VOCALIZATION BEHAVIOR OF THE RING-NECKED PHEASANT

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THIS study examines the behavioral significance and sound spectrographic structure of the vocal repertoire of the Ring-necked Pheasant (*Phasianus colchicus*).

METHODS

Field observations were made over 3 years at several farmland areas in southern Michigan. Most observations of captive birds were made at the Mayer Pheasant Farm in Brighton, Michigan; other captive pheasants were kept at the Rose Lake Wildlife Experimental Research Station and at Michigan State University in outdoor and indoor pens, and, in the case of small chicks, in brooder pens.

Calls were recorded at 7½ inches per second on a portable Uher 4000 Report-L tape recorder equipped with a Uher M514 microphone, which was often used with a 24-inch parabola. Spectrographic analysis of vocalizations was made on a Kay Electric 661A Sonograph on wide band analysis. Recorded calls were played back to pheasants on a portable Ampli-Vox S-200 Diplomat amplifier and loudspeaker unit

To stimulate crowing in one male, one dose of 100 mg testosterone propionate U.S.P., suspended in corn oil, was injected intramuscularly into its leg.

CATALOG OF CALLS

Described here are 16 calls of fairly definite meaning; we recorded several other vocalizations that we considered not well enough understood to include in the catalog at this time. There seem to be no calls that humans cannot hear, and only minor parts of any call fall outside the hearing range of the pheasant, which Stewart (1955) found to extend from at least as low as 250 cycles per second (cps) up to a minimum of 10,500 cps. To avoid confusion in the literature we have not renamed any calls previously described by other authors; caution should be taken, however, not to place undue emphasis and meaning on such anthropomorphic call designations as "alarm," "content," and "caution." The terms used to describe sound spectrographs are, in large part, those set down by Davis (1964).

ADULT MALES

Crow.—The crow is a harsh two-syllable call that may be heard all year but is by far most commonly uttered in the spring when males establish territories. Dawn and dusk are favored times for crowing, although we have heard this call throughout the day, and Kimball (1949) notes that crowing is sometimes heard on moonlit nights. The amount of crowing by a male is reportedly not significantly affected by the following weather factors: dew, temperature, nebulosity (Kozicky, 1952), relative humidity, fog, or mild rain (Kimball, 1949).

Leffingwell (1928) and Allen (1956: 20) state that the crow warns males not to trespass into the territory defended by the crowing bird. In 1966 we tested the response of territorial males to tape-recorded crowing and found that resident cocks approached the loudspeaker and voiced the alarm call; this response is discussed in detail under the alarm call. In 1968 we were never successful in eliciting the alarm call response by playing tape-recorded crowing within a male's territory. We cannot at this time explain the failure, but the 1966 results indicate that the crow call may alert a male to the intrusion of another male into its territory. As yet no evidence supports the hypothesis that crowing inhibits one male from entering into another's defended area. Leffingwell (1928) and Allen (1956: 20) also suggest that crowing may advertise the presence of a male to hens, but hens never approached tape-recorded crowing in our study, nor did Ruffing (1952: 70) ever see hens attracted to live crowing males.

Both hormonal factors and sensory releasers may act as stimuli for crowing. Kimball (1949) demonstrates a direct relationship between gonad weight and crowing frequency that suggests testosterone may be in part responsible for crowing, as it has been shown to be important in the vocalizations of so many other species. We were able to induce crowing in a male entering summer molt by injecting it intramuscularly with 100 mg of testosterone propionate. Various external factors have been reported to evoke crowing: thunder, slamming of car doors, crowing of other males (Kimball, 1949), explosions (McClure, 1944), and earth tremors (Leffingwell, 1928). Gates (1966) demonstrates statistically that the amount of crowing by a population of males is related to the density of that population, indicating a greater competition for territory or a mutual stimulation of crowing. Bendell and Elliott (1967) similarly report that males of Blue Grouse (*Dendragapus obscurus*) in a dense population hoot (the territorial call) more than males in a sparse population. However in direct observation of Ring-necked Pheasant males, Ruffing (1952: 70) never saw one male respond vocally to the crow of another. In our study broadcast of tape-recorded crowing did not increase crowing in wild males.

The structure of the crow call is disyllabic with each syllable having the same harmonic structure of a fundamental at about 800 to 1,000 cps and a set of overtones at 800 to 1,000 cps intervals above the fundamental (Figure 1). Frequency and amplitude modulations result in a harsh quality in the crow. The call is generally about ½ second long, but the timing of the syllables and pause between syllables varies considerably. Although we did not measure the intensity of any pheasant calls quantitatively, the crow appeared to be the loudest call. Kimball (1949) describes the crow as audible for about 9/10 mile under favorable conditions.

