

A COMPARATIVE STUDY
OF THE BREEDING BIRD POPULATION
OF THE SHENANDOAH MOUNTAINS, VIRGINIA

BY ROBERT E. STEWART

WHILE working on habitat studies of the Ruffed Grouse (*Bonasa umbellus*) in the George Washington National Forest during the late spring and early summer of 1941, the author found it possible to carry out a supplemental study on the relative abundance of the breeding birds of the area. Since considerable time was spent in traversing certain sections of the forest in search of Ruffed Grouse broods, an unusual opportunity was afforded to make a general comparative census of the species of birds found therein.

The original intention was to obtain data on the relative abundance of the birds found in the various types of habitat within the area. However, it was soon found to be impracticable to carry out such a study with any degree of accuracy, since the various forest types were found to be overlapping and intermixed to such an extent that it was not possible to segregate them into separate areas except in a very general way. Consequently, it was necessary to limit the objective to a study of the comparative abundance of the birds found in the general region.

The area selected for this study was sufficiently restricted in size so that it was possible to cover it fairly well during the course of one month. This area comprises approximately 135 square miles and is located in the Shenandoah Mountains, Augusta and Highland counties, Virginia. It is bounded by Narrow-back Ridge on the east, by 'Briary Branch-Reddish Knob Road' and the Virginia-West Virginia boundary on the north, by 'Cow Pasture River Valley Road' on the west, and by U. S. Highway No. 250 and an imaginary line running from Lebanon to Stokesville on the south.

In order to be more certain that the study was restricted to the breeding birds of the region, only observations made during the month of June were included in the data. All birds found in the region during this month were believed to be breeding species, with the possible exception of the Redstart (*Setophaga ruticilla*). Only one individual of this species was recorded; and since that was on June 1, this bird may have been a late migrant.

The census procedure was simple. Whenever it was possible to devote full attention to the birds in the immediate surroundings, all individuals (adults or full-fledged young of adult size) that were either seen or heard and that could be positively identified were re-

corded. Special effort was made to walk at a fairly constant pace and to cover the various habitats in such a manner that the amount of time spent in each was as nearly as possible proportional to the relative extent of each within the region. The time consumed in conducting this census aggregated exactly 48 hours. The resulting totals do not by any means represent all the individuals observed during the entire period of stay in the area, but only those recorded during the time that a regular census was being taken.

National Forest land, with altitudes ranging up to 4410 feet, comprises more than 95 per cent of the study area. With the exception of a few isolated, brushy, old clearings, this land is overgrown with timber of various kinds, mostly second growth. The census method used in this study seemed to work very well on this type of land.

On the outer margins of the National Forest are found small private holdings of farm lands comprising a heterogeneous mixture of farm yards, small pastures, and fields. Because of their small size and patchwork composition, the census method employed was not found to be practicable for these farms. Inasmuch as several species of breeding birds found on them were not observed elsewhere within the study area, they are listed separately below, without any attempt to indicate their relative abundance:

- Quail (*Colinus virginianus*)
- Killdeer (*Oxyechus vociferus*)
- Kingbird (*Tyrannus tyrannus*)
- Barn Swallow (*Hirundo erythrogaster*)
- Cliff Swallow (*Petrochelidon albifrons*)
- House Wren (*Troglodytes aëdon*)
- Bluebird (*Sialia sialis*)
- Starling (*Sturnus vulgaris*)
- Yellow Warbler (*Dendroica aestiva*)
- English Sparrow (*Passer domesticus*)
- Meadowlark (*Sturnella magna*)
- Red-winged Blackbird (*Agelaius phoeniceus*)
- Grasshopper Sparrow (*Ammodramus savannarum*)
- Vesper Sparrow (*Poocetes gramineus*)

The Rough-winged Swallow (*Stelgidopteryx ruficollis*) should be mentioned here, as it was observed only at the small lake formed by the Staunton dam, a type of habitat that is foreign to this mountainous region.

