Sonograms as Aids in Bird Identification

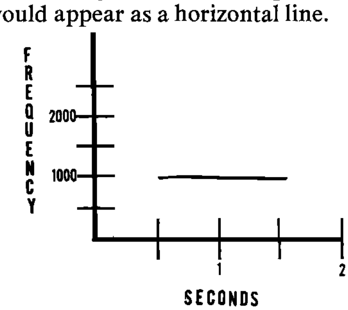
How to become as facile with sonograms as with all other distinguishing characteristics . . .

*Joseph C. Beaver**

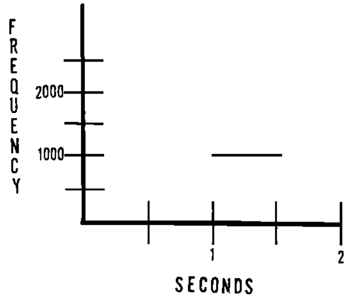
Peterson's classic field guides may never be replaced, but increasingly birders are using Robbins, Bruun, and Zim's *Birds of North America*, A Guide to Field Identification. This book incorporates several improvements over Peterson's; birds occurring in North America are shown in one volume, instead of two; pictures and descriptive texts occur on facing pages; a map of North America shows by means of shaded areas and coded iso-bars each species' distribution, migration routes, and approximate arrival dates. These are the principal improvements that have caused many birders to take afield both Peterson and Robbins *et al.*

Another feature of Robbins *et al.* is the sonograms depicting the songs, and calls of many of the species. However, this feature is not widely used, and on group trips one often hears it said that birders can't figure out how to use it. Others, in contrast, have found the sonograms of immense value The purpose of this article is to offer some suggestions about the use of sonograms that may be helpful in identifying poorly seen species in the field.

A spectrogram, or sonogram as it is also called, is a visual display of sound, made by an electronic instrument called a sonograph. An audible recording (maximum length 2.4 seconds) is fed into the sonograph as input. The "signal" is burned by a needle onto a special sheet of carbon-impregnated paper wrapped around a drum at the top of the sonograph. Technically, what the spectrogram shows is a plot of all audible frequencies (vertical axis) against time (horizontal axis), with intensity (or loudness) proportional to the darkness of the trace. By way of example: a steady tone one second long at 1000 cycles per second (1000 Hz), would appear as a horizontal line.

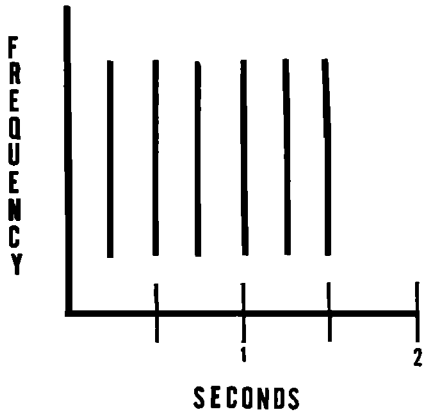


If it lasted only half a second it would be half as long.



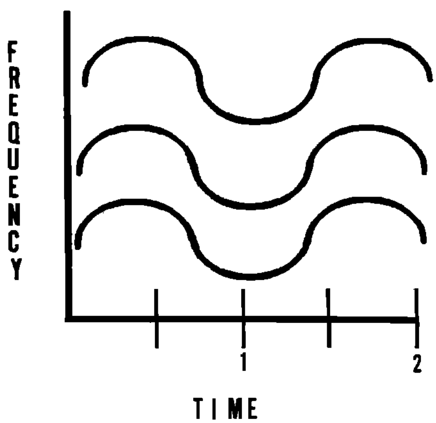
*Department of Linguistics, Northeastern Illinois University, Chicago, Illinois 60625.

A series of six knocks on a door, one-quarter second apart, would look like this:



Noise — as opposed to tonal sound — consists of random frequencies occurring simultaneously, or, on top of each other.