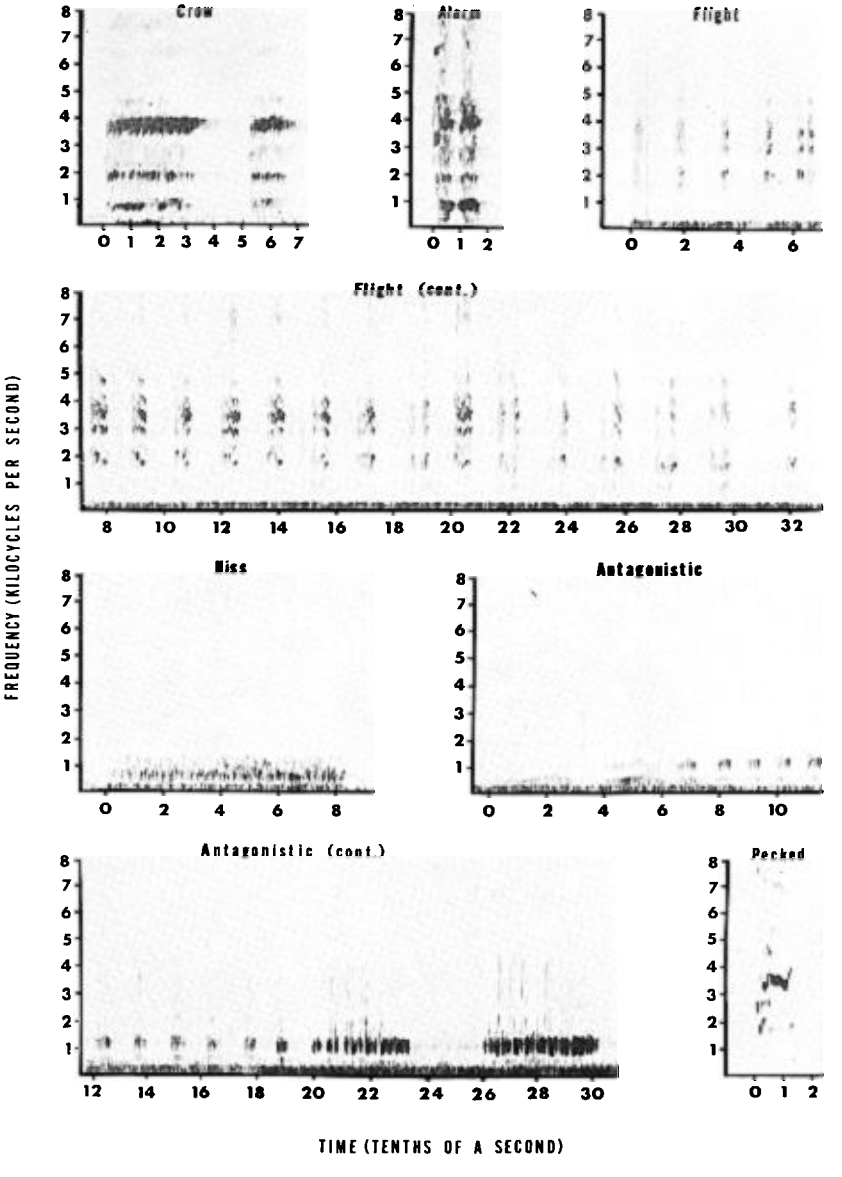

Figure 1. Calls of adult male Ring-necked Pheasants.

Alarm.—The alarm call is often given when a strange or menacing sight or sound confronts captive or wild males, and frequently calls from one male will elicit calling in another. At dawn and dusk one occasionally hears a chorus of alarm calls with no apparent stimulus. In addition to

its function as a warning signal, the alarm call may signify antagonism between males. In 1966, the alarm call response to tape-recorded crowing was a stereotyped form of calling behavior in which the territorial cock silently approached the loudspeaker and began voicing alarm calls when about 10 to 50 feet away. As the approaching male began calling the alarm calls were spaced about ½ second apart; calling gradually diminished over a period of minutes to about one call every 2 or 3 seconds. Males often continued calling for over 10 minutes. Beebe (1931: 45) felt that the alarm call might function to attract hens or act as a guiding call to the feeding grounds, but we have no evidence to support either claim.

Structurally the alarm call is similar to the crow, although it has less well-defined harmonic bands (Figure 1). Leffingwell (1928) describes the call as "a di- or tri-syllabic call which may be given as cucket, tucket, or tucketuck," but actually the predominant forms are the mono- and disyllabic calls. Calls sometimes seem to gain one syllable by changes in inflection within a syllable, and therefore Leffingwell was probably describing one- and two-syllable calls. There appear to be no behavioral differences in the use of mono- and disyllabic alarm calls, and the same male may voice both forms, although one always predominates. Fundamental frequencies are somewhat below 1,000 cps, and frequency bands exhibit frequency and amplitude modulations to a greater extent than in the crow. One-syllable calls are about 1 decisecond long, and two-syllable calls are composed of two 1-decisecond syllables separated by a pause that varies in length but seldom exceeds 1 decisecond.

Flight.—When approached closely in the field, males generally give voice to the flight call as they take wing to escape. We also heard flight calls from males as they rose, presumably undisturbed, from a roosting area in early morning. Stokes (1961) reports the same unexplainable phenomenon for the ground alarm call of the Chukar Partridge (*Alectoris graeca*), a call which he characterizes as "similar in nature" to the pheasant's flight call. We noted the use of the flight call by one male that flew toward a loudspeaker broadcasting crowing calls within its territory.

Males begin calling upon taking flight and continue calling for a variable length of time up to several seconds. Calls are spaced fairly evenly apart every 1 or 2 deciseconds until the few final calls, which may be more irregularly spaced. Flight calls may be either mono- or disyllabic, and occasionally a male will use both forms in the same flight call sequence. Mono- and disyllabic flight calls are generally shorter than the same two forms of the alarm call, but the harmonic structure is similar with the fundamental at 1,000 cps or less (Figure 1).