Other birds observed that would not be adequately represented in the comparative type of census are those that are inactive during the greater part of the daylight hours. The species falling into this category are: Barred Owl (*Strix varia*), Screech Owl (*Otus asio*), Whip-

poor-will (*Antrostomus vociferus*), and the Nighthawk (*Chordeiles minor*). Since no definite recorded data were obtained on their relative abundance, the following classification is derived from general observations only: Barred Owl, common; Screech Owl, uncommon; Whip-poor-will, abundant; and Nighthawk, rare.

The data pertinent to the relative abundance of the species of birds observed within the study area, with the exception of those that have already been listed, are presented in the following tables. The frequency classes depicting relative abundance used in these tables are listed as follows: abundant, plentiful, common, occasional, uncommon, and rare. The average number of individuals observed and heard, 31 per species, is used as the median point in the class definitions. The range of figures below the median figure (1-31) is divided into three classes that are approximately equal in size: rare, 1-10; uncommon, 11-20; and occasional, 21-31. The range of figures above the median point (32-275) is also divided into three classes that are about equal in size. These are defined as follows: common, 32-113; plentiful, 114-194; and abundant, 195-275. The data relating to the comparative populations of the larger taxonomic groups are also summarized in these tables, so as to indicate the size ratios and prevalence of each within the area.

TABLE 1
BIRDS RECORDED, LISTED BY SPECIES

Name	No. seen	No. heard but not seen	Total	Percentage	Relative abundance
Turkey Vulture (<i>Cathartes aura</i>)	18	—	18	0.83	Uncommon
Black Vulture (<i>Coragyps atratus</i>)	1	—	1	0.05	Rare
Cooper's Hawk (<i>Accipiter cooperi</i>)	1	—	1	0.05	Rare
Red-tailed Hawk (<i>Buteo borealis</i>)	4	1	5	0.23	Rare
Red-shouldered Hawk (<i>Buteo lineatus</i>)	1	—	1	0.05	Rare
Broad-winged Hawk (<i>Buteo platypterus</i>)	2	—	2	0.09	Rare
Ruffed Grouse (<i>Bonasa umbellus</i>)	32	2	34	1.57	Common
Wild Turkey (<i>Meleagris gallopavo</i>)	2	—	2	0.09	Rare
Woodcock (<i>Philohela minor</i>)	10	—	10	0.46	Rare
Spotted Sandpiper (<i>Actitis macularia</i>)	1	—	1	0.05	Rare
Mourning Dove (<i>Zenaidura macroura</i>)	3	—	3	0.14	Rare
Yellow-billed Cuckoo (<i>Coccyzus americanus</i>)	3	12	15	0.69	Uncommon
Black-billed Cuckoo (<i>Coccyzus erythrophthalmus</i>)	2	1	3	0.14	Rare
Chimney Swift (<i>Chaetura pelagica</i>)	9	—	9	0.42	Rare
Ruby-throated Hummingbird (<i>Archilochus colubris</i>)	5	—	5	0.23	Rare
Belted Kingfisher (<i>Megasceryle alcyon</i>)	1	—	1	0.05	Rare
Flicker (<i>Colaptes auratus</i>)	8	8	16	0.74	Uncommon
Pileated Woodpecker (<i>Ceophloeus pileatus</i>)	3	23	26	1.20	Occasional
Yellow-bellied Sapsucker (<i>Sphyrapicus varius</i>)	7	—	7	0.32	Rare
Hairy Woodpecker (<i>Dryobates villosus</i>)	8	—	8	0.37	Rare

TABLE 1—(Continued)

