

THE SUMMER BIRDS OF THE TOXAWAY RIVER GORGE OF SOUTHWESTERN NORTH CAROLINA

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THE objectives of this study were to determine the species composition, relative abundance, habitat associations, and altitudinal distribution of the summer bird populations of the Toxaway River Gorge, Transylvania County, North Carolina.

Toxaway Gorge is one of several gorges which dissect the southern face of the Blue Ridge Plateau in southwestern North Carolina. The gorge was formed by the eroding action of the Toxaway River flowing over the Blue Ridge escarpment and down to the upper Piedmont of South Carolina, the river descending vertically 1,900 feet in a linear distance of approximately 6 miles. The depth of the V-shaped gorge from river bottom to ridge tops averages 500 to 600 feet.

Access to the gorge is limited. U. S. Highway 64 crosses its upper end at the 3,000-foot level. Logging roads penetrate the gorge at 1,400 feet and the mouth at 1,100 feet. Access otherwise is by foot over extremely rough, steep terrain.

The summer climate of the gorge region is generally warm and wet. The steep wall of the Blue Ridge escarpment, rising above the foothills of the South Carolina Piedmont, faces the prevailing moist winds and results in heavy summer rainfall. A total of 102 inches of rain was recorded in 1961 at nearby Lake Toxaway; 35.3 inches of this amount fell from 1 June to 31 August. This is slightly above the long-term average but is indicative of the unusually wet climate. Temperatures are moderate in summer, but annual averages are not available for any nearby point. The advance of spring up the full length of the gorge takes about 2 weeks.

The vegetation of the gorge progresses from that of typical Piedmont affinity at the lower end to montane aspects on the higher slopes. The five habitat-type designations used in this report follow those of Cooper (1963) for the same region, as outlined below.

The Pine Flats are of two types. The extensive alluvial pine flat in the mouth of the gorge has been severely altered by man over the past 50 to 60 years. Much of the area has been farmed, some of it until rather recently, and most of the forest has been disturbed. In places succession has progressed only to the sapling pine and blackberry (*Rubus* spp.) stage. Recent logging has also resulted in further opening of the canopy of the pole-sized forest. Virginia pine (*Pinus virginiana*) is dominant, with tulip poplar (*Liriodendron tulipifera*) and white pine (*Pinus strobus*) also present. Alder (*Alnus serrulata*) and willow (*Salix nigra*) grow along the riverbanks. The understory is primarily mountain laurel (*Kalmia latifolia*), with blackberry occurring in dense thickets in the earlier successional stages.

The Pine Flats along the river in the gorge proper are much more limited in extent and are generally more mesic, more mature, and less disturbed. Here a complete canopy of white pine, Virginia pine, hemlock (*Tsuga canadensis*), and tulip poplar is usually present. The main understory species is *Rhododendron maximum*.

The Mixed Mesophytic Cove and Slope Forest begins at the base of the coves and slopes and extends upward for varying distances, depending primarily upon moisture. The canopy may contain as many as 15 to 20 species (Cooper, 1963). Red maple (*Acer rubrum*), sweet birch (*Betula lenta*), beech (*Fagus grandifolia*), basswood (*Tilia heterophylla*), hickories (*Carya* spp.), tulip poplar, and hemlock are most frequently encountered. The shrub layer is generally poorly developed, but local, dense thickets of mountain laurel and rhododendron do occur. A well-developed herbaceous layer is usually present.

The Oak Forests gradually become differentiated from the Mixed Mesophytic type as the sites become drier. The upper slopes and most of the higher ridges are Oak Forest. Scarlet oak (*Quercus coccinea*), white oak (*Quercus alba*), chestnut oak (*Quercus prinus*), and hickories are most abundant in the canopy. Mountain laurel forms a nearly solid understory beneath much of this type.

The Pine Ridges are limited in extent and occur only on the very dry, most exposed ridges. Virginia pine and pitch pine (*Pinus rigida*) are dominant in this type.

It should be noted that, with the exception of the lower parts, the whole gorge area is covered by relatively unbroken forest. Some disturbance due to logging may be found in nearly all types, but generally this is not enough to create any extensive edge effect, except in the heavily disturbed Pine Flats of the gorge mouth.