Hiss.—This call seems to have two functions. In both sexes the hiss is sometimes given when a captive bird is intimidated. Watson and Jenkins

(1964) report a hiss call given by the Red Grouse (*Lagopus lagopus scoticus*) under various intimidation situations and also during attack or sexual display. Bendell and Elliott (1967) note that female Blue Grouse with young chicks hiss as a defense display. We heard hisses from fighting chicks, but did not hear this call during sexual display of adults. Leffingwell (1928), however, reports hissing in male pheasants after a display pose was held, and Kozlowa (1947) notes that males of *Phasianus colchicus bianchii* hissed after copulation.

The hiss is audible only at close range and is composed of harmonic bands, although only the fundamental, occupying a wide band of frequencies from baseline (80 cps) to nearly 1,500 cps, is emphasized (Figure 1). Call lengths vary from 1 to more than 9 deciseconds, and the interval between calls is highly variable, ranging from less than 1 second to several seconds.

Antagonistic.—We noted penned males using this call during antagonistic encounters with other males. If we placed a mounted male pheasant in a pen with a resident male, the captive bird approached the mount, slowly circled and pecked at it, and produced the antagonistic call. Taber (1949) describes this call in the field as a hoarse "krrrrah" and feels that it might also be used as a warning by the dominant male against a subordinate cock, an observation supported by behavior we noted in penned pheasants. We once heard this call from a hen, believed to be either an intersex or a sex-invert bird (see Morejohn and Genelly, 1961), as she attacked and mounted another hen. The threat call or rattle of the male Blue Grouse described by Bendell and Elliott (1967) appears to be a similar close-range antagonistic call.

The antagonistic call is fairly complex in structure. Although the most intense sound occurs in a wide frequency band at about 1,000 cps, parts of the call extend throughout the 8,000 cps frequency range of the sonograph (the higher frequencies did not reproduce in the photograph in Figure 1). Sometimes two 500-cps syllables, each about 2 deciseconds long and spaced about 1 decisecond apart, initiate the antagonistic call sequence. After another1-decisecond pause, follow 10 or more ½-decisecond syllables spaced about 1 decisecond apart and loudest at 1,000 cps. Then follow several 2- to 5-decisecond pulses of calls with call syllables 1 to 5 centiseconds long within a pulse and with pulses separated by 3 to 5 deciseconds.

Pecked.—When pecked by another pheasant of either sex at times other than while fighting, males emit a dissonant sound that is accompanied by momentary retreat and no signs of antagonism. Nearby pheasants give no response to the pecked call. The structure of this call is harmonic with emphasized frequency bands from about 2,000 to 4,000 cps (Figure

1). Rapid changes in frequency are not uncommon during the call's 1-decisecond duration.

ADULT FEMALES

Pecked.—This call seems identical to the male's pecked call in both stimulus and meaning. The female's pecked call is a sharp, high-pitched sound characterized by a rapid slurring of the frequency upward, a bowed frequency band in the middle of the call, and a rapid slurring of the frequency downward (Figure 2). The call varies from less than 1 to over 3 deciseconds in length, and the frequency of greatest intensity ranges from about 4,000 to over 7,000 cps.

Squeak.—Sometimes when we approached a captive hen it responded with a high-pitched squeak, often as it flew to escape danger. On one occasion a wild hen used this call as she approached her chicks from which she had been frightened. The squeak is thus probably given by a hen distressed by potential danger. The squeak sound is composed of an upward slur, a concentration of sound energy at about 7,000 to 8,000 cps, and then a downward slur, all taking place in somewhat less than 1 decisecond (Figure 2). Calling is usually irregular, although sometimes hens squeak call once every few seconds.

Precopulatory.—Captive hens that crouched into the submitting posture often gave the precopulatory call, which they sometimes continued after being mounted by the male. Males quickly approached and mounted the calling hen. Hens called at all daylight hours, but most frequently in early morning. Stirling and Bendell (1966) report a precopulatory call for the Blue Grouse, and Stokes (1961) describes a copulatory call of the Bobwhite (*Colinus virginianus*) that did not attract the male and began slightly before or just as the male mounted; Stokes considers the Bobwhite's copulatory call a form of escape or distress call. Williams (1969) found that a peeping call from crouching female California Quail (*Lophortyx californicus*) attracted the male to mount and copulate. As with the precopulatory call of female pheasants, which the peeping call of female California Quail closely resembles structurally, the peeping call is sometimes not given until the male has mounted. Like the pecked and squeak calls, the precopulatory call is composed of an upward and downward slurred sound; the fundamental is at about 2,500 to 3,000 cps (Figure 2). Calls vary in length from less than 1 to more than 3 deciseconds, and the interval between calls ranges from 2 to 7 deciseconds.

