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Physical Properties of Cawing in the Common Crow

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The physical properties of the cawing of crows are examined. The results confirm that different sequences of cawing differ in the physical properties of their caws as well as in their temporal properties.

Recent research on the vocalization of crows (Thompson, 1968, 1969) has suggested that their cawing is a system of individual identification. This inference is based on an accumulation of evidence that a cawing crow maintains a pattern of sound which is consistent and distinct at least over several minutes and probably for several hours or more. Caws are commonly emitted in bursts of from one to six caws per burst. Sequences of cawing, made up of several of those bursts, have been shown to differ reliably in a number of independent temporal properties–in the duration of the individual caws, in the intervals between caws, and in the number of caws per burst. To the observer in the field, these differences are heard as differences in the speed of the caws and in the length of the bursts.

Heard in the field, different sequences of cawing seem also to differ in the physical properties of the individual caws. The caws of some sequences seem to be high, clear, and sharp while the caws of other sequences seem to be low, blurred, and rough. Apparently sequences of cawing differ not only in the rules by which the caws are assembled into bursts but also in the physical nature of the caws themselves.

METHOD

To check this observation, several hundred recordings were made of wild birds in the field. From these, 19 sequences were isolated of high and consistent recording quality. From each of the sequences a sample of 12 caws was taken representing a variety of bursts within the sequence and a variety of positions within a burst. These caws were visualized on a Kay Electric Sonogram using a wide band pass filter.

RESULTS AND DISCUSSION

The results of these procedures was the array of 190 caws shown much reduced in Fig. 1. From this array, certain facts about the caws of crows are evident.

The caw of the common crow is composed of one or more chevron-shaped harmonics, mostly in the range from 250 to 5000 Hz. A common feature of all caws recorded was a strong harmonic centered around 1000 Hz with an average inflection of 200 Hz and an average breadth of 400 Hz. This basic element may be elaborated in a number of ways. Additional harmonics may be emphasized above the usual harmonic as in sequences 17C, 09, 24, and many others, or below it, as in sequences 09 and 10. Additional elements may also be tacked on to the end of the chevron as in sequences 01, 09, and 04.

As field observations suggest, the caws within a particular sequence tend to be more similar in their physical properties than the caws of different sequences. Qualitatively this inference can be confirmed by studying Fig. 1 and ascertaining that the caws of different sequences have idiosyncratic elements which they share with few or any other sequences. Many of these idiosyncracies are apparent in Fig. 1 despite the great reduction. For instance, 17C has a second harmonic which is wrapped around the typical harmonic; this second harmonic commonly has a break near its apex. Sequence 09 displays a uniquely complex harmonic