A wailing siren has pitch but the pitch varies, so it looks like this:



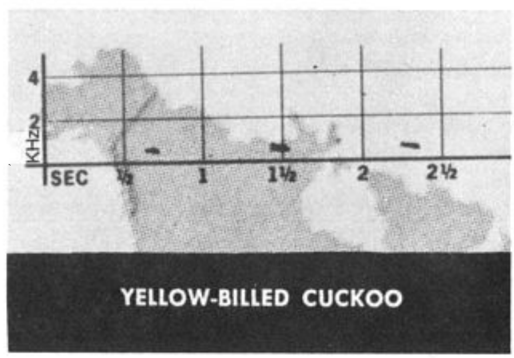
The presence of the multiple parallel sine lines (harmonics) shows that a "tone" can consist of not one frequency only, but several different frequencies.

For purposes of identifying bird songs, sonograms show **pitch, intensity**, and **duration**. In combination, they show a **pattern** referred to as a song.

Additionally, Robbins *et al.* usually indicate at the end of the verbal description of the bird, approximately how often the song is repeated per minute.

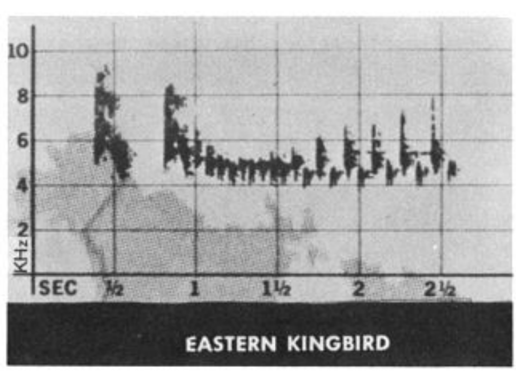
Of these four characteristics, the most valuable for the birder are the **duration** (both of the song as a whole, and of its individual parts), and the **pattern** (the total look of the spectrogram, i.e., where the breaks occur, etc.). Pitch (frequency) and intensity (loudness) are less useful. Let us consider each aspect, beginning with pitch and intensity.

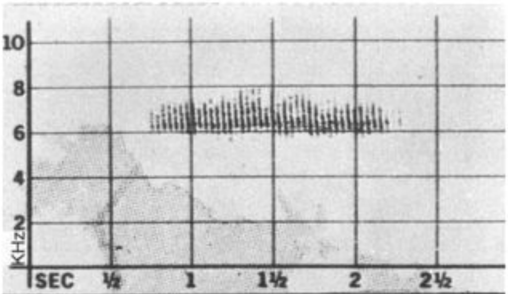
Photographs of sonograms in Robbins *et al.* are printed above many of the species distribution maps, and appear as rectangular grids of perpendicular and horizontal lines. On the vertical axis is plotted frequency or **pitch** (how high the sounds are). The scales consist of a number of parallel horizontal lines, depending on the pitch range of a particular song. For example, the sonogram of the Yellow-billed Cuckoo has three parallel horizontal lines: the lowest represents 0 Hz (cycles per second); the next one represents 2000 Hz, and the next one represents 4000 Hz (Robbins *et al.*, use only "2", "4" etc., as abbreviations but it is understood that this is 2000 Hz, 4000 Hz, etc.) There are three marks on the graph showing sounds made by the cuckoo — they appear to occur at about 400 or 500 Hz (about an octave above middle C on the piano), and the sounds occur about three-quarters of a second apart.



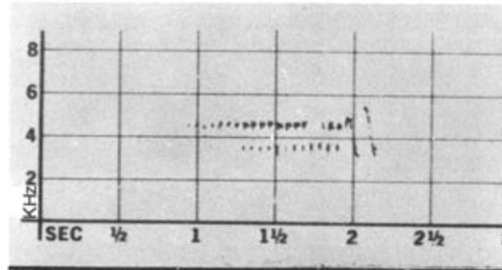
By contrast, the sonogram for the Eastern Kingbird shows pitch up to 10,000 Hz, because the pitches present in the kingbird's song range from 4000 Hz to 10,000 Hz. Incidentally, 4000 Hz is roughly the pitch of the highest note on the piano.