Flight.—The hen's flight call is a high-pitched sound that we often heard in the field as a hen with a brood was frightened to flight. Kozlowa (1947) wrote of this call in *Phasianus colchicus bianchii*:

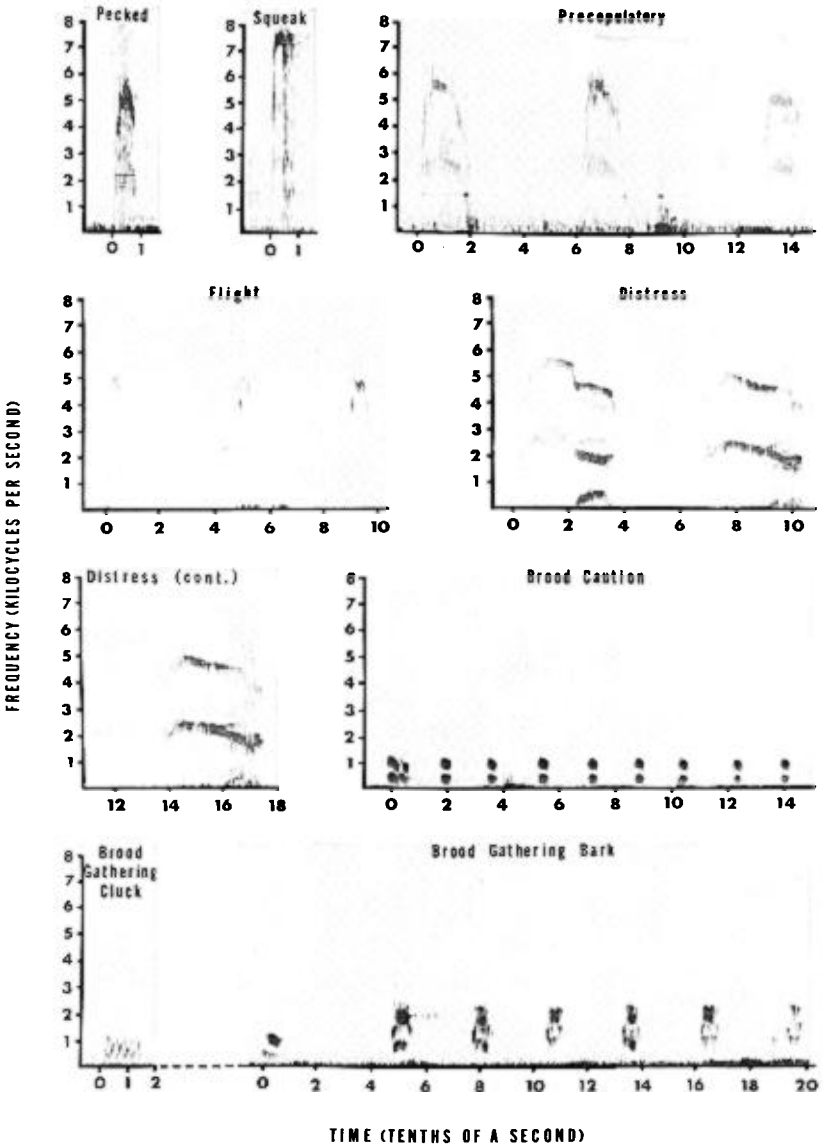

Figure 2. Calls of adult female Ring-necked Pheasants.

"If the intrusion happens to occur at the moment of rest, the hen takes wing silently and the chicks at once crouch on the ground under available cover. If, on the contrary, the family is surprised when feeding and the chicks are scattered about in the grass, the female, when taking wing, gives a soft cry. At this signal, evidently meaning alarm, the young immediately disperse, running or flying away."

This call, which probably functions to warn the brood of danger, begins when the hen is flushed and continues for a few seconds with calls spaced from less than 1 to more than 8 deciseconds apart. The call is a slurred syllable 4 to 6 centiseconds in length and is loudest in a frequency band between 2,500 and 5,000 cps (Figure 2).

Distress.—Captured hens sometimes made a high-pitched distress call that alarmed nearby pheasants and often evoked alarm calling from males. A similar call has been reported as a hand-held distress call for Gambel Quail (*Lophortyx gambelii*) by Ellis and Stokes (1966), and for California Quail in which both sexes give the "pseu pseu" call (Williams, 1969). The distress signal is harmonically structured with a fundamental at about 2,000 to 3,000 cps, but great frequency and amplitude modulations exist (Figure 2). Calls and pauses between calls are 3 to 4 deciseconds long.

Brood caution.—This sound is abrupt and low-pitched and is similar to the ground predator warning call of the domestic fowl (*Gallus gallus*) described by Collias and Joos (1953). Beebe (1931: 45) also reports this call, whose apparent function is to warn chicks of danger.

It is not uncommon to hear both caution and gathering calls in the same sequence of hen vocalizations. The study of hen-brood vocal behavior in the field is difficult because of the dense cover where the birds generally hide and call from; thus little can be said of the response of the brood to the hen's calls.

A low-pitched set of harmonics with the fundamental occupying a band of frequencies from 200 to 600 cps comprises the brood caution call (Figure 2). The first overtone is often as loud as the fundamental in the call, which averages 4 centiseconds in length with 1 to 3 deciseconds between calls.

Brood gathering.—According to our field observations, when a hen and brood are surprised the hen usually flies up to 60 yards away, while the chicks either run to cover or also fly away. From a few minutes to more than an hour later the hen is heard giving clucking and barking calls from about 10 to 20 yards distant as she returns to the spot from which she and her brood were flushed. The gathering calls of the hen generally silence the scattered chicks, which begin cheeping and wandering about before the hen's return. Hens continue calling for a few minutes and apparently regroup the brood in that time. If frightened away while calling, a hen returns later to resume brood-gathering calls.