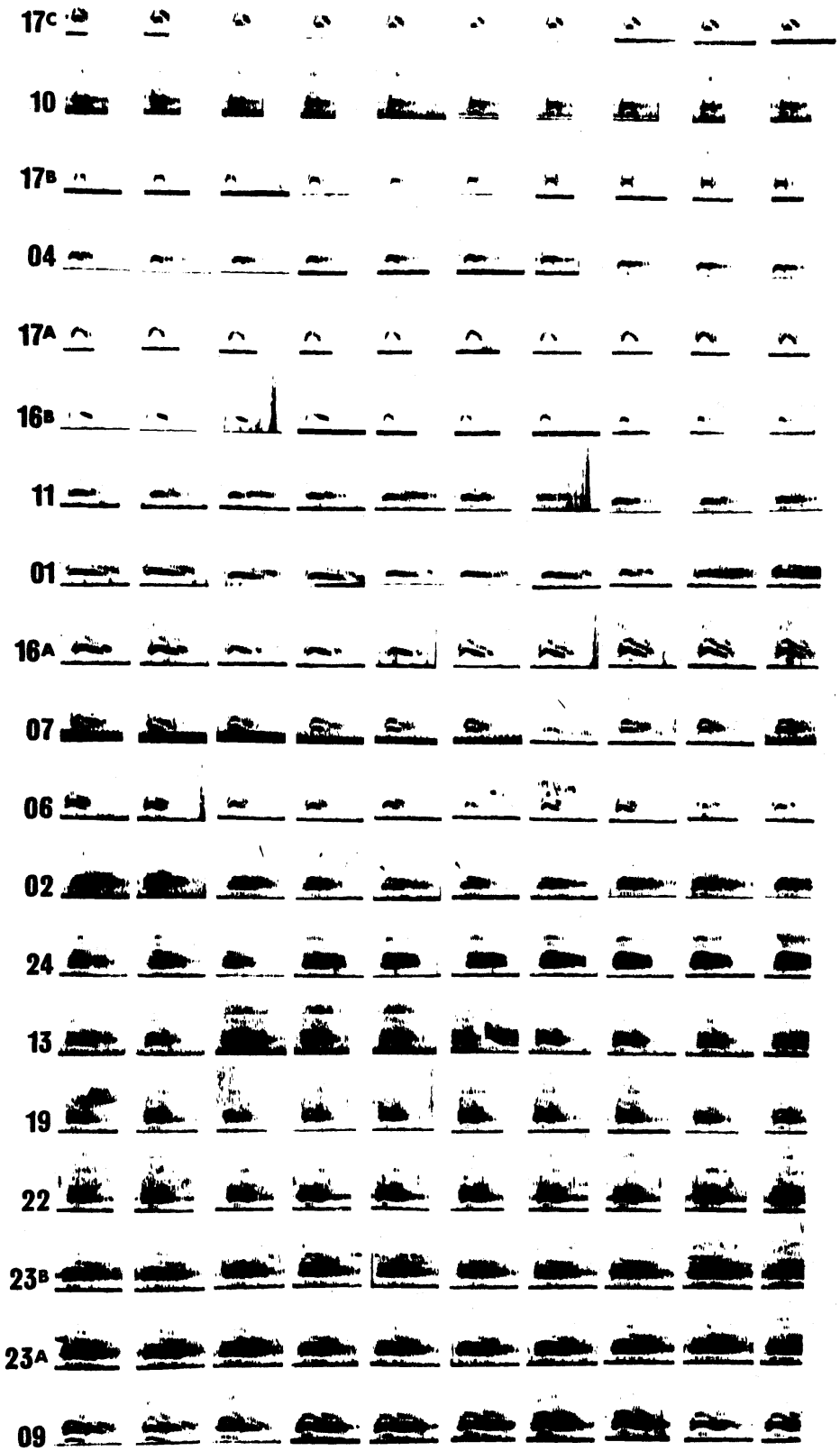

Fig. 1. Sound spectographs of 190 caws. Each row is a sample of 10 caws from a sequence of caws given by a single crow. Each sequence displays characteristic patterns of sound.

structure with harmonics being added and discontinued throughout the caw. Sequence 17B has a second harmonic which appears at the very beginning and very end of the caw, but not elsewhere. For a final instance, the harmonic of sequence 16B is very steady in its emission, whereas most show pronounced oscillations both of pitch and amplitude.

Quantitatively, the homogeneity of caws within a sequence can be demonstrated by making measurements on that element which is common to all sequences. Overall, the common harmonic ranges approximately 500 Hz in pitch, 400 Hz in the depth of its inflection, and 300 Hz in its breadth. Within sequences, the variation is somewhat less. The average range within sequences on all three variables is about 150 Hz, a value which approaches the limits of accuracy of the equipment used to estimate pitch. Nonparametric analyses of variance confirm that the pitch, the breadth, and the inflection of the common harmonic are stable features within a sequence (P values all less than 0.001, Kruskall-Wallis test).

Apparently, a common parameter underlies variation in these three measures. Spearman correlation coefficients computed between the three measures reveal that the higher pitched calls tend to be narrower (Rs equals 0.72) and more deeply inflected (Rs equals 0.56).

These results confirm that different sequences of cawing differ in the physical properties of their caws as well as in the temporal properties previously demonstrated.

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