METHODS

Field work was initiated in late April of 1961, when 2 days were spent in a preliminary survey of the gorge. Full-time research began on 13 June 1961, when the senior author moved into a permanent campsite established by the Highlands Biological Station. The unavoidably late start prevented a complete survey of the nesting period, and many first broods were in the fledgling stage when field work began. The field program was terminated on 22 August 1961. While in the gorge, censuses were conducted from three base elevations. The period 13 June to 1 August was spent primarily in the middle gorge (1,300 to 1,700 feet base elevation) and 2 to 10 August in the lower gorge (1,100 to 1,200 feet base elevation). No campsite was established in the upper gorge (2,600 to 3,000 feet base elevation), but one-day trips were made to this section throughout the summer. The area between 1,800 feet and 2,600 feet was not studied due to the difficulty of reaching this part of the gorge from the base camps. Censuses were conducted at all levels from the river bottom to the ridgetops from each base station.

The census method made use of daily transects of no definite width, each extending through a series of habitat types. Along each transect observations were timed by habitat and altitude to allow expression in birds per hour for each type included. The period of sampling was from daylight until the lessening of morning activity, or about 3 hours. The transect method was chosen

after some experimentation, rather than the more precise method of quadrat analysis, due to the extremely rough, steep terrain and dense shrub layer that was present throughout much of the gorge. The choice of transects as the sampling method necessarily resulted in the use of relative abundance as a measure of the population level rather than absolute abundance (Kendeigh, 1944; Stevenson, 1941).

In addition to the transects, considerable time each day was spent in spot checking. This information was used to help evaluate the overall situation. However, only the data from the specific transects were used in Table 1.

During the study period 42 specimens were collected. These skins have been placed in the collection of the Department of Zoology of North Carolina State College.

Plant names conform to Fernald (1950), and bird names to the American Ornithologists' Union (1957).

RESULTS

The relative abundance of each species in the five major habitats considered is listed in Table 1. Those species not directly associated with any of these habitat types, such as the hawks, the Spotted Sandpiper, the Rough-winged Swallow, and the Kingfisher, are listed in the last column.

We have presented the actual values, in birds per hour, in order to allow direct comparisons with other studies. In view of the differential observability of the various species, the more secretive birds appear less abundant while the obvious ones appear more numerous (Kendeigh, *op. cit.*:74). Also, birds such as hawks are almost certain to be recorded as uncommon or rare, whereas they may actually be present in numbers approaching the carrying capacity of the habitats.

The major portion of the field work for this study was accomplished at altitudes of from 1,200 to 2,000 feet. Thus the results more clearly represent this section of the gorge.

Sixty-four species of birds were recorded. None of these had an abundance rating of over one bird per hour throughout all habitat types. However, the Red-eyed Vireo, the Cardinal, the Carolina Chickadee, the Black-and-white Warbler, and the Tufted Titmouse had values of 0.50 bird per hour or above in all habitat types.

The largest number of species in a single type was 45 in the Pine Flats of the mouth of the gorge. The other habitats each had between 25 and 34 species and were thus relatively similar in species number. A comparison of total abundance between habitats also showed that the Pine Flats of the gorge mouth contained relatively more individuals than did the other types. Both of these abundance conditions appeared to be due to the increased vegetative

