4	~	+		-
Sparrow Hawk		÷	÷	F	-	v		-	-H	+	ŀ		-	-	-	÷	-		-	~	+	4	-	-	ł			
Buffed Grouse								+								+		+	+		+	+	+	+	+	+		
Bobwhite	289	19	09	54 25	24 2	3 35	2 50	-	15	23	5	68	57	61	128	18	6 2	0	4	7	22	N				-		
Ring-necked Pheasant	1.60%	`	,			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	~7" +	4	16					+	-	$\sim$	+		EI 0		~	m		+		+		
Gray Partridge	288.1							. +																				
Turkey	310		+		+														+									
Sandhill Crane	206							1	+	+								_								-		
Limpkin	207			-						1								 										
King Rail	208									+																		
Clapper Rail	211		+							+	+	+	+									+						
Virginia Rail	212															+						+						
Sora	214		+				_	+																				+
Purple Gallinule	218		+	-							+																	
Common Gallinule	219		+					+	,	~~~	+										_							
Am. Coot	221		+	+						+													+		+			
Wilson's Plover	280									+												-				-		
Killdeer	273	1	CJ	1	CV.	N	2	u^ →	5	1	+		+		1	r,	_		2	U 1		4	CU I	+	21	┥		1
Am. Woodcock	228							+	+			+		+	+	+					+			+	-		- 1	
Common Snipe	230							-	+								+		+			+	+	+		5		
Upland Plover	261						+	_	+						-	÷	+		+			r			÷	r	-	Υ.
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#### Population Trends

Twenty-eight Maryland routes were covered by the same observers in both 1965 and 1966. Figure 8 shows the mean population index and fiducial limits (95 percent confidence interval) for five species. There was no change from 1965 to 1966 in populations of the Carolina Wren or the Yellowthroat. A decline is suggested for the Eastern Bluebird and the Song Sparrow, but the number of comparable routes is too small to demonstrate that the decline was statistically significant. There was, however, a significant increase in Downy Woodpeckers, and we hasten to point out that this increase was not a result of the date bias discussed on page 9. The mean date of coverage of these routes in 1966 was just one day later than in 1965.

The principal objective of the Breeding Bird Survey is to measure changes on a regional or continental scale. By feeding the raw data, plus the necessary weighting factors, into an electronic computer such as the UNIVAC 1004 we can, within seconds, obtain weighted means and weighted variance; and from this we can predict the minimum population change that can be detected if a given number of routes are surveyed in two consecutive years.





If, for example, the same 585 routes are run again in 1967, we would be able to detect a change of 10 percent or greater in populations of the Blue Jay, Catbird, Robin, Yellowthroat, or Indigo Bunting. There is a little more variability between routes for species such as the Mourning Dove, Yellow-shafted Flicker, Cardinal, Chipping Sparrow, and Song Sparrow, but the 1966 data suggest that a change of 12 percent could be detected in any of these. For most species, a change of between 10 and 20 percent could be detected.

On a State or Provincial basis where there are 40 or 50 routes per State, few changes in population could be documented unless the change exceeded 30 or 40 percent. However, by combining several adjacent States or Provinces, much smaller changes could be detected.

#### Mapping of Relative Abundance

One advantage of an electronic computer is that totals for a given species can be plotted directly on maps in such a way that relative abundance can be shown without going through the tedious procedure of locating hundreds of positions on maps and indicating the relative abundance in each of these positions. Figure 9 shows a sample map that was prepared by the UNIVAC 1004 and Figures 10 through 21 show how appropriate shading can be applied by hand onto a map that has been machine printed with the field data. This is the first time that it has been possible to map relative abundance of breeding songbirds throughout a large portion of their range.



Figure 9. Portion of Rufous-sided Towhee distribution and abundance map prepared by UNIVAC 1004. All numbers on this map are less than 100.



Figure 10. Bobwhite distribution, 1966



Figure 11. Mourning Dove distribution, 1966



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Figure 12. Red-bellied Woodpecker distribution, 1966



Figure 13. Carolina Wren distribution, 1966



Figure 14. Mockingbird distribution, 1966



Figure 15. Warbling Vireo distribution, 1966



Figure 16. Prothonotary Warbler distribution, 1966



Figure 17. Orchard Oriole distribution. 1966



Figure 18. Blue Grosbeak distribution, 1966



Figure 19. Rufous-sided Towhee distribution, 1966









#### FUTURE PLANS

It is planned to extend the Breeding Bird Survey in the summer of 1967 to include Ontario, Manitoba, and all States west through the Dakotas, Nebraska, Kansas, Oklahoma, and Texas; and by the summer of 1968, we hope to include the remainder of the continental United States and the accessible portions of Canada.

In order to achieve the best possible comparisons between years. as many routes as possible should be covered by the same observer who ran them in 1966. Coverage should be scheduled for approximately the same date insofar as possible.

#### ACKNOWLEDGMENTS

The Breeding Bird Survey would not have been possible without the wholehearted and enthusiastic cooperation of the coordinators for each State and Province. Their job was especially difficult in this first year of the Survey, but the splendid coverage that was achieved surpassed expectations. It is difficult to single out some coordinators for special mention since the efforts of each coordinator and, in many cases, several of the very capable assistants, contributed so much to the success of the Survey. We feel, however, that the following persons deserve special thanks for the tremendous amount of effort that they expended to assure that there would be fairly complete coverage of their State or Province. In many cases these individuals personally covered several routes in areas that otherwise would not have been covered: Ben B. Coffey, Dr. James B. Cope, Dr. Anthony J. Erskine, Thomas Foster, Dr. Katherine Goodpasture, Dr. George A. Hall, Mrs. Vera Hebert, Dr. Joseph Howell, Thomas A. Imhof, Dr. Burt L. Monroe, Jr., Dr. James F. Parnell, Rev. Samuel D. Robbins, Paul Schwalbe, Winslow Shaughnessy, William Turcotte, and Dr. Milton B. Trautman.

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