A "low cluck" (Beebe, 1931: 46) and a "kee kee kee" (Bent, 1932: 315) have been reported as brood-gathering calls; these verbal descriptions fit fairly well the cluck and bark calls we observed in our study. Structurally the two brood-gathering calls are not similar. The cluck is a wide band of sound extending from baseline on the sonogram to about 1,500

cps and with some streaks reaching higher frequencies (Figure 2). Extreme frequency and amplitude modulations are present within the duration of the sound, which averages about 14 centiseconds; 8- to 14-decisecond intervals separate calls. The bark is higher-pitched; the most intense frequencies are at about 1,800 to 2,000 cps with lower- and higher-pitched streaks (Figure 2). Also a faint bowed frequency band occurs at about 4,000 to 4,500 cps, and calls are consistently 6 to 7 centiseconds long and are spaced every 2 or 3 deciseconds apart.

Chicks

The calls discussed below are peculiar to young up to 7 weeks of age:

Content.—We found chicks used this call, which Leffingwell (1928) describes as "ter-rit" or "ter-wit" with the accent on the last syllable, when they were warm, feeding, resting with other young, or settling down for the night. Like other chick calls, the content call changes structure as the young mature, but the general form is harmonic with the fundamental located at 3,000 cps or greater (note that in Figure 3 no examples are as low as 3,000 cps). Various rising and falling patterns of frequency characterize the content calls of different chicks, and only mild frequency modulation exists. Calls of young chicks may exceed 5 deciseconds, whereas those of older young decrease to about 1 decisecond. An interval of from 1 to greater than 5 deciseconds separates calls in a series.

Caution.—When we presented a strange object to a chick, the young bird slowly approached it, gave the caution call, and then generally pecked at it. Chicks also used this call during antagonistic encounters with each other, indicating that the call reflects both inquisitive and antagonistic behavior in young. The pitch of the main part of the caution call is about the same as for the content call, of which Leffingwell (1928) considers the caution call to be a modified form. Otherwise the content call bears little resemblance to the caution call, which is composed of three 2-centisecond-long syllables separated by pauses also 2 centiseconds long (Figure 3). Calls are spaced 2 to 4 deciseconds apart.

Flock.—We heard flock calls by chicks that had been separated from the hen in the field, and also by captive young that were isolated, hungry, or cold. The call therefore seems to function as a general distress call. Leffingwell (1928), who originally described the flock call, recognizes a separate fright call that chicks gave if held captive by an enemy and that frightened away nearby pheasants. In our study we felt that the more vehement calls given by a restrained chick were merely loud flock calls.

The flock call is harmonically structured with the fundamental variably pitched somewhere between 2,000 and 7,000 cps (note that in Figure 3 no examples have fundamental frequencies as low as 2,000 cps), and with

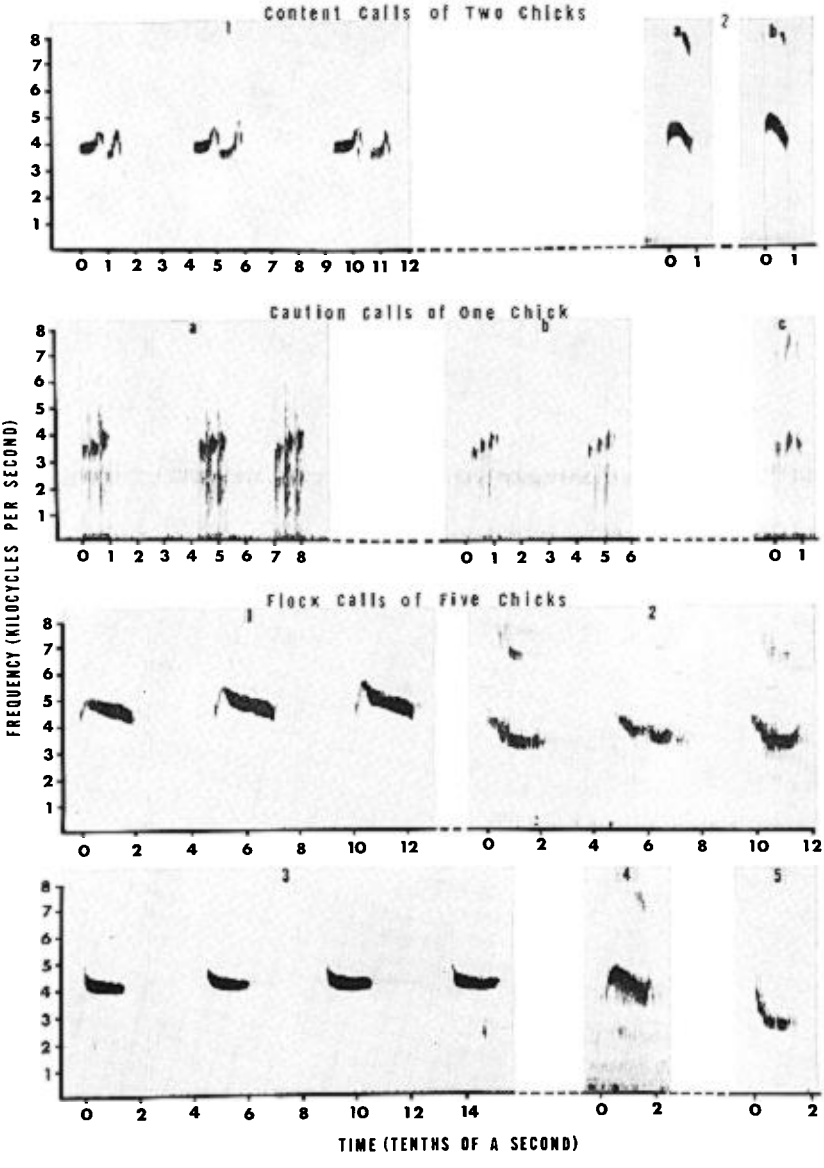

Figure 3. Calls of Ring-necked Pheasant chicks up to 7 weeks of age.

