Bird Song

*Donald J. Borror**

" . . . There is much more to bird song than using it to recognize the species singing . . ."

Bird songs are of interest to many people — to the ornithologist because of the role they play in communication and behavior, to the bird watcher because of their value in indentification, and to almost everyone because of their aesthetic value. Progress in the study of bird songs through the years has been relatively slow, but has been given added impetus in recent years by the development of some electronic tools. One of these tools, the tape recorder, enables us to *capture* a song; we can listen to this recorded song over and over again at our leisure, and we can play it (or a "doctored" version of it) to a bird to see how the bird responds. Another tool, the sound spectrograph, enables us to analyze that song with considerable precision. The aim of this paper is to briefly examine these new tools, and to note some of the things about bird song their use has revealed.

RECORDING BIRD SONGS

An important first step in studying bird songs today is to make recordings of them, and this is usually done in the field with special equipment. This equipment (shown in an accompanying photo) consists of a battery-powered tape recorder carried over one's shoulder, a microphone mounted in a hand-held parabolic reflector, and a set of headphones to monitor the recording. The parabola is a very important part of this equipment; it gives the microphone directionability and reduces the pick-up of many background sounds, and it enables one to make a recording from some distance away.

The two major problems one encounters in recording birds in the field are getting close enough to the bird to get a good recording, and getting the recording with a minimum of background sound. Solving the first problem requires a knowledge of where and when to go to get recordings, a lot of travel, a great deal of patience, and — when the birds are not very cooperative — sometimes the use of such tricks as playing songs back to the bird to get it to sing Unwanted background sound may be that of other animals, wind, water, or such man-made sounds as motor noise (airplanes, cars and trucks, trains, and the like); the best solution to this problem is to avoid such sounds as much as possible, but this is often not easy; some undesirable background sounds can be filtered out after the recording is made.

ANALYZING BIRD SONGS

One of the problems encountered by early students of bird song was describing what they heard. Many of the terms one might use in describing a song (high-pitched, fast or slow, and terms referring to the quality of the song) are not

*Department of Entomology, The Ohio State University, 1735 Neil Ave., Columbus, Ohio 43210.

very precise, many of the details in a song cannot be detected by ear, and a given song may sound different to different people because of differences in their hearing ability. The sound spectrograph and similar tools have largely overcome the problem of accurate description.

The sound spectrograph makes graphs of sounds — graphs showing time on the horizontal axis and frequencies (pitch) on the vertical axis. The graphs can be made at different scales, and they portray a lot of detail; making such graphs is almost like putting the song under a microscope. The examples shown here are of a Chipping Sparrow and a Wood Thrush.

To the ear, a Chipping Sparrow song appears to be a rapid series of similar notes, uttered too fast to count, with a somewhat mechanical quality. The accompanying graph shows a part of one song of this species (not all Chipping Sparrow songs are exactly like this one). The notes in this song are uttered at the rate of about 18 per second, and each note consists of an abrupt downslur followed by an even more abrupt upslur; the upslur, over nearly an octave, takes place in about 0.01 second. It is the very rapid slurring that gives this song its mechanical quality.

The author in the field, equipped with tape recorder and parabolic reflecter microphone.

