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# Vocalizations of White-tailed Deer

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**ABSTRACT:** Twelve different white-tailed deer (*Odocoileus virginianus*) vocalizations were recorded. Ten of these were analyzed with a sound spectrograph. Alarm calls consisted of the snort, given when a deer detected danger, and a bawl, given when a deer was traumatized. Three agonistic calls were recorded. The low grunt was given in low-level agonistic interactions. The grunt-snort, given during more intense dominance interactions, consisted of the low grunt with 1-4 rapid snorts added. The grunt-snort-wheeze consisted of the grunt-snort with the addition of a wheezing exhalation through the nostrils. It was characteristic of dominance interactions among bucks during the breeding season. Four maternal-neonatal sounds were recorded. The maternal grunt was used by does searching for their bedded fawns. The mew was given by fawns and appeared to solicit care from the mother. The bleat was a more insistent care solicitation call and was given when fawns were disturbed or deprived. A nursing whine was given repeatedly while suckling. Mating calls consisted of a tending grunt and the flehmen-sniff. When separated from members of their group, females gave a contact call.

## INTRODUCTION

Ungulate vocal communication has received little scientific attention. Tembrock (1963) noted the fundamental frequency of some calls from several species of ungulates, but Kiley (1972) made the first in-depth measurements of the sounds of domestic cattle, swine and horses. Espmark (1975) used sound spectrograms to analyze the calls of reindeer calves (*Rangifer tarandus*) and concluded that the calls were distinct among individuals. Other studies of wild or captive ungulates are those by Nikolskii (1975) of red deer (*Cervus elaphus*), Gunderson and Mahan (1980) of American bison (*Bison bison*) and Yahner (1980) of muntjac (*Muntiacus reevesi*).

Various vocalizations of the white-tailed deer have been described by several authors (Hatt, 1937; Cowan and Geist, 1961; Faatz, 1976; Hirth and McCullough, 1977). Richardson (1981) and Richardson *et al.* (1983), however, were the first to systematically describe the calls of whitetails. Their study classified seven vocalizations and described social functions for each. We describe several additional vocalizations and further illustrate the social contexts in which these calls are used.

## METHODS

Vocalizations were recorded from a captive herd of white-tailed deer maintained by the School of Forest Resources of The University of Georgia. Most recording was in a 1.2-ha pen containing mature and immature animals of both sexes. Deer were allowed to interact and breed freely, except for short periods when they were segregated into various paddocks to facilitate certain types of interactions. Additional recordings were made from deer held in an auxiliary 0.4-ha pen and from hand-reared fawns maintained in smaller pens. Social situations associated with each call and additional field observations were used to classify sounds into 12 general types.

Recordings were made with a Uher 4000 Report IC reel-to-reel tape recorder using Scotch 1.5-mil polyester magnetic tape 211 and a Sennheiser MKH 816T directional studio microphone or a Supercone EC-7 cardioid condenser microphone. Tape speed was 19 cm/s. Sonagrams were made using a Kay Sona-Graph 6061B spectrum analyzer

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with a narrow band filter for greatest definition of sound patterns. Only calls with a suitable signal-to-noise ratio were selected for sonographic analysis. Sonagrams were made in the 80-8000 Hz mode.

#### RESULTS AND DISCUSSION

Approximately 400 deer vocalizations were recorded of which 90 were selected for sonographic analysis. We identified 12 calls in five categories (Table 1).

##### ALARM AND DISTRESS CALLS

*Snort.*—The snort is probably the most widely recognized of the whitetail's calls. It is an intense, unvoiced, fricative sound of moderate pitch and variable tonality (Fig. 1a) produced by vibration of expired air through the nasal passages. Some snorts were atonal sounds like sharp blasts of "white noise," while others had a moderately tonal whistling quality.

