THE SONG OF KIRTLAND'S WARBLER

BY HAROLD H. AXTELL

IN late May, 1937, while assisting Mr. Albert R. Brand, I had the good fortune to accompany him and Dr. Arthur A. Allen of Cornell University on a trip to Michigan for the purpose of making sound recordings, photographs, and field studies of Kirtland's Warbler (*Dendroica kirtlandi*). When we confessed ignorance as to where we might hope to find these birds, four of Michigan's ornithologists volunteered to lead us to a colony in Crawford County originally discovered in 1922 by Norman A. Wood. So, under the guidance of Miss Margaret E. Gross, Secretary-Treasurer of the Michigan Audubon Society, Mrs. Marguerite Baumgartner, a former student of Dr. Allen's, and Mr. and Mrs. Theodore Peterson, ardent bird students, we were taken to the jack-pine country near Grayling where a colony of six or more pairs of Kirtland's Warblers inhabited an area about a half-mile square. The songs and singing habits of these birds were studied throughout most of the day on May 27 and the morning of May 28. A more detailed analysis of the song was made from our recordings upon our return to the Cornell University Laboratory of Ornithology.

May 27 was clear all day. The Kirtland's Warblers sang most regularly during the first three or four hours after dawn, but there was a great deal of song well distributed throughout the day. The dawn of May 28 found the jack pines shrouded in dense fog. Only an occasional burst of song was heard until sometime after the sun had risen and the fog was clearing away, when the concert finally began at about six o'clock. Even at this, the nest-building season, there were frequent periods during the day when no sound was heard for several minutes from any of the six or more males. If any one individual was observed constantly for some time, it was noted that there were frequent intervals of silence between periods of singing, even in the early morning. There seemed to be little predictability as to the length of these singing periods or the intervals between them. After a period of silence lasting from half a minute to an hour or more, a bird might sing two or three repetitions of its song or might remain vocal for more than half an hour. During the singing period the song, itself less than two seconds in length, was commonly repeated with considerable regularity at intervals of from eight to twelve seconds. But here, also, some irregularities might frequently be injected into this timing.

At this season, each male did a great deal of his singing while patrolling his territory, sometimes alone, at other times accompanied by his mate. Her presence or absence on these tours did not seem to determine whether or not he sang. I observed one singing from a stick within a foot of the

ground and another nearly fifty feet up in the tip-top of one of the tallest trees in his territory. The greater part of the singing was done from the branches of the dense growth of ten-foot-high jack pines, perhaps several songs from one branch and only one song from the next, while the bird fed between. One individual interspersed preening with rather evenly timed singing while perched nonchalantly almost within arm's reach of me. Any dead tree, rising above the level of the pine-tops, seemed often to influence a bird to perch and sing from one of its higher branches, sometimes for several minutes, whether the tree were near his nest or in the farther reaches of his territory. On a later trip through the same part of his domain, the bird might choose to do his singing from a different dead tree nearby, or might ignore such high perches in that vicinity until a later round. During observations at two nesting sites, the approach of the female with nest material was invariably heralded by a resumption of song on the part of the male who accompanied or slightly preceded her and continued to sing a few yards away until she had completed her work on the nest, when he usually became silent and flew away with her.

In the case of one male whose peregrinations were noted for several hours, there was certainly no set route, even in a general way, by which he went about his territory. The major part of the evidence in the cases of the others in the colony would lead one tentatively to the same conclusion. Even more decisively was it possible to conclude that the three males most carefully observed, did not have favorite song perches. Even in the case of one male that usually (but not always) did his singing in a certain nearby dead tree while the female was working on the nest, he showed no preference for any particular branch or part of a branch, but would perch anywhere on the tree, although he used this general location over and over again. All these observations were made early in the nesting season. Perhaps as the season wears on, the Kirtland's Warblers may become habituated to specific song perches, since Leopold says (Auk, 41: 44–58, 1924), "It appears that each male has a favorite perch, generally a dead branch of some description on a tree somewhat taller than the surrounding short jack-pine and to this he returns both before and after feeding, to sing."