Absolute pitch indication is of little help. Consider the trills of the Worm-eating Warbler, the Orange-crowned Warbler, and the Pine Warbler





WORM-EATING WARBLER

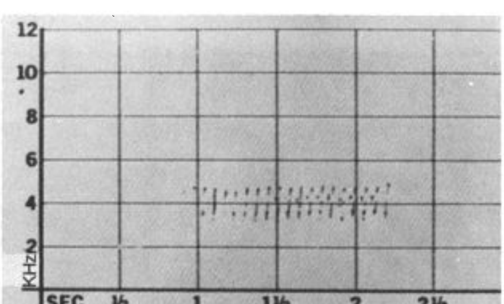


ORANGE-CROWNED WARBLER

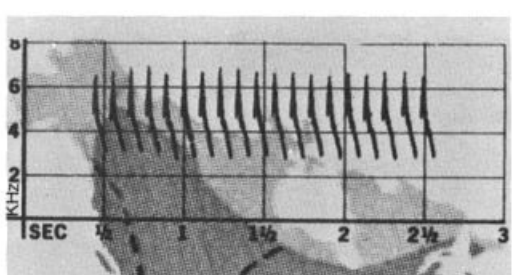
The Worm-eating Warbler's trill is between 6000 and 7000 Hz; the Orange-crowned's is about 4000 Hz,and the Pine's about 4000 Hz. However, since 4000 Hz is near the upper limit of absolute pitch distinguishable by the human ear, the *perceived* pitch of the Worm-eating Warbler's song in the field, may seem to be no higher than the other two. Although 6000 Hz may seem like much more than 4000 Hz, it would in fact be only a third of an octave higher, in a range where the human ear is not equipped to perceive absolute differences well.

To demonstrate that the ear will not ordinarily perceive absolute differences in pitch above 4000 Hz, compare the sounds "sssss" and "shhhh." They may sound qualitatively different to you, but probably indistinguishable as difference of "pitch." The former consists of random noise beginning at about 7000 Hz and ranging upwards, the latter, of noise beginning at about 5000 Hz and ranging upward. This is comparable to the difference in pitch of the trills of the Worm-eating and Orange-crowned and Pine Warblers. The length of the three trills is about the same. Even the frequency of repetition is no help: Robbins *et al.* gives the Worm-eating's as four to six times a minute, the Pine's as four to seven, and does not mention the frequency of repetition of the Orange-crowned's. To add further complication, the authors note that the Pine Warbler's trill is "slower" than that of a Chipping Sparrow. This is clearly not so, for comparison of the Pine's song with the Chippie's song, actually counting the trills, shows that the Chippie's is about eight times per second, while the Pine's is 12-14 times per sec ond. The comment by the authors indicates their subjective, or perceived impressions. These are not always in accord with the facts. In these cases, one must seek corroboration by visual means, or, in nesting season, by habitat.

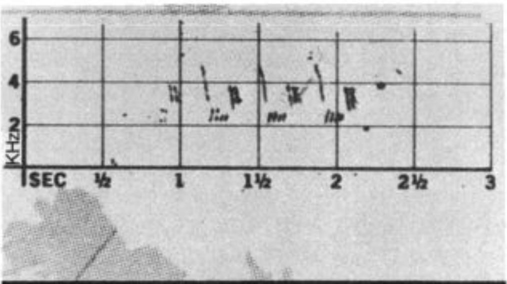
Intensity (loudness) is depicted on the sonogram by the relative darkness of the bird's song — the darker, the louder. Although it is difficult to compare the loudness of one song with another, within one sonogram one can usually tell if one part of the song is louder than another. One should not assume that because the song of species A looks fainter on the sonogram than the song of species B, that Song A is necessarily softer. The song of the Worm-eating Warbler appears much louder (darker) than either of the other two, but in the field, the volume of all three warblers sounds nearly the same. The sonograms show the song of