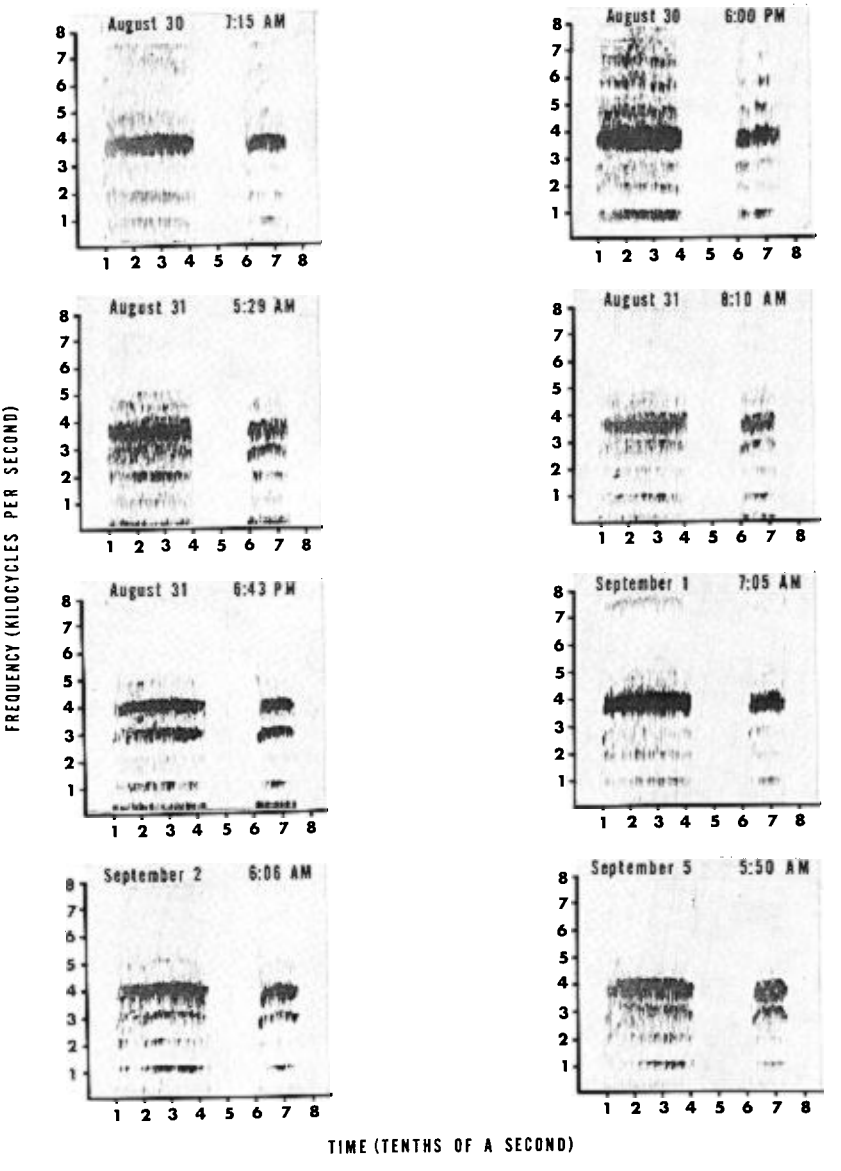

Figure 4. Intra-individual crow-call variation for a male on different days and at different times of the day.

slurring frequency bands covering as much as 2,000 cps. Calls are 1 to 3 deciseconds in length, and 2- to 3-decisecond intervals separate calls within one group. As a chick continues to call, the number of calls in a group increases to five or more. Groups of calls are usually separated by several seconds.

VARIATION IN CALL STRUCTURE

We examined both intra-individual call variation (changes in the structure of a call by one bird on different occasions) and inter-individual call variation (differences in call structure in different birds). Thus far the literature on galliform vocalizations makes little mention of either type of call variation, and reference has generally been to "typical" calls.

We found that inter-individual variation always exceeds intra-individual variation as best shown in the crow call. Little variation exists in the sonographs of eight crow calls, representative of extremes found in more than 40 sonographed calls of the same male (Figure 4); some apparent variation in these calls, recorded on different days and at different times of the day, is caused by distortion of sound during recording and by artifacts produced by the sound spectrograph. Figure 5 shows three crow calls for cocks 1 and 2; again the consistent character of this call within each male is evident, whereas distinctive differences in timing and pitch are noticeable among the eight different males represented. Greater intra-individual variation exists in the alarm call than in the crow; although each male uses a predominant alarm call form, occasional changes in structure are noticeable (Figure 6), particularly if a male is vocally fatigued after several minutes of alarm calling. Calls of chicks vary much more inter-individually than intra-individually; this is easily seen in the flock call (Figure 3).