Before discussing *what a bird sings*, we must come to the realization that there is another, perhaps equally important phase of the study of bird song; that is: *what we hear*. It is a thoroughly established fact that there is a tremendous degree of variation in the inherent capacity of different people to count notes when delivered rapidly as in a Kirtland's Warbler's song; also to determine changes in pitch. As we grow older (starting in our early twenties) our hearing for very high tones diminishes. It is the overtones in any sound that determine its quality, and these are mostly high-pitched. When our hearing for these high overtones fails, we become incapable of

hearing quality as others with younger ears hear it. We seem to note resemblances of tone which do not exist for them. So with these individual differences in our hearing, we may in an extreme instance have two people listening to the same warbler song, each hearing it with equal intensity, but with one hearing four notes, the other hearing twelve. Neither of them can hear what the bird actually does with its voice. As revealed by a study of the film recording, a Kirtland's Warbler may sing more than a hundred notes in a second, most of which follow one another too rapidly for any human ear to distinguish. To make matters worse, the quality may sound to one of the listeners like that of an oriole, to the other like that of a Yellow-throated Warbler, whereas to a more 'average' listener, it will sound like neither. Then there is the simple psychological factor of suggestion or first association by which we hear a bird song for the first time and are immediately impressed with how much it reminds us of this or that bird, and thereafter, because of this initial prejudice, we cannot understand how other people can say that it sounds more like something still different. Bringing our hearing under scientific control seems to be at best an especially difficult accomplishment. Then there is the matter of syllabication. Since vowel and consonant sounds are not produced by birds in the same way that they are by man, most of them cannot be exactly reproduced by man-made vocal sounds. Hence there may be several possible syllabic interpretations of a bird sound, all of which may be almost equally close to what the bird actually utters. The syllabication of the Kirtland's Warbler, in particular, is in most cases not very distinct. Although it is my opinion that too much reliance has been put on syllabication as a means of describing bird songs, one must not jump at the conclusion that it is of no value. A well-chosen syllabication may describe more than it seems. The choice of consonant sounds often gives a subtle suggestion of the quality, and correctly chosen vowel sounds indicate relative pitch, from $\bar{e}$, the highest tone, down through the shorter and broader vowel sounds to the lowest tone $\overline{oo}$. Whistling from your highest to your lowest possible tones will illustrate how this correlation between vowel sounds and relative pitch is almost inevitable in a whistled tone. It will be noted that a *w*-sound indicates an up slur, *y* a down slur. The most important thing to remember in applying someone else's syllabication to a song is: interpret the syllables freely. You may even have to add or subtract syllables in order to make it fit.

This brings up the next point that I wish to stress. There are undoubtedly many who, having heard the rapidly articulated jumbles that constitute the songs of Kirtland's Warblers, would say, "They all sound the same to me." These students may be fortunate in that they catch only the main features in the song, including most of those that are typical of the species. They have the whole song in a nutshell, as it were, while some of the rest of

us are trying to accomplish the same end by putting together details to which they were deaf. All of us, however, may better understand any whole if we have a knowledge of its parts.

The Kirtland's Warbler as a species does not have just one song of so many notes and a certain syllabication, nor does it have just two such songs, nor is it limited to several distinct songs. Not only does an individual sing differently from any of his neighbors, but he changes his own song several times each day. Even while singing essentially the same song, a little perhaps accidental variation is indulged in now and then, such as the omission or interjection of one or two notes, slurring a couple of notes usually sung separately, variations in relative pitch of one or two notes, and a gradual shifting in key of the song as a whole through a range of nearly three tones. Most of these minor variations would not be twice repeated in the same way, but are apparently unintentional when they occur. Occasionally, however, they would constitute a new variation which the singer would retain for a time. More commonly these more enduring revisions would involve a sudden shift in pitch or in rhythm or both of an entire group of notes in the song. Then this would be repeated several times or through several singing periods, in some cases for several hours. It was my observation that when a new variation was selected for its share of repetition, the previous song was not again used. A day and a half may be too short a span of observation to warrant calling this a proved fact, but if further observation shows this to be true, as I strongly suspect it will, then even a single individual Kirtland's Warbler is not a creature of several distinct songs, but of an almost infinitely varied repertory, simply following his musical whims and fancies. However, in the variations that have come within my experience, certain general characteristics may be noted as perhaps diagnostic.