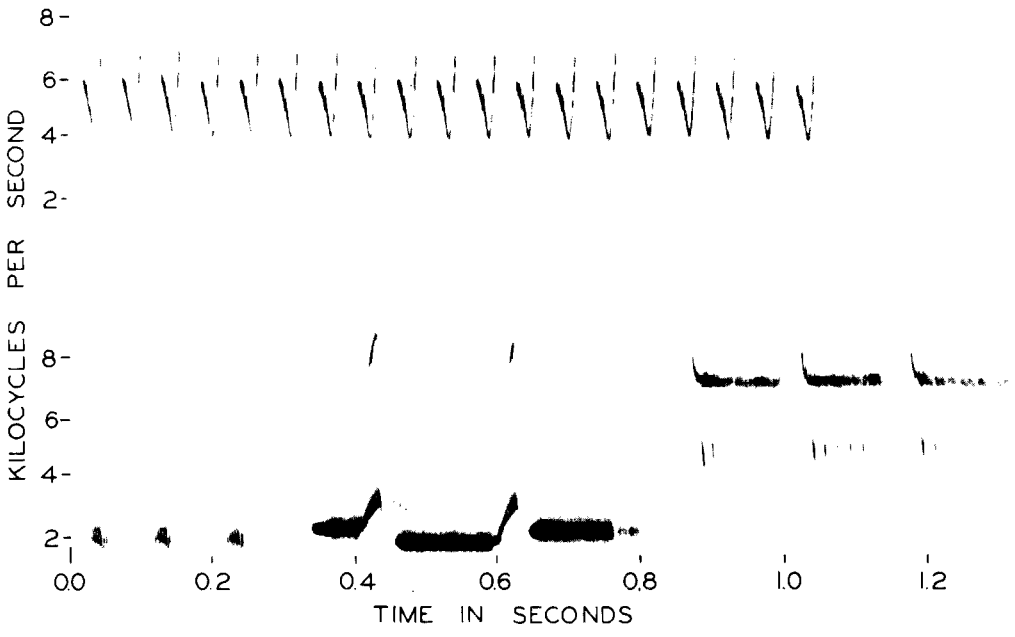
The Wood Thrush song shown — a fairly typical example of the many songs this species may sing — is much more complex. It shows an interesting feature found in the songs of a number of birds — two non-harmonically related notes uttered simultaneously. In the last part of this song the bird utters three high-pitched notes that are relatively steady in pitch, and *at the same time* utters a rapid series of abruptly downslurred notes at a lower pitch; it is singing, all by itself, what amounts to a duet.

SOUNDS PRODUCED BY BIRDS

The sounds produced by birds are of two general sorts, vocal and non-vocal. Vocal sounds are produced by the syrinx, a structure somewhat comparable to our larynx but located at the lower end of the trachea, where the two bronchial tubes come together. Vocal sounds may be modified by the structure of the vocal tract, such as the mouth and tongue. Non-vocal sounds are produced by other means, and include various incidental sounds (wing noise in flight, splashing or diving, or scratching on the ground) and some sounds produced deliberately, such as the drumming of woodpeckers. Non-vocal sounds may be communicative, and in some cases more or less species-specific (for example, the drummings of different species of woodpeckers are not all alike), but we will not be concerned with such sounds here.

Vocal sounds are of two major types, songs and calls. Songs are generally more complex than calls, they are produced almost exclusively by the male, they are hormone-controlled, and are largely confined to the breeding season. They appear to function principally in advertising the presence of the male, attracting (and keeping) a mate, and/or in defense of territory. Calls are generally short and simple, they are produced by individuals of all ages and by both sexes, and they are largely involved in other than sexual situations — food, fear, and the like. Because the distinction between songs and calls is not always always clear-cut, it is sometimes difficult to determine whether a particular vocalization is one or the other. We are concerned here with songs, which are best developed in the "song" birds (Oscines: in North America, all the Passeriformes except the flycatchers).

Most bird song is heard from late winter or early spring to about midsummer; song ceases after the breeding season (during the postnuptial molt), and is generally only rather sporadic from then to the following spring. Some birds begin singing before starting their spring migration and sing during migration, but most song is heard on the nesting grounds. The song is usually more



Sound spectrographic recordings of Chipping Sparrow (top) and Wood Thrush songs.

persistent before nesting, it drops off during nesting, and picks up again after nesting. Many birds do most of their singing at certain times of the day (for example, early in the morning), frequently from a few favorite perches on their nesting territory; a few birds sing in flight, and a few sing from the ground. The singing rate varies in different species, and at different times in a given species; it is usually higher before a bird gets a mate. The principal function of song appears to be advertising; it identifies the species (and sometimes also the individual) and sex, it may indicate the matedness of the singer (and sometimes also the singer's age), and thus may be of interest to a female of that species. Song on the nesting territory seems to advertise the fact that the territory is that of the singer, and other males of that species should stay off. The settling of territorial disputes in birds is mainly by song duels rather than actual physical encounters.

INTRASPECIFIC VARIATION IN SONG

One does not have to listen to birds very long before discovering that the songs of a given species are not all alike; different individuals may have slightly different songs, and a given individual may have a repertoire of more than one song. Modern methods of song analysis have enabled us to learn quite a bit about the nature and extent of this variation.