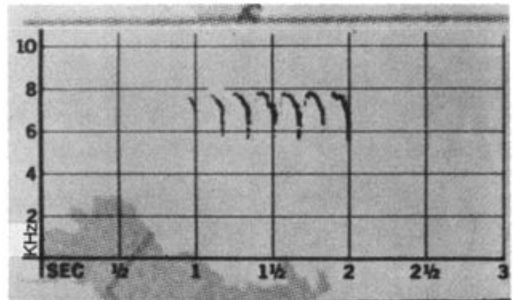
PINE WARBLER



CHIPPING SPARROW

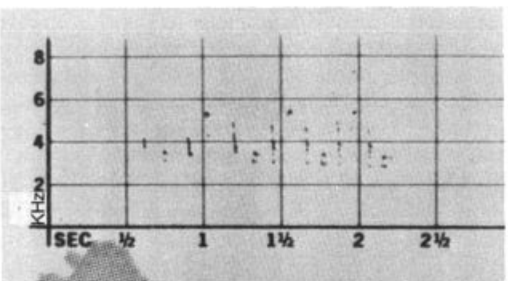


MOURNING WARBLER



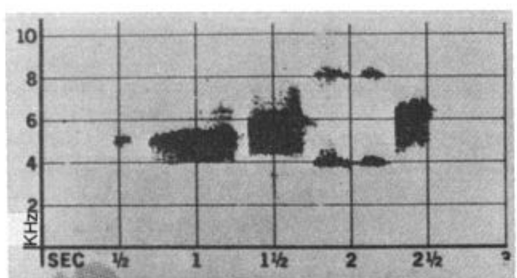
CAPE MAY WARBLER

the Mourning Warbler as much stronger than that of the Connecticut Warbler, but the authors say that the Mourning's is "soft," the Connecticut's "loud."



CONNECTICUT WARBLER

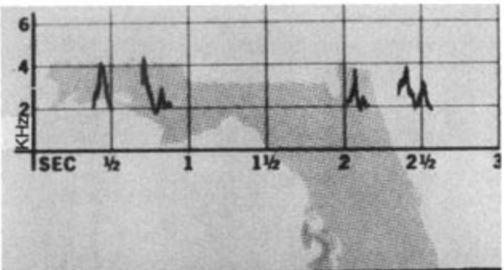
Now let us turn to the most valuable features in song identification — **duration** and **pattern.** On the horizontal axis, is plotted **duration**, the time between each successive pair of vertical lines being one-half second. The time unit is always one-half second. Thus each sonogram depicts a 3 second length, though in fact an actual sonogram can show only 2.4 seconds. To show some lengthy songs, i.e., the Yellow-breasted Chat's, several successive sonograms are pieced together, (Somehow the authors failed to do this for the Yellow-billed Cuckoo). With practice, by counting aloud while watching the sweep second hand on a watch, one can learn to estimate duration at a rate of 60 beats per minute or one every second. Here is an old piano tuner's trick: whisper "from Milwaukee to Chicago" over and over again as fast as possible with the stress on the second syllable of "Milwaukee." The time between successive "wauk's" will be approximately one second. This is twice the length of time between two adjacent vertical lines in the sonograms, which, again, are one-half second apart. Notice that the song of the Chipping Sparrow is about two seconds long. Note that the Cape May Warbler's is one second long. The familiar Black-throated Green's song, represented mnemonically as "trees, trees, murmuring trees," is about two seconds long. This suggests an



BLACK-THROATED GREEN WARBLER

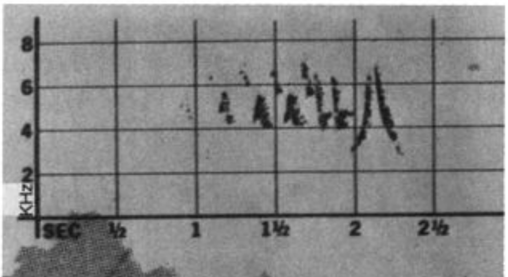
approach to determining total song length. By counting the number of seconds between the beginning of successive songs, then dividing 60 by that, the frequency of song utterances per minute is determined. Length of individual parts of the song may also be seen. The first two utterances of the Black-throated Green Warbler's song are typically longer than the remaining ones.