The *loudness* of the song is one of its most outstanding characteristics. In the bird's desolate jack-pine haunts it may be heard from a quarter to a half mile. Its liquid, bubbling quality, and its lively, emphatic manner of delivery seem to be invariable features. The quality, and frequently the style of the song, bear a remarkable resemblance to that of the Northern Water-Thrush and sometimes to that of the House Wren.

Norman A. Wood (in Chapman, F. M., 'Warblers of North America') states that the songs of the Kirtland's Warbler "have the clear, ringing quality of the Oriole's." But Leopold (l. c.) found that "neither on this occasion, nor during our entire stay, was any member of the party able to detect anything suggesting the Oriole." My observation was similar to that expressed by Leopold. Blackwelder (Auk, 3: 360, 1886) should not be mentioned as likening the quality of this warbler's song to that of the Oriole. Let us look closely at his statement about the song being "almost like an

Oriole's in the depth of its tone—a contrast to the high notes of many warblers." The expression "depth of tone" as used correctly in reference to sound, means lowness of pitch, and does not refer to quality. If there is any doubt as to Blackwelder's meaning, a reference to the last phrase in the above quotation should assure us that he was writing about pitch, not quality.

The Kirtland's Warbler has the lowest-pitched song of any of the eastern *Dendroicas*. The average pitch of its notes is about A flat in the highest octave on the piano. This note was the median as well as the mean, for the highest tone I noted was the D above the piano, the lowest was D, an octave lower. As Text-fig. 3 shows, apparently some still-lower tones were sung which were inaudible to my ear but which were recorded on the film.

I am indebted to the method developed by Aretas A. Saunders ('A Guide to Bird Songs,' 1935) for graphically writing down bird songs in the field. In this system the notes heard are represented by dashes and lines the horizontal length and spacing of which show the time and rhythm, and the relative vertical positions signify their pitch relationships much as do notes on the musical staff. At the left of the graph is placed a letter denoting the pitch of the notes on a horizontal line opposite. Degrees of loudness are shown by drawing heavier lines to represent louder notes. Words descriptive of the quality may be written above the graph, and the listener's interpretation of the syllabication below it. The accompanying graphs of several songs made by the Saunders method show some of the considerable variation that occurs, as well as the general pattern which persists throughout all these variations and seems to be diagnostic. I would describe this pattern as follows: the melody is introduced by from one to four staccato notes, usually on the same pitch, followed by from one to three staccato notes on a higher pitch, and concluded with from one to five notes which are usually slurred but may less often sound staccato. A common form of ending sounds similar to that of the Northern Water-Thrush and the Mourning Warbler. The songs are from four-fifths to one and three-quarters seconds in length, and *normally increase in volume, speed, and emphasis toward the end.*

Undoubtedly there must be individual Kirtland's Warbler songs which will not fit this pattern. Since my own field acquaintance with the bird is relatively limited, and I was curious to know how generally this song pattern is followed by individuals heard by other observers, I have looked up descriptions given by them. After attempting the rather uncertain interpretation of the syllabications by the choice of vowels as probably indicating relative pitch, and the presence or absence of *w* and *y* sounds as possibly denoting (when present, at least) slurring or its absence, it seems reasonably possible to conclude that most of the songs represented by their syllabica-

tions may fit into the pattern. The syllabications given by other observers follow:

Arnold (Auk, 21: 488, 1904): *trp, trp, terp, terp, terp, ser-wit, er, wer.*

Leopold (Auk, 41: 44–58, 1924): *chip, chip-chip, chip, chip—chip, chip, wheeou.*

The accompanying verbal description states that the middle group of notes is higher than the first, and the third group still higher, ending with a slurred note.