TABLE I
RELATIVE ABUNDANCE OF THE SUMMER BIRDS OF THE MAJOR HABITAT TYPES OF THE
TOXAWAY RIVER GORGE*

Species	Pine Flats in mouth of gorge (20 hr)	Mixed Meso- phytic Coves and Slopes (30 hr)	Oak Forests (19 hr)	Pine Flats in the gorge proper (15 hr)	Pine Ridges (7 hr)	No direct habitat associa- tion
Turkey Vulture	—	—	—	—	—	R (0.05)
Red-tailed Hawk	—	—	—	—	—	U (0.20)
Cooper's Hawk	—	—	—	—	—	R (0.05)
Broad-winged Hawk	—	—	—	—	—	U (0.14)
Ruffed Grouse	—	—	R (0.05)	—	—	—
Spotted Sandpiper	—	—	—	—	—	R (0.05)
Mourning Dove	U (0.15)	—	R (0.05)	—	—	—
Yellow-billed Cuckoo	U (0.50)	U (0.20)	—	—	—	—
Screech Owl	R (0.10)	—	—	U (0.20)	—	—
Barred Owl	R (0.05)	—	—	—	—	—
Whip-poor-will	U (0.25)	—	—	—	—	—
Chimney Swift	—	—	—	—	—	C (0.85)
Ruby-throated Hummingbird	U (0.30)	U (0.13)	U (0.26)	C (0.53)	C (0.53)	—
Belted Kingfisher (1)	—	—	—	—	—	R (0.05)
Yellow-shafted Flicker	R (0.05)	R (0.10)	U (0.32)	—	U (0.14)	—
Pileated Woodpecker	U (0.15)	U (0.30)	U (0.42)	—	—	—
Hairy Woodpecker	U (0.50)	U (0.16)	—	—	U (0.14)	—
Downy Woodpecker (2)	C (0.60)	U (0.37)	U (0.37)	—	U (0.29)	—
Great Crested Flycatcher	R (0.05)	—	—	R (0.06)	—	—
Eastern Phoebe	—	U (0.33)	R (0.05)	U (0.33)	U (0.43)	—
Acadian Flycatcher (1)	R (0.05)	R (0.10)	U (0.32)	—	—	—
Rough-winged Swallow	—	—	—	—	—	C (0.54)
Blue Jay (1)	R (0.05)	C (0.61)	U (0.37)	A (1.13)	C (0.86)	—
Common Raven	—	—	R (0.10)	—	—	—
Common Crow	U (0.20)	R (0.10)	U (0.21)	—	—	—
Carolina Chickadee (1)	A (1.45)	A (1.70)	C (0.89)	A (1.20)	A (1.71)	—
Tufted Titmouse	C (0.60)	C (0.67)	C (0.89)	U (0.47)	C (0.86)	—
White-breasted Nuthatch	—	—	R (0.05)	—	—	—
Carolina Wren	A (1.85)	U (0.43)	U (0.42)	U (0.40)	—	—
Catbird	R (0.05)	—	R (0.05)	—	—	—
Brown Thrasher (1)	C (0.60)	R (0.03)	—	R (0.07)	U (0.14)	—
Robin	R (0.10)	R (0.07)	—	—	U (0.43)	—
Wood Thrush	R (0.05)	U (0.17)	U (0.16)	U (0.16)	C (0.60)	—
Blue-gray Gnatcatcher	U (0.40)	R (0.07)	—	R (0.07)	—	—
Yellow-throated Vireo (1)	R (0.05)	R (0.07)	—	—	—	—

* The numbers in parentheses following the species name refer to the number of individuals collected. The letters in the columns represent assignment of the following ranges of variation, in birds per hour, to the standard relative frequency terms: A = Abundant, greater than 1.01 birds per hour; C = Common, 0.51 to 1.00 bird per hour; U = Uncommon, 0.11 to 0.50 bird per hour; and R = Rare, less than 0.11 bird per hour. The values in parentheses following the letter code are the actual number of birds per hour calculated for each habitat type. The numbers in parentheses immediately below the habitat type designations represent the number of hours upon which the data were calculated. No hours are given for the last column as these were calculated in the habitat types being censused at the time of the observations.

TABLE 1 (Continued)

Species	Pine Flats in mouth of gorge (20 hr)	Mixed Mes- ophytic Coves and Slopes (30 hr)	Oak Forests (19 hr)	Pine Flats in the gorge proper (15 hr)	Pine Ridges (7 hr)	No direct habitat associa- tion
Solitary Vireo (3)	C (0.55)	U (0.20)	R (0.10)	C (0.87)	—	—
Red-eyed Vireo (2)	A (2.15)	A (2.07)	A (1.79)	C (0.87)	C (0.71)	—
Black-and-white Warbler (2)	U (0.50)	C (0.80)	A (1.32)	A (1.31)	C (0.71)	—
Swainson's Warbler (2)	—	U (0.23)	U (0.26)	C (0.67)	U (0.14)	—
Worm-eating Warbler (5)	U (0.25)	A (1.33)	U (0.47)	C (0.67)	U (0.14)	—
Parula Warbler	U (0.20)	U (0.27)	R (0.11)	U (0.33)	—	—
Black-throated Blue Warbler	R (0.15)	R (0.03)	—	R (0.07)	—	—
Black-throated Green Warbler	U (0.20)	U (0.50)	C (0.53)	U (0.27)	U (0.29)	—
Blackburnian Warbler	—	—	—	R (0.07)	—	—
Yellow-throated Warbler	C (0.65)	R (0.03)	R (0.05)	—	—	—
Chestnut-sided Warbler	—	—	R (0.05)	U (0.13)	U (0.14)	—
Pine Warbler	R (0.05)	—	—	—	—	—
Prairie Warbler (1)	U (0.40)	—	—	—	U (0.29)	—
Ovenbird (1)	U (0.20)	U (0.20)	U (0.31)	U (0.20)	—	—
Louisiana Waterthrush (1)	R (0.05)	U (0.27)	—	C (0.73)	—	—
Kentucky Warbler (1)	—	—	U (0.11)	U (0.27)	U (0.14)	—
Yellow-breasted Chat	U (0.25)	—	—	—	—	—
Hooded Warbler (1)	U (0.25)	C (0.83)	C (0.63)	U (0.27)	U (0.29)	—
Canada Warbler (1)	—	R (0.03)	—	R (0.07)	—	—
American Redstart (1)	R (0.10)	R (0.03)	—	R (0.07)	—	—
Scarlet Tanager (1)	C (0.65)	U (0.37)	C (0.58)	U (0.20)	U (0.43)	—
Summer Tanager	R (0.05)	R (0.03)	—	—	—	—
Cardinal (1)	U (0.25)	U (0.43)	C (0.74)	A (1.67)	C (0.71)	—
Indigo Bunting	U (0.45)	—	U (0.21)	U (0.20)	U (0.14)	—
American Goldfinch	A (1.35)	U (0.37)	—	—	—	—
Rufous-sided Towhee	—	R (0.10)	U (0.11)	—	C (0.71)	—
Chipping Sparrow (1)	C (0.55)	—	—	—	—	—
Field Sparrow	C (0.55)	—	—	—	—	—
Song Sparrow	—	—	—	R (0.07)	—	—
Total species	45	34	33	30	25	8 = 64 total
Total birds per hour	18.55	13.83	12.95	10.47	11.00	species