Name	No. seen	No. heard but not seen	Total	Percentage	Relative abundance
Downy Woodpecker (<i>Dryobates pubescens</i>)	5	—	5	0.23	Rare
Crested Flycatcher (<i>Myiarchus crinitus</i>)	3	19	22	1.02	Occasional
Phoebe (<i>Sayornis phoebe</i>)	6	7	13	0.60	Uncommon
Acadian Flycatcher (<i>Empidonax virescens</i>)	4	26	30	1.39	Occasional
Least Flycatcher (<i>Empidonax minimus</i>)	2	1	3	0.14	Rare
Wood Pewee (<i>Myiochanes virens</i>)	5	61	66	3.06	Common
Blue Jay (<i>Cyanocitta cristata</i>)	7	13	20	0.93	Uncommon
Raven (<i>Corvus corax</i>)	6	—	6	0.28	Rare
Crow (<i>Corvus brachyrhynchos</i>)	18	36	54	2.50	Common
Chickadee (<i>Penthestes</i> sp.)	24	27	51	2.36	Common
Tufted Titmouse (<i>Baeolophus bicolor</i>)	2	23	25	1.16	Occasional
White-breasted Nuthatch (<i>Sitta carolinensis</i>)	6	3	9	0.42	Rare
Carolina Wren (<i>Thryothorus ludovicianus</i>)	7	6	13	0.60	Uncommon
Catbird (<i>Dumetella carolinensis</i>)	4	3	7	0.32	Rare
Brown Thrasher (<i>Toxostoma rufum</i>)	11	1	12	0.56	Uncommon
Robin (<i>Turdus migratorius</i>)	10	5	15	0.69	Uncommon
Wood Thrush (<i>Hylocichla mustelina</i>)	6	75	81	3.75	Common
Veery (<i>Hylocichla fuscescens</i>)	3	3	6	0.28	Rare
Cedar Waxwing (<i>Bombycilla cedrorum</i>)	23	—	23	1.07	Occasional
Yellow-throated Vireo (<i>Vireo flavifrons</i>)	2	—	2	0.09	Rare
Mountain Vireo (<i>Vireo solitarius</i>)	10	6	16	0.74	Uncommon
Red-eyed Vireo (<i>Vireo olivaceus</i>)	6	224	230	10.65	Abundant
Black and White Warbler (<i>Mniotilta varia</i>)	29	83	112	5.19	Common
Worm-eating Warbler (<i>Helmitheros vermivorus</i>)	7	15	22	1.02	Occasional
Golden-winged Warbler (<i>Vermivora chrysoptera</i>)	5	10	15	0.69	Uncommon
Parula Warbler (<i>Compsothlypis americana</i>)	4	96	100	4.63	Common
Magnolia Warbler (<i>Dendroica magnolia</i>)	5	—	5	0.23	Rare
Cairns's Warbler (<i>Dendroica caerulescens</i>)	17	51	68	3.15	Common
Black-throated Green Warbler (<i>Dendroica virens</i>)	8	50	58	2.69	Common
Blackburnian Warbler (<i>Dendroica fusca</i>)	7	57	64	2.96	Common
Chestnut-sided Warbler (<i>Dendroica pensylvanica</i>)	11	23	34	1.57	Common
Prairie Warbler (<i>Dendroica discolor</i>)	2	30	32	1.48	Common
Oven-bird (<i>Seiurus aurocapillus</i>)	34	241	275	12.73	Abundant
Louisiana Water-thrush (<i>Seiurus motacilla</i>)	12	28	40	1.85	Common
Maryland Yellow-throat (<i>Geothlypis trichas</i>)	5	13	18	0.83	Uncommon
Yellow-breasted Chat (<i>Icteria virens</i>)	3	7	10	0.46	Rare
Hooded Warbler (<i>Wilsonia citrina</i>)	4	46	50	2.31	Common
Canada Warbler (<i>Wilsonia canadensis</i>)	41	33	74	3.43	Common
Redstart (<i>Selophaga ruticilla</i>)	1	—	1	0.05	Rare
Cowbird (<i>Molothrus ater</i>)	3	—	3	0.14	Rare
Scarlet Tanager (<i>Piranga erythromelas</i>)	4	57	61	2.82	Common
Cardinal (<i>Richmondia cardinalis</i>)	6	6	12	0.56	Uncommon
Rose-breasted Grosbeak (<i>Hedymeles ludovicianus</i>)	4	1	5	0.23	Rare
Indigo Bunting (<i>Passerina cyanea</i>)	4	31	35	1.62	Common
Goldfinch (<i>Spinus tristis</i>)	9	6	15	0.69	Uncommon
Towhee (<i>Pipilo erythrophthalmus</i>)	24	97	121	5.60	Plentiful
Junco (<i>Junco hyemalis</i>)	15	5	20	0.93	Uncommon
Chipping Sparrow (<i>Spizella passerina</i>)	4	6	10	0.46	Rare
Field Sparrow (<i>Spizella pusilla</i>)	6	13	19	0.88	Uncommon
Song Sparrow (<i>Melospiza melodia</i>)	2	2	4	0.19	Rare
	567	1593	2160	100.00	