Wing (Wilson Bull., 45: 72, 1933): *ba tu tu weet weet* (an exceptionally well-chosen syllabication); *butte butte weet weet weet weet.*

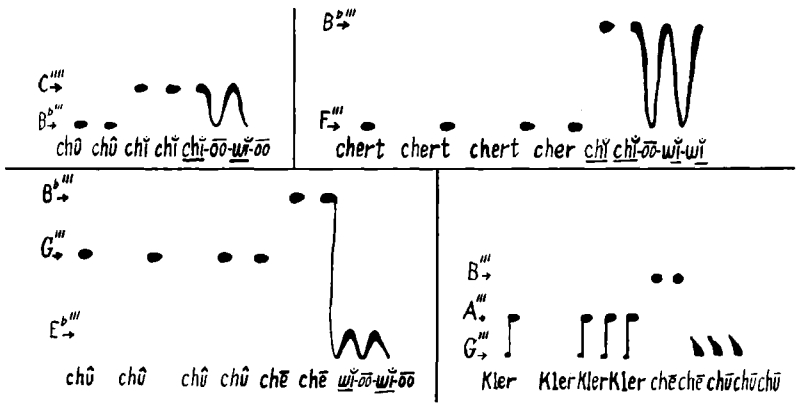
Wood (in Chapman's 'Warblers of North America'):

chip-chip-che chee chee-r-r-r.
wichy-chee-chee-chee-r-r.
ch-ch-che-che-che-ah.
che-che-che-chee-wich-a-a.
tsip tsip, chze-chze-e-e.

Probably only a person who has himself heard and tried to select the best (if any!) possible syllabication for the sound can appreciate how *weet weet* and *r-r* may possibly both refer to the same sound,—appearing in my graphs as *wi wi,* well illustrating one of the weaknesses of syllabication when used by itself. Even if most of these syllabified songs may be imagined to fall within the pattern, songs mentioned by two or three other writers most certainly do not. It has been written (Roberts, T. S., 'Birds of Minnesota,' p. 243, 1932) that the song of the Kirtland's Warbler suggests that of the Maryland Yellow-throat. This would have to be a very different variation from any I have heard or have seen described by others. I doubt if a large proportion, even of southern ornithologists, would note a striking resemblance of the song to that of the Yellow-throated Warbler as Hoxie (Auk, 3: 412, 1886) did. Perhaps the most freakish song of all was noted in Alabama by Saunders (Auk, 25: 422, 1908) where a Kirtland's was reported singing a song rather like that of a Black-throated Green Warbler. The described pattern was very different from what I assume to be the normal style. Perhaps this individual, several hundred miles from the rest of his brethren, had not been able to hear the songs of his own kind and had been forced to learn his melodies from other species. If the pattern is as closely followed in this species as it seems to me to be, then it should be reasonably diagnostic. The Yellow, Blackburnian, Yellow-throated, and Chestnut-sided Warblers and Redstart, all have variations that occasionally fall within the fringe of the Kirtland's pattern, but are rarely sufficiently typical of that pattern to create confusion. Besides, these warblers have higher-pitched, weaker, thinner, and more sibilant voices. The Northern Water-Thrush

and the House Wren are the most likely sources of confusion. The Water-Thrush's song starts high and descends; the Kirtland's starts low, goes higher, and may end either high or low. As compared with the wren, the warbler's song is shorter, of fewer notes, and has a more definite beginning and ending.

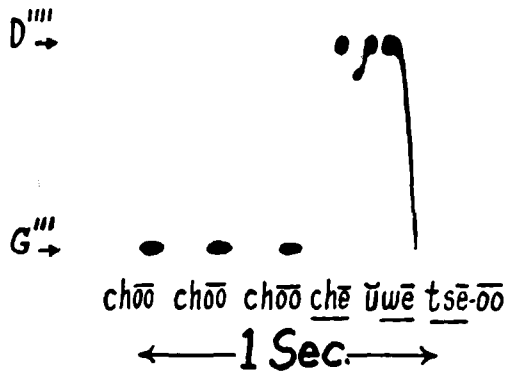
Since experience has shown that the Kirtland's Warbler is usually located by means of its song, some foreknowledge of what one should listen for is desirable, in fact almost necessary, for the seeker after the bird. To one of limited experience in learning bird songs from graphs, I would suggest that he concentrate attention on the upper-left graph in Text-figure 1. This is a