complexity which resulted in more available niches in the Pine Flats of the gorge mouth.

Most species occurred in more than one of the types. However, only 11 were recorded in all five major types, while 12 were found in only a single type. As calculated from all species ratings in the five habitat types (Table 1), the general relative abundance scores were: rare—30%, uncommon—43%, common—19%, and abundant—8%.

DISCUSSION

The general affinities of the bird life of the Toxaway Gorge were with the upper Piedmont. However, six birds that may be called mountain species (Black-throated Blue Warbler, Swainson's Warbler, Parula Warbler, Black-and-white Warbler, Black-throated Green Warbler, and Scarlet Tanager) were present throughout the gorge. Five additional montane species (Common Raven, Chestnut-sided Warbler, Canada Warbler, Blackburnian Warbler, and Song Sparrow) were recorded at least once, primarily in the upper gorge. In late summer, as postbreeding wandering became evident, observations of the more typically montane species increased. The apparent limitation of some species to the lower gorge appears to have been due to the availability of habitat rather than being a function of altitude as such, since Stevenson (1957) recorded all of these species at considerably higher elevations in regions where their preferred habitat types extended to greater altitudes.

In a study of the summer bird population of the Highlands Plateau, 20 miles west and about 1,000 feet higher in elevation than the highest point in the present study area, Odum (1950) found a generally high population of birds in comparison with similar but drier areas farther north in the Appalachians. He concluded that the high moisture level, by increasing the amount and diversity of the vegetation of the Highlands Plateau, was probably responsible for this increased abundance. This hypothesis should also apply to the Toxaway Gorge area with its high annual rainfall. A direct comparison between the two studies is not possible, but in the oak sere Odum recorded 26 species of birds, whereas in the gorge we recorded 33 species in the Oak Forest. In the Piedmont of Georgia a study showed 24 species nesting in the climax Oak-Hickory type (Johnston and Odum, 1956). This general comparison is indicative of the high number of species inhabiting the Toxaway Gorge area in summer. The abundance of individuals may also be considered as relatively high throughout the gorge.

Several observations were made which seem to deviate significantly from Stevenson's altitudinal records (Stevenson, 1941, 1957). A Canada Warbler was recorded at 2,200 feet, about 1,200 feet lower than recorded by Stevenson, and Black-throated Blue Warblers were found at 1,200 feet, almost 2,000 feet lower than Stevenson's records. Black-throated Green Warblers at 1,200 feet in the Toxaway Gorge were also lower than commonly reported, the lowest published record being 1,600 feet (Odum, 1945). These were all late summer observations, however, and probably most represented postbreeding wanderers rather than nesters.

The status of the Spotted Sandpiper in the gorge was uncertain. It has been

recorded nesting in the North Carolina mountains (Pearson et al., 1959), but all of our observations were in August and may have been of fall migrants.