TABLE 2
BIRDS RECORDED, LISTED BY GENERA

<i>Name</i>	<i>Total</i>	<i>Per-centage</i>	<i>Name</i>	<i>Total</i>	<i>Per-centage</i>
Cathartes	18	0.83	Thryothorus	13	0.60
Coragyps	1	0.05	Dumetella	7	0.33
Accipiter	1	0.05	Toxostoma	12	0.56
Buteo	7	0.33	Turdus	15	0.70
Bonasa	34	1.57	Hylocichla	87	4.03
Meleagris	2	0.09	Bombycilla	23	1.06
Philohela	10	0.46	Vireo	248	11.48
Actitis	1	0.05	Mniotilta	112	5.19
Zenaidura	3	0.14	Helminthos	22	1.02
Coccyzus	18	0.83	Vermivora	15	0.70
Chaetura	9	0.42	Compsothlypis	100	4.63
Archilochus	5	0.23	Dendroica	261	12.08
Megaceryle	1	0.05	Seiurus	315	14.58
Colaptes	16	0.74	Geothlypis	18	0.83
Ceophloeus	26	1.20	Icteria	10	0.46
Sphyrapicus	7	0.33	Wilsonia	124	5.74
Dryobates	13	0.60	Setophaga	1	0.05
Myiarchus	22	1.02	Molothrus	3	0.14
Sayornis	13	0.60	Piranga	61	2.82
Empidonax	33	1.53	Richmondena	12	0.56
Myiochanes	66	3.06	Hedymeles	5	0.23
Cyanocitta	20	0.93	Passerina	35	1.62
Corvus	60	2.78	Spinus	15	0.70
Penthestes	51	2.36	Pipilo	121	5.60
Baeolophus	25	1.16	Junco	20	0.93
Sitta	9	0.42	Spizella	29	1.34
			Melospiza	4	0.19

TABLE 3
BIRDS RECORDED, LISTED BY FAMILIES

<i>Name</i>	<i>Total</i>	<i>Per-centage</i>	<i>Name</i>	<i>Total</i>	<i>Per-centage</i>
Cathartidae (Vultures)	19	0.88	Corvidae (Crows, Jays, etc.)	80	3.70
Accipitridae (Hawks)	9	0.42	Paridae (Titmice)	76	3.52
Tetraonidae (Grouse)	34	1.57	Sittidae (Nuthatches)	9	0.42
Meleagrididae (Turkeys)	2	0.09	Troglodytidae (Wrens)	13	0.60
Scolopacidae (Sandpipers)	11	0.51	Mimidae (Thrashers, etc.)	19	0.88
Columbidae (Doves)	3	0.14	Turdidae (Thrushes)	102	4.72
Cuculidae (Cuckoos)	18	0.83	Bombycillidae (Waxwings)	23	1.06
Micropodidae (Swifts)	9	0.42	Vireonidae (Vireos)	248	11.48
Trochilidae (Hummingbirds)	5	0.23	Compsothlypidae (Wood Warblers)	978	45.28
Alcedinidae (Kingfishers)	1	0.05	Icteridae (Blackbirds, etc.)	3	0.14
Picidae (Woodpeckers)	62	2.87	Thraupidae (Tanagers)	61	2.83
Tyrannidae (Flycatchers)	134	6.20	Fringillidae (Finches)	241	11.16

Totals 2160—100%

TABLE 4
BIRDS RECORDED, LISTED BY ORDERS

<i>Name</i>	<i>Total</i>	<i>Percentage</i>
Falconiformes (Hawks and Vultures)	28	1.29
Galliformes (Grouse and Turkeys)	36	1.67
Charadriiformes (Sandpipers, etc.)	11	0.51
Columbiformes (Doves)	3	0.14
Cuculiformes (Cuckoos)	18	0.83
Micropodiformes (Swifts and Hummingbirds)	14	0.65
Coraciiformes (Kingfishers)	1	0.05
Piciformes (Woodpeckers)	62	2.87
Passeriformes (Passerine or Perching Birds)	1987	91.99
<i>Totals</i>	2160	100.00

The biotic communities within the forested area may be classified into at least four major habitats as follows: (1) old brushy clearings, (2) cove types, (3) lower slopes and ridges, and (4) higher slopes and ridges.