TEXT-FIG. 1.—Graphs of four songs of Kirtland's Warblers, showing variations in pattern. The song has a quality similar to that of the Northern Water-Thrush—a "lively bubbling whistle" or a "liquid gurgle," loud and low-pitched for a warbler.

short, simple, and typical song. Since this song lasted only four-fifths of a second, the syllables should be pronounced very rapidly, and those that are underlined should be strongly emphasized. A glance at the other graphs will show that notes may be added to any part of this theme, but the general pattern remains essentially unchanged. The upper-right and the lower-left graphs in Text-figure 1 show two consecutive variations in the singing of one individual. In this case the rhythm did not change. The difference lies in the relative pitches of groups of notes within the song, and although rather strikingly apparent on paper, this is difficult to detect with the ordinary type of superficial field-listening. The lower-right graph in Text-figure 1 is of a song that sounded remarkably like that of a House Wren, especially from a distance. The upper graph in Text-figure 2 shows a type of ending not heard from others in the colony. This ending is rather reminiscent of that in a Magnolia Warbler's song. The similarity begins and ends on that feature, however.

Further variations in the song of one individual are presented in the upper-left graph of Text-figure 1, the lower graph in Text-figure 2, and the graph (note the larger scale) in Text-figure 3. These are all songs of one male, given at different times during our visit. A critical study of these three variations will show that although very different, they more resemble one another than they resemble any of the other songs represented by the other graphs which are those of other singers. Again, a casual listener

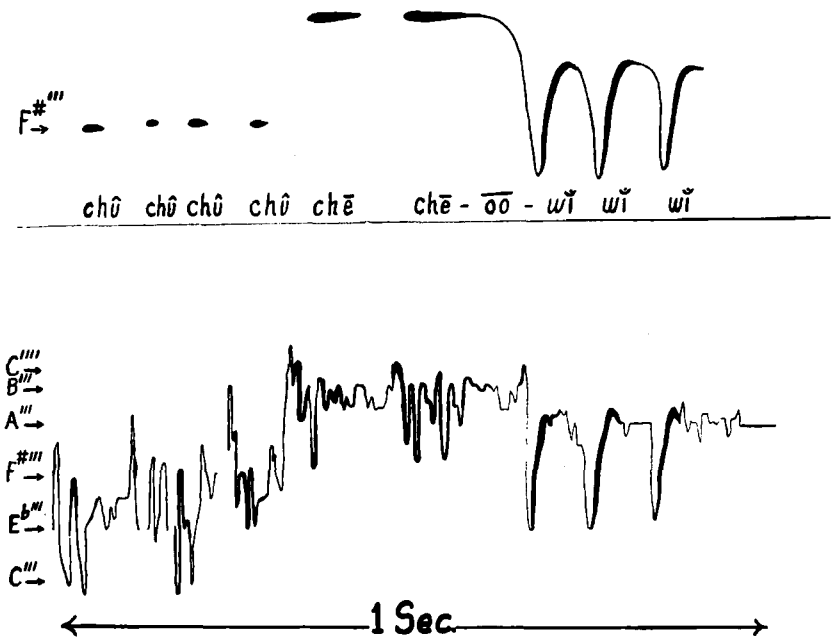


TEXT-FIG. 2.—Two more song variations of Kirtland's Warbler.

might readily overlook the existence of this variation. The difference, as heard in the field, is not striking unless one has a fairly good musical ear and listens attentively. If the singer gave one variation right after another, the difference would be more noticeable by contrast, but this seldom occurs.