Intra-individual call variation probably does not affect pheasant behavior, but inter-individual variation may act to identify a calling bird to other nearby pheasants. Kozlowa (1947) reports that females answer the "nuptial call" [crow] only of the male to which they are mated, and Edminster (1954: 11) remarks that males guard their harem's broods and respond to alarm notes of these hens. In the hen-brood relationship, inter-individual call variation could identify a hen to her chicks, but as yet no studies have been designed to establish whether pheasants recognize and act differentially toward inter-individual differences in calls. With both sexes of California Quail a bird, separated from its mate, gave vocal responses to the tape-recorded "cu ca cow" calls of only its mate (Williams, 1969). Apart from its effect on pheasant behavior, inter-individual call variation provides a possible tool by which one might identify individual birds confidently in the field without capturing and marking them.

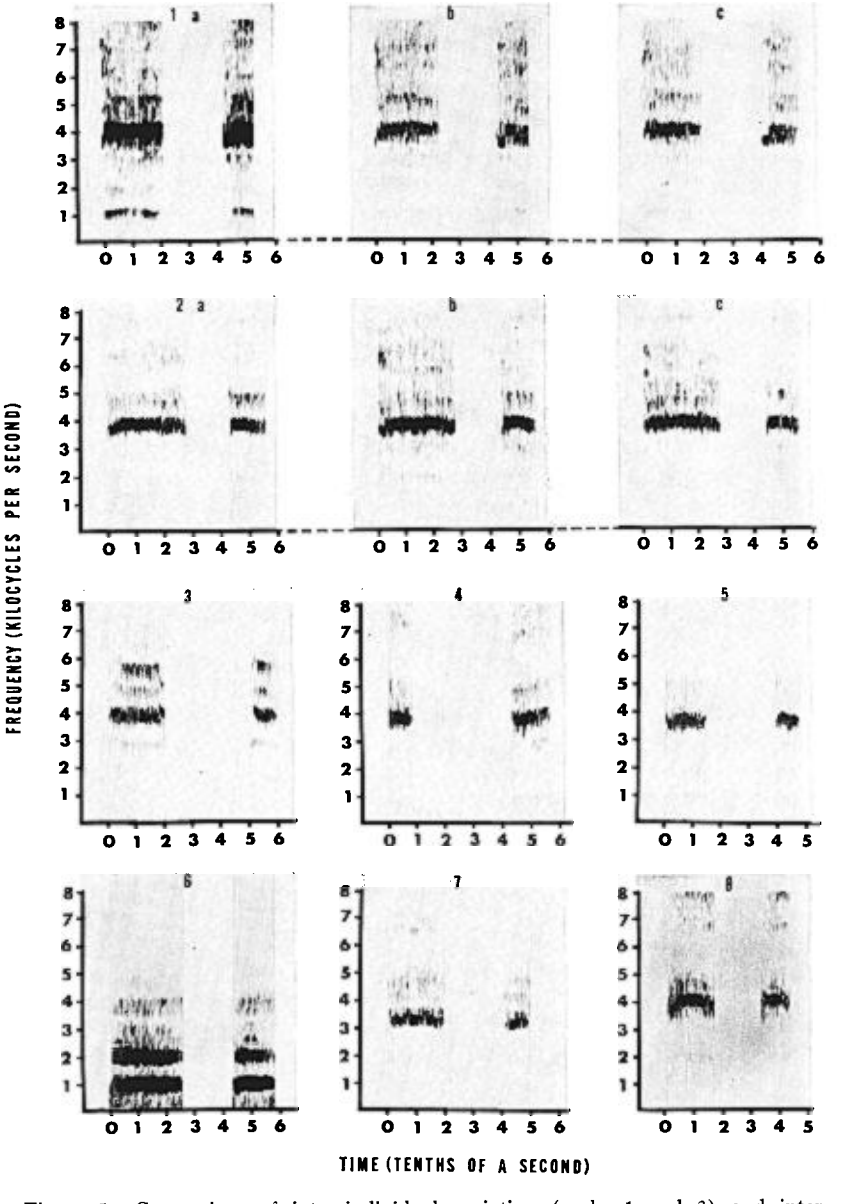

Figure 5. Comparison of intra-individual variation (cocks 1 and 2) and inter-individual variation (cocks 1 through 8) in the crow call.