On the bottomland flats within a few of the larger coves are located scattered old brushy clearings, relics of a time when human beings found such places habitable. These clearings generally contain a few small areas of open turf that are surrounded by tangled growths of small trees, bushes, bramble (*Rubus* spp.), briar (*Smilax* spp.), and grape (*Vitis* spp.). Those birds that were found to be characteristic of these old clearings were: Robin, Cedar Waxwing, Golden-winged Warbler, Prairie Warbler, Yellow-breasted Chat, Cardinal, Indigo Bunting, Goldfinch, Chipping Sparrow, Field Sparrow, and Song Sparrow.

The cove forests are made up largely of white pine (*Pinus strobus*), hemlock (*Tsuga canadensis*), and various species of hardwoods, the most common of which are: white oak (*Quercus alba*), hickory (*Carya* spp.), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), cherry birch (*Betula lenta*), basswood (*Tilia americana*), red oak (*Quercus borealis*), and cucumber tree (*Magnolia acuminata*). Certain species of birds were found regularly distributed throughout the coves, others were found predominantly in the lower portions, and still others were confined largely to the higher parts near the headwaters of streams. Differences in vegetation were due mainly to the more common occurrence of certain boreal types, such as yellow birch (*Betula lutea*), moosewood (*Acer pennsylvanicum*), and mountain maple (*Acer spicatum*) in the higher,

cooler sections of the coves. Species of birds which were regularly found throughout the coves were the Woodcock, Crested Flycatcher, Phoebe, Wood Pewee, White-breasted Nuthatch, Wood Thrush, Blackburnian Warbler, and Louisiana Water-thrush. Those which were found predominantly in the lower portions were the Yellow-billed Cuckoo, Acadian Flycatcher, Carolina Wren, Worm-eating Warbler, Parula Warbler, and Hooded Warbler. The species which were confined largely to the higher parts were the Yellow-bellied Sapsucker, Veery, Mountain Vireo, Magnolia Warbler, Cairns's Warbler, Black-throated Green Warbler, and Rose-breasted Grosbeak.

The lower slopes and ridges constitute a large percentage of the total area within the region and also represent the poorest type of habitat as far as numbers and species of birds are concerned. The canopy of this type is made up largely of chestnut oak (*Quercus montana*), scarlet oak (*Quercus coccinea*), and hard pine (*Pinus pungens*, *P. rigida*, and *P. virginiana*). No species of birds were found to be especially characteristic of this type.

The higher ridges and slopes are covered with isolated tracts of timber made up principally of red oak (*Quercus borealis*), cherry birch (*Betula lenta*), and chestnut (*Castanea dentata*) sprouts, with larger intervening expanses of brushland, the more common components of which are bear oak (*Quercus ilicifolia*), fetterbush (*Andromeda floribunda*), and mountain laurel (*Kalmia latifolia*). Scattered northern species such as mountain ash (*Sorbus americana*), pin cherry (*Prunus pennsylvanica*), and red raspberry (*Rubus idaeus*) were found on a few of the higher knobs; and small tracts of hard pine were also present. The birds that were more commonly found in this habitat than elsewhere were the Raven, Chestnut-sided Warbler, Maryland Yellowthroat, Towhee, and Carolina Junco.

The Canada Warbler was commonly found in the upper reaches of the coves as well as on the higher slopes and ridges. Other species not listed under the four major habitat types either occurred regularly over the entire region or were so rare as to make it unwise to reach any conclusions pertaining to their ecological distribution.