It will be noted that the scale used in Text-figure 3 is much larger than that for the first six graphs. These two graphs of the same song show comparative results from two different methods of study. The upper graph represents how this particular song sounded to me. In order to draw the lower graph a photographic enlargement was made of the motion-picture film on which the song had been recorded, so that a single song as represented on an eighteen-inch strip of film was enlarged to a length of about fifteen

feet to simplify its study. The pitch was determined for each one two-hundredth part of a second, and the lower graph was made from these figures. Relative volume, as indicated by the height of the peaks of the sound waves shown on the film, is represented on the graph by the heaviness of the lines. The result is a highly detailed picture of the bird's musical performance, in which some rather surprising facts are revealed. Pitch changes of several tones in less than one-hundredth of a second—far too fast to be caught by the



TEXT-FIG. 3.—Graphs of a single song of Kirtland's Warbler, showing comparative results from two methods of study. Upper figure, a graph as made by ear using Saunders's method; lower figure, a graph as made from analysis of sound track on film for the same song.

human ear—are a typical feature. Notes that sound staccato turn out to be merely the louder portions of a long, rambling slur. We observe that a tone consuming less than one two-hundredth of a second of time may be heard by the human ear unless it is immediately preceded and followed by other notes, conditions under which a sound equally loud and of three times the duration will not be distinguished at all, even by a 'quick ear.'

Perhaps most surprising of all is the fact that out of this apparent jumble of rapidly shifting pitches, one is able to determine which of these pitches he hears by selecting on the graph the most heavily shaded lines. Where the pitch slurs rapidly up and down, we hear only the top notes in the slurs, even though the volume may remain the same throughout. By checking

from the upper to the lower graph, it will be observed that the notes in the upper correspond in a general way to the most heavily marked areas in the lower graph, thus illustrating that although the human ear is a relatively imperfect recording device and misses many details, it does pick out the essentials.

In our field studies of the Kirtland's Warbler only one type of call-note was heard. It was loud and low-pitched for a warbler. It closely resembled the smack of the Brown Thrasher, but was slightly less loud. Likening it to the common scolding note of the Oven-bird would be better still. The syllabication may be said to vary from *tsyip* to *tshyook*. The birds did not seem to be addicted to scolding during our visit, so this note was not heard frequently.

SUMMARY AND CONCLUSIONS

At the time of nest-building the male Kirtland's Warblers under observation did not have favorite song perches.

The bird may have different habits at different periods of the breeding season.

The confusion and contradictions appearing in the literature on the song of the Kirtland's Warbler, especially in respect to the quality, syllabication, and observations on number of song variations possessed by the species, are probably due in most cases to differences in the musical and auditory acuity and in the individual interpretations of the various hearers who have described their impressions. It is impossible to give a wholly objective description of this warbler's song. My personal impressions, however, are that it does not have a quality at all like the Oriole's, nor can I detect any resemblance to the songs of the Maryland Yellow-throat or the Black-throated Green Warbler. To my ear it most nearly resembles the songs of the Northern Water-Thrush or the House Wren. Nearly all the published syllabications fit fairly well; none (my own included) is wholly satisfactory.

Each male observed changed his song now and then, and was not noted to use a song again after changing from it. Songs of one individual were always different from those of others in the colony. The song of the species may be almost infinitely varied, usually within the limits of a definite but general melody pattern, which appears to be diagnostic in most cases.

The song has notably more carrying power and a lower pitch than most warbler songs.

Anyone, however poor his musical ear, should be able easily to identify all reasonably typical songs (probably over 99 per cent) of Kirtland's Warbler, if acquainted with the essential facts mentioned herein, especially if he knows the songs of the Water-Thrush and the House Wren.

A study of the sound track, as recorded on motion-picture film by Mr.

Brand, shows that a Kirtland's Warbler song of one second's duration is an almost continuous slurring up and down, with varying degrees of loudness throughout. More than a hundred up or down slurs may occur in that one second of time, but no human ear can catch more than a small fraction of all these rapid changes of pitch.

There is much yet to be done in the advanced study of the Kirtland's Warbler's singing by some musical ornithologist. My own effort has been directed largely toward clearing up some of the confusion in the literature, presenting a more analytic and graphic description of the song, along with a number of elementary observations on the singing habits as observed at the beginning of the nesting season.

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