There are different amounts of song variation in different species (see Table 1). In some species, for example, the Kentucky Warbler and White-throated Sparrow, each individually normally sings only one song, and there are relatively few songs (less than 20) to be found in the species, and one often hears the same song from different individuals. In some other species, for example, the Chipping Sparrow and yellowthroat, each individual sings only one song, but there are many (dozens, possibly hundreds) to be found in the species, and only occasionally will one find different individuals singing the same song.

In other species, for example, the Rufous-sided Towhee and Carolina Wren, each individual has a repertoire of several songs, and one only occasionally finds different individuals singing the same song. The maximum amount of intraspecific variation is found in such species as the Song Sparrow and Wood Thrush, where each individual has a sizeable repertoire of songs, and where different individuals rarely if ever sing the same song. Individual repertoires are fairly high in some species; for example, we have found 23 different songs sung by a Rufous-sided Towhee, 24 by a Wood Thrush, and 39 by a Bachman's Sparrow. The repertoires of some *species* are extremely high — including hundreds of songs

In a great many species, including the Song Sparrow, Rufous-sided Towhee, Wood Thrush, Field Sparrow, Chipping Sparrow, Common Yellowthroat, and Carolina Wren, the variation in song from bird to bird is such that one can recognize individual birds by their songs — just as one recognizes different people by their voices. In cases where individual differences are difficult or impossible to detect by ear, graphs of the songs will identify the individual singer — much like a signature.

The *way* songs vary differs in different species, and depends to some extent on the character of the song. Where the song consists of a series of similar syllables or phrases (as in the Chipping Sparrow, Carolina Wren, yellowthroat, and many others), different songs are composed of different syllables or phrases. In some species where the song consists of two or three distinct parts, a bird may have in its vocal repertoire two or more variations of each part, and may combine these differently in different songs. The song of an eastern Rufous-sided Towhee, for example, normally consists of two parts — an introduction (of one to three, rarely four or five, notes) and a trill, and each bird has a repertoire of several different introductions and several different trills. A Song Sparrow usually has a repertoire of some 30 to 50 different notes and phrases, which are variously combined to produce a dozen or more distinctly different songs.

Different species of birds that have an individual repertoire of two or more songs may use their repertoire differently. Some, such as the Carolina Wren and Song Sparrow, usually sing one song for a while, and then change to another, others, such as the Wood Thrush, mix up their songs, and rarely if ever sing the same song twice in succession. Some birds that have a sizeable individual repertoire, such as the Bell's Vireo, may sing two of their songs more or less alternately for a while, and then change to two others

GEOGRAPHIC VARIATION IN SONG

Anyone who does a little traveling will soon discover that the individuals of a given species living in different places sometimes have slightly different songs. With some species, such as the Cardinal, one need go only a dozen miles or so to find birds with slightly different songs; with most species one must travel considerably farther before song differences become evident. In some species the songs of widely separated individuals may be so different that they might seem to be different species. Some information on the geographic variation in two species we have studied may be of interest.

The song of a Common Yellowthroat consists of up to about five similar phrases; a common song of this species might be paraphrased *wichity-wichity-wichity*. Individual notes in the song consist of from one to about five abrupt slurs, and the phrases may contain from two to six notes. The minimum number of slurs per note, and the maximum number of notes per phrase, occur in birds along the East Coast; as one goes west the number of slurs per note tends to increase, and the number of notes per phrase to

Intraspecific Variation in Bird Song

Species	No. of Songs by an Individual Bird	No. of Songs in the Species	Frequency of the Same Song from Different individuals
White-throated Sparrow Kentucky Warbler	1	Less than 20	Frequently
Chipping Sparrow Com. Yellowthroat	1	Many[1]	Occasionally
Rufous-sided Towhee Carolina Wren	10 or more	Many[2]	Occasionally
Song Sparrow Wood Thrush	10 or more	Many[3]	Rarely if ever

[1]We have found 51 different songs in 350 Chipping Sparrows, and 200 in 700 yellowthroats.

[2]We have found 950 different songs in 500 Rufous-sided Towhees, and over 150 in 500 Carolina Wrens.