To illustrate the usefulness of duration and timing, let me relate the following. While on Sanibel Island, Florida, where we knew that the Black-whiskered Vireo occurred, my wife and I searched for it. The song is vireo-like, and within the typical vireo range (2000 to 4000 Hz). But notice in the sonogram that the song consists of a set of paired notes — the notes are about one-half second apart, and the song is repeated 20-32 times per minute. I heard a vireo-type song of this time pattern in some trees in the Bailey tract of the J. Ding Darling Refuge, and immediately knew it was the bird for which we were looking. Thus it was worthwhile to keep looking (as one must for some vireos) until we located the bird with its tell-tale black whisker mark. It is a simple fact that one can



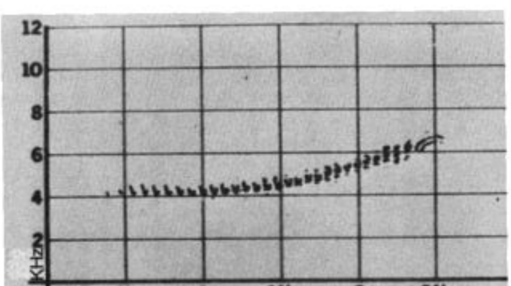
BLACK-WHISKERED VIREO

identify a heard song by reading the picture of the song, just as one may identify a seen bird by looking at a picture of the bird.



CHESTNUT-SIDED WARBLER

Let us consider finally, **pattern.** Though many bird songs are far too high to conclude anything about absolute pitch, it is evident that they go up or down relative to themselves, and on the sonogram, the pattern of ups and downs, and the pattern of noise and silence is evident. The Prairie Warbler's rising trill is an example. From the sonogram of the Chestnut-sided Warbler, one can visualize that which is mnemonically represented in "I want to see Miss *Beecher*."