CONCLUSIONS

A total of 89 species of birds was found inhabiting the selected study area in the Shenandoah Mountains during the month of June, 1941. All are believed to be breeding species within the area, with the possible exception of the Redstart. Of these, fourteen were confined to the few outlying farms, one was found in a specialized type of habitat distinctly extraneous to the region, and four were nocturnal or crepus-

cular forms. The remaining 70 were diurnal species found on the forested lands. The use of a comparative type of census was not found to be satisfactory for those birds other than the diurnal species found on the forest.

The results of the comparative census, obtained from the identification and recording of 2160 individual birds, indicate that the breeding bird population within the forests of the region is composed of a mixture of southern (Austral) and northern (Boreal) species, with the southern species generally predominating. The three most abundant species, the Ovenbird, Red-eyed Vireo, and Towhee, comprised nearly 29 per cent of the total. The three most prevalent genera, *Seiurus*, *Dendroica*, and *Vireo*, constituted over 39 per cent of the total. More than 45 per cent of the birds were found to belong to one family, Compsothlypidae (Wood Warblers); while almost 92 per cent belonged to the order Passeriformes (passerine or perching birds).

Other points of interest brought out by this census are the representative percentages of the game birds to the total as well as the predator-prey ratios. The Ruffed Grouse and Wild Turkey, the two most important game birds in the region, made up slightly more than one and one-half per cent of the total. Other game birds of minor importance in this region, the Woodcock and Mourning Dove, constituted 0.6 per cent. The ratio of the diurnal birds of prey to the smaller non-predatory forms was about 1 : 259.

At least four major habitat types were recognized in the forested regions within the study area. Three of these were found to contain species of birds that were to a considerable extent peculiar to them. No attempt was made to conduct separate comparative censuses of these habitat types because of the extensive ecotones occurring between them. However, care was taken to cover each of the types in such a manner that the amount of time spent in each was approximately proportional to the relative expanse of each within the total area.

There are admittedly many variables which enter into work of this type. While attempts were made to reduce many of them, there still remain a few which were impossible to avoid by any amount of attention. The variation in vocal activity between various species would be a good example of this. Usually, however, natural compensating factors were present which would tend to neutralize the effects of such variation on the results of the census. Because of these variable factors, the resulting data on relative abundance should not be con-

sidered as absolute, but only as indicative of the general prevalence of the species and the larger taxonomic groups. At the very least, the results of using this method are certainly more accurate than relative abundance determinations based on general observations alone.

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A STUDY OF THE VIOLET-GREEN SWALLOW

BY J. M. EDSON

FOR many years I have been observing the habits of the Violet-green Swallow, *Tachycineta thalassina lepida*, in the vicinity of Bellingham Bay, western Washington. During that time a considerable volume of notes has been accumulated, from which I have endeavored to epitomize the significant facts.

Of the five species of swallows common to this region, the Violet-green is first to arrive in spring, although the Tree Swallow, *Iridoprocne bicolor*, is scarcely later. The earliest appearance is ordinarily in the latter part of March. The three other species arrive considerably later. The Violet-green likewise is first to leave when nesting is over, taking its departure in late July or early August. My records of first arrivals during 35 years range in date from February 25 to April 7; March 21 is about the average. February 25, 1906, the earliest spring date, was quite exceptional; the next earliest was March 12. The latest arrival date recorded was April 7, 1917. Of course it is quite possible that previous arrivals escaped observation. That no doubt did happen in numerous instances. The first appearance in March seems often to be followed by an interval before others of the species are seen. Following the second wave they become common. The earlier birds sometimes appear in considerable flocks, quickly passing on, likely destined for some habitat farther north.

Upon arrival, the local birds promptly visit their last year's nesting quarters and perch on wires at accustomed places. By the middle of April, on the average, the birds commence to evince an interest in nesting. However, activities are not usually started in earnest till about the second week in May. The eggs are laid usually late in May or early in June. In ten nestings the earliest hatching date was June 6, the latest July 11 (a second effort). The average date is June 20. The average date of leaving the nest is July 13. The incubating period is approximately fifteen days, and the brooding period twenty-