[3]We have found 893 different songs in 183 Song Sparrows.

decrease. About two-thirds of the yellowthroat songs in Maine contain 4- and 5-note phrases, and the only six-note phrases in yellowthroat songs occur along the East Coast (from New Brunswick to Florida). In Ohio, on the other hand, about 85 per cent of the songs contain 3-note phrases, and four- and five-note phrases are rare. In the West four-note phrases are relatively uncommon, and five- and six-note phrases are apparently not sung by western birds.

The geographic variation in songs of the Rufous-sided Towhee is considerable; a person familiar only with the *drink-your-teeee* type of song common in eastern birds would probably not recognize the *chup-chup-chup-chup-chup-zeeeeee* of a bird in the Dakotas or Colorado, or the *chweeeeeee* of a bird on the West Coast. The songs of eastern birds consist of an introduction of one to three (rarely four or five), usually *different* notes, followed by a trill that is rarely so fast as to sound buzzy. The songs of western birds in the prairie states have an introduction of up to eight, usually *similar* notes, followed by a trill that is usually so fast that it sounds buzzy. Birds of the West Coast (east at least to western Montana and western Nevada) have songs that usually lack the introduction, and the trill is often so fast that it sounds buzzy.

SOME QUESTIONS

The tremendous variation in song that occurs in many species of birds raises a few questions: (1) with all this variation, how can the serious student of birds ever learn to recognize species by their songs? (2) do the birds themselves recognize songs of their own species? and (3) how does a bird come to sing the particular song(s) that it sings? Space does not permit a detailed discussion of these questions here, but at least a few comments can be made.

In spite of the intraspecific variation that occurs in the songs of many species, a good field ornithologist can recognize most songs he hears. He may sometimes be hard pressed to explain just *how* he recognizes a particular song, but — consciously or unconsciously — his recognition is based on such things as the general quality of the song, its pattern (the kinds of notes it contains and how these are arranged), and the time and place he hears it. Such recognition requires a lot of experience with the songs, and a good musical memory.

It has been experimentally demonstrated in many species that the birds themselves *can* recognize songs of their own species, and (in at least some species) can recognize individual birds by their songs.

There are many instances in the bird world where two (or more) species have very similar songs — sometimes so similar that a good field ornithologist, or the birds themselves, can't tell the songs apart. A few examples that might be noted are songs of the Chipping Sparrow, Pine Warbler, Worm-eating Warbler, and Slate-colored Junco; and those of the Song Sparrow and Bewick's Wren. If one finds two species singing practically identical songs, he generally finds them in different places; where two such species occur together, the songs *of those individuals* are usually different enough to be relatively easily distinguished. The Solitary Vireo in many parts of the West sings songs that have a burry quality, like those of the Yellow-throated Vireo, but the Yellow-throated Vireo does not occur in these western areas. In the East, where the two vireos might occur together, the songs of the Solitary Vireo are not all burry in quality.

Many Bewick's Wrens songs are very similar to many Song Sparrow songs. If a Bewick's Wren song from Texas is played to a Song Sparrow in Ohio (which never heard a Bewick's Wren), the sparrow reacts in much the same way as when a Song Sparrow song is played to it; it apparently cannot distinguish the wren song from a song of its own species. Where a Song Sparrow and a Bewick's Wren occupy adjacent or overlapping territories, the songs *of these two birds* are quite different.

The problem of how a bird comes to sing the particular song(s) it sings leads to the question of whether a bird's song is learned or hereditary Experiments, and such field data as the existence of local song dialects, indicate that learning is often involved in song acquisition. And this raises a question: a bird grows up in an environment where it hears the songs of many species, so how does it happen that the bird learns only songs characteristic of *its own* species? One can only say, in answer to this question, that a bird must be receptive to, and picks up for its own songs, only those notes and phrases characteristic of its own species, which — through hereditary control — it puts together in a species-specific fashion. Actually, a bird occasionally *may* develop a "wrong" song — like that of another species — but such instances are relatively rare.

There is much more to bird song than merely using it to recognize the species singing. There is much enjoyment to be had, and much to be learned, by listening to bird song a little more carefully — to check on such things as how the bird varies its songs, how it sings when the female is nearby, how it sings when another male is on its territory, just when and where the bird sings — and whether or not you can recognize the individual bird by its songs.