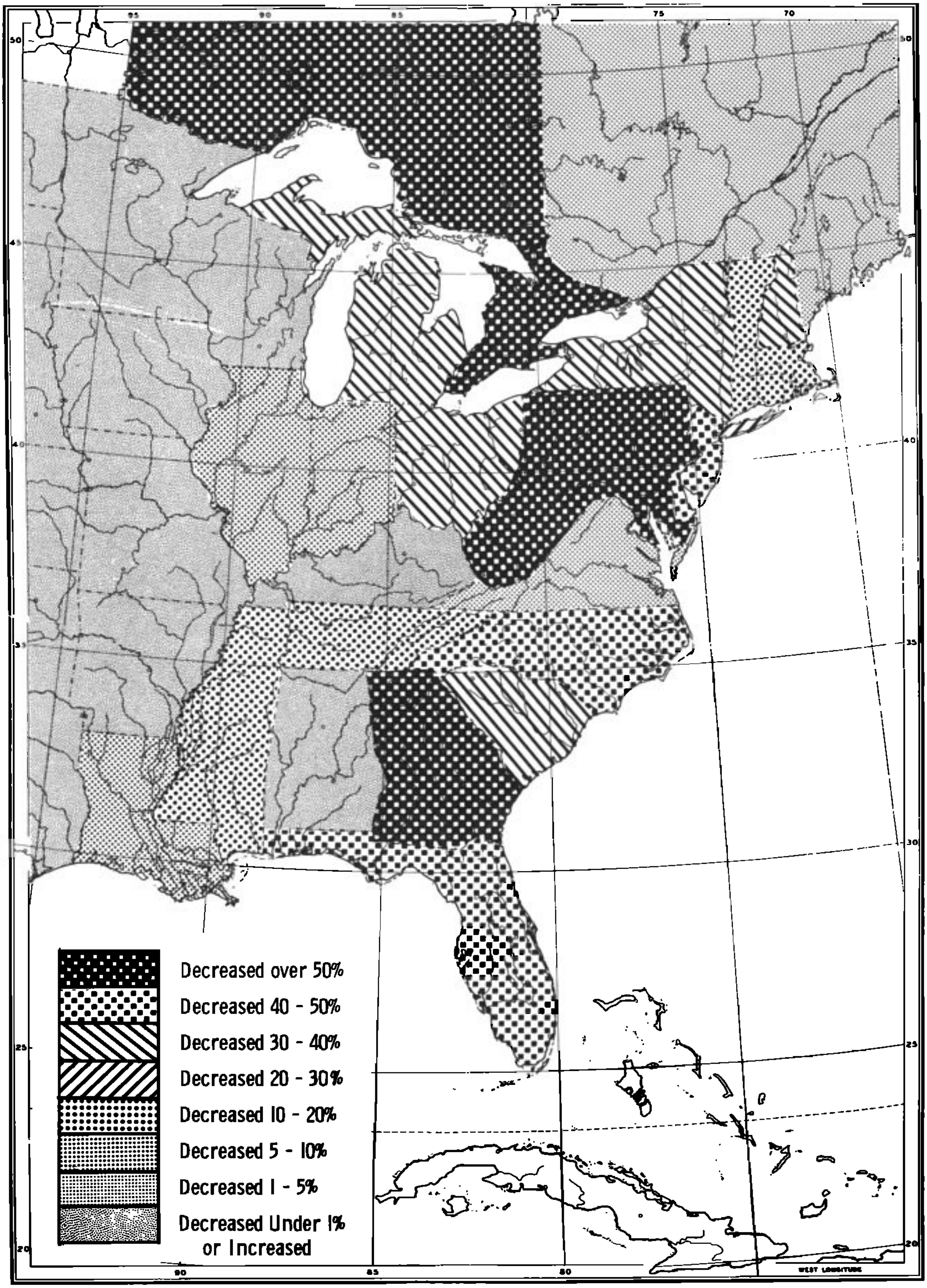
PRAIRIE WARBLER

In the Indiana Dunes Park, a fleeting glimpse of a Connecticut Warbler was confirmed by the sonogram. It was a loud, jerky song repeated about six times a minute (notice that the sonogram does not look loud). Near the same spot a Kentucky Warbler's song was recorded. Sonograms made from the recording corresponded exactly with those in Robbins *et al.*

The Black-throated Green's song shows a pattern of sound and silence, which, when timed properly, can be a means of absolute identification. Notice that the fourth and fifth segments represented by "murmuring," in "trees, trees, murmuring trees", show frequencies at two levels, 4000 Hz and 8000 Hz, occurring simultaneously Many bird songs do not show this phenomenon, particularly those of the smaller birds. Such harmonics give various musical instruments their characteristic sound qualities. This is the explanation for the frequent description of the Veery's song as "fluty," for it exhibits simultaneous sounds at different frequency levels in much the same relationship as in a flute. The American Coot, some rails, Laughing Gull, and Black-necked Stilt are other birds that show pronounced harmonics in their calls. Perceptually, such calls appear to have greater depth or richness.

Although the songs sung by individual birds of a species are not precisely the same, and although it is well-known that many species show "dialectical" differences, they do not vary as much as the sentences of human language. The songs are normally remarkably alike with individual differences, frequently sufficient to set a particular bird apart from others. While assisting in the annual count of Kirtland's Warblers conducted by the Michigan Department of Agriculture, I made tape recordings of six or seven different males. These show sufficient idiosyncratic differences so that I could undoubtedly return to the Jack Pine region of north central Michigan, and by recordings fed into the sonograph identify whether or not I again had one of those same birds.

Next spring, don't neglect the sonograms in Robbins' book. One should listen to a bird whose song one knows well while simultaneously studying the sonogram. In this way, familiarity with the parameters of pattern and duration is gained This is most useful with the birds which do sing frequently, but which are most difficult to see — various warblers, some thrushes and sparrows, rails, etc. Before going on a field trip, ascertain from the distribution maps which species one can expect to find. Listening to recordings of these species' songs in advance will prove an invaluable aid in identification. Most importantly, take the Robbins' book afield and become as facile with the sonograms as with all of the other distinguishing characteristics of birds.



Overall Changes in Black Duck Percentages Reported in Table I