Perhaps the most significant finding of this survey as regards species presence was the discovery of the Swainson's Warbler as a rather common summer resident throughout the gorge. This bird was known only as a coastal swamp nesting species in the southeast until it was found nesting in the mountains of Georgia in 1950 (Burleigh, 1958). It has also been observed occasionally in summer in the North Carolina mountains (Pearson et al., 1959) and once in the South Carolina mountains, only one-half mile from the North Carolina state line (Schuler, 1962). Stevenson (1941) called it a rare summer resident near Highlands on the basis of two singing males in late June and early July. However, no actual evidence of nesting had been found until Parnell observed an adult Swainson's Warbler feeding two fledgling young in the mouth of a densely vegetated cove at 1,400 feet in the Toxaway Gorge. The young birds were capable of only short flights and appeared to have been out of the nest only one or two days. Singing males were recorded throughout the summer from 1,200 feet up to 2,800 feet, but no nests or subsequent young were found. Two male Swainson's Warblers were collected, and both had the enlarged testes characteristic of breeding birds. Most first broods of this species probably were fledged prior to the 13 June initiation of the field work.

The Toxaway Gorge habitat chosen by the Swainson's Warbler was basically similar to the description given by Burleigh (1958). They showed a preference for dense stands of rhododendron, mountain laurel, and dog hobble (*Leucothoe editorum*) along the narrow river bottom Pine Flats. The Mixed Mesophytic Coves and Slopes and the Oak Forest were utilized to a lesser degree.

The presence of this rather sizable population of Swainson's Warbler in the Toxaway Gorge suggests that this species may also be a common summer resident in the other river gorges that drain the Blue Ridge Plateau. The senior author found the song of this species to be very similar to that of the Louisiana Waterthrush, which was usually found in the same habitats. Confusion between these songs would be very likely by persons familiar with the Louisiana Waterthrush but not with the Swainson's Warbler. Williams (1953) noted a decided similarity between the songs of these two species in the Tryon region of the North Carolina mountains. F. R. Scott noted, in an observation in the Great Smoky Mountains National Park, a Swainson's Warbler song resembling that of an aberrant Louisiana Waterthrush (Stupka, 1963). This problem would be compounded by the retiring habits of the Swainson's Warbler which make it very difficult to see. It is likely that this confusion is partially responsible for the scarcity of records of this species.

Further intensive research is needed to determine the extent and abundance of this poorly known population.

The Worm-eating Warbler was found commonly in the same habitats as the Swainson's Warbler. No nests were located, but two broods of fledglings were observed. This species generally could be found along any brushy ravine, regardless of which more extensive vegetative type it penetrated. Pearson et al. (1959) listed this species as being "locally common" in the mountains of North Carolina, and Burleigh (1958) found it "fairly common" in the Georgia mountains. It was one of the most abundant warblers in the present study area. The presence of both the Worm-eating Warbler and the Swainson's Warbler in sizable populations in very similar habitat conditions provides an excellent opportunity for a comparative study.

SUMMARY

A study of the summer bird populations of the Toxaway River Gorge was conducted in 1961. Altitudes in this deep gorge draining a portion of the Blue Ridge Plateau range from 3,000 feet down to 1,100 feet. The climate is warm and wet. The luxuriant vegetation represents a transition from upper Piedmont affinities to the mixed mesophytic and oak forests of the southern Appalachians.

Timed transects were chosen as the method of censusing the bird population, due to the rough terrain and dense vegetation throughout most of the gorge. This resulted in relative values as the measure of population abundance.

Sixty-four species were recorded in the five major habitat types studied. The Pine Flats of the mouth of the gorge had the largest number of species with 45, the Mixed Mesophytic Slopes and Coves had 34 species, the Oak Forests 33 species, the Pine Flats of the gorge proper 30 species, and the Pine Ridges 25 species. Eight species had no direct habitat associations. Most species occurred in several types. However, 11 were recorded in all five types, while 12 were limited to a single type.

The general affinities of the birds of the gorge were with the upper Piedmont, with some montane species present as nesters and a few others recorded as late summer wanderers. The general abundance levels were considered to be relatively high, both in species and individuals, as determined from the present investigation and in limited comparison with published studies in the Piedmont and mountains.

The Swainson's Warbler was discovered to be a common summer resident of the Toxaway Gorge. This was the first positive record of this species nesting in western North Carolina. This warbler showed a preference for the dense thickets along the narrow river bottom Pine Flats, but it was recorded also in the Mixed Mesophytic Slopes and Cove Forests and the Oak Forests.

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