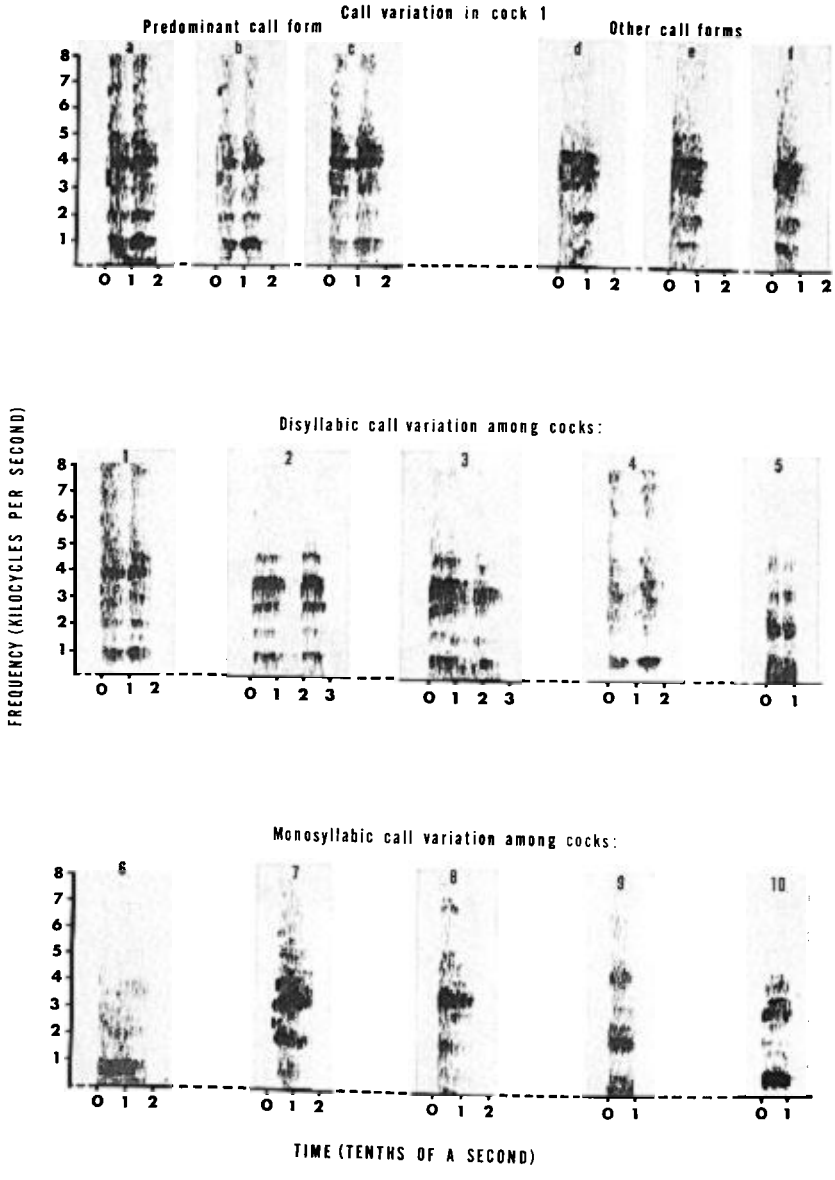

Figure 6. Comparison of intra-individual variation (cock 1) and inter-individual variation (cocks 1 through 10) in the alarm call.

Discussion

The variety of functions of the calls of the Ring-necked Pheasant indicates that vocalizations play an important role in this species' behavior and meet the needs to avoid danger, order social and reproductive interactions, and care for the young. Unfortunately assigning precise meanings to some calls is often difficult because no simple patterns of behavior can be associated with them. Just as intra- and inter-individual variations exist in call structure, both forms of variation are evident in the overall behavior of the pheasants using calls. Some of the differences in Ring-necked Pheasant vocalization behavior may be attributable to the genetic background of our wild birds. Edminster (1954: 1) recognizes three species —*Phasianus versicolor, Phasianus torquatus,* and *Phasianus colchicus* (several subspecies)—as having been introduced periodically into the United States, and MacMullen (1960: 11–13) concludes from a study of the variation in Michigan pheasants that the genetic origin of pheasants in this state is equally complex.

Because certain calls were seldom heard or were not easily assigned any definite behavioral significance, we have not included them in the catalog of calls at this time; some male breeding calls and a variety of female calls fall into this category. Hopefully additional study will reveal the significance of these less well understood vocalizations.

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Summary

This study was made to classify the behavioral significance and structure of Ring-necked Pheasant vocalizations. The results of 3 years of pen and field studies are summarized in Table 1. The calls in the vocal repertoire play an important role in the behavioral interactions of pheasants and convey information necessary in situations of danger, breeding, and care of the young. Spectrographic analysis of calls revealed that inter-individual variation in structure is greater than intra-individual variation,

TABLE 1
SUMMARY OF RING-NECKED PHEASANT CALLS

Call	Age	Sex	Probable stimulus	Possible function and behavioral response
Crow	Adult	M	Hormonal (?), loud noises	Eastablish territory, attract hens (?)
Alarm	Adult	M	Danger, territorial intrusion of another male, other calls	Warning signal, contact call (?), escape from danger
Flight	Adult	M	Close approach of danger, spontaneous	Warning signal, escape by flight
Hiss	Adult	M & F	Courtship, intimidation	Courtship display, antagonism
Antagonistic	Adult	M	Antagonistic confrontation with a male	Challenge signal, attack
Pecked	Adult	M	Pecked by another bird	Momentary discomfort, retreat
Pecked	Adult	F	Pecked by another bird	Momentary discomfort, retreat
Squeak	Adult	F	Approach of danger	Alarm signal, escape
Precopulatory	Adult	F	Hormonal (?)	Attract male
Flight	Adult	F	Close approach of danger	Warn brood of danger, escape by flight
Distress	Adult	F	Capture	Alarm, danger signal
Brood Caution	Adult	F	Danger	Warn chicks
Brood Gathering	Adult	F	Separation from brood	Attract chicks
Content	Chick	M & F	Comfort, food, companionship with others	Contact call (?)
Caution	Chick	M & F	Strange object, antagonism toward another	Investigatory or aggressive behavior
Flock	Chick	M & F	Isolation, discomfort	Contact call, regrouping

and it is often possible to distinguish individual birds on the basis of call structure.

Table 1 shows only the best understood vocalizations; additional work is needed to clarify the role of other calls in pheasant behavior, as well as to evolve practical uses of calls to census, trap, and study the behavior of pheasants, to understand better the importance of inter-individual variation in calls, and to describe more precisely and quantitatively stimulus-response patterns involving vocalizations.

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