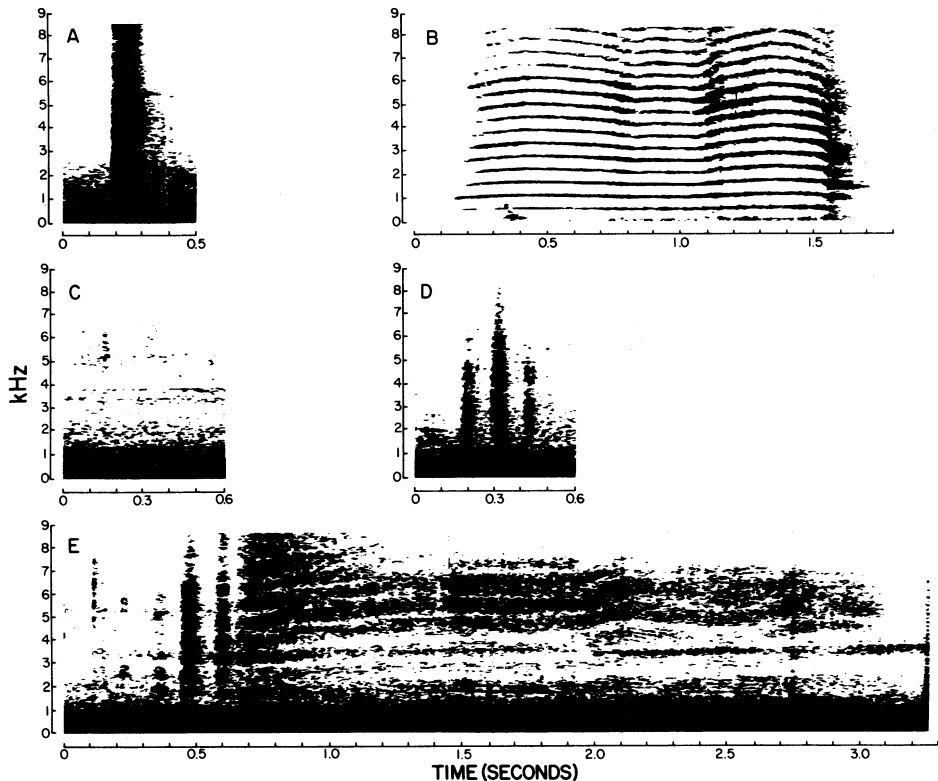


Fig. 1. — Sonagrams of alarm, distress and agonistic calls of white-tailed deer (The broken and unbroken dark areas below 2000 Hz in a and c-e represent background noise.): A. Snort—a single, atonal sound that is shown by a vertical bar covering all frequencies. B. Bawl—a prolonged tonal sound with rising and falling inflections. C. Low grunt—a low intensity sound that was recorded only with poor signal-to-noise ratio and correspondingly poor definition when reproduced. Signal consists of a series of closely spaced vertical bars between 0.1 and 0.4 s. D. Grunt-snort—a low grunt as in c followed by three snorts. Again the grunt portion did not reproduce well. E. Grunt-snort-wheeze—consists of a grunt (0.1 to 0.3 s) followed by 3 snorts (0.3 to 0.6 s) and a prolonged low tonality exhalation of through pinched nostrils (0.7 to 3.0 s)

TABLE 1. — Characteristics of 12 vocalizations of white-tailed deer

Calls	Duration (s) ( $\bar{X} \pm SE$ )	Fundamental frequency (Hz)			Inflection	Tonality	Pitch	Intensity
		Minimum ( $\bar{X} \pm SE$ )	Maximum ( $\bar{X} \pm SE$ )	Modulation ( $\bar{X} \pm SE$ )				
Alarm/distress calls								
Snort	0.245 ± 0.035	— <sup>1</sup>	—	—	low or high	moderate	high	high
Bawl	0.996 ± 0.096	496 ± 10	570 ± 10	74 ± 7	moderate	low to high	low to high	high
Agonistic calls								
Low grunt	0.237 ± 0.035	—	—	—	low	low	low	very low
Grunt-snort	0.499 ± 0.060	—	—	—	low	moderate	moderate	moderate
Grunt-snort-wheeze	2.391 ± 0.128	—	—	—	moderate <sup>2</sup>	high	high	low
Maternal/neonatal calls								
Maternal grunt	0.232 ± 0.011	—	—	—	low	moderate	moderate	low
Mew	0.542 ± 0.029	523 ± 27	725 ± 23	201 ± 28	moderate	high	high	low
Bleat	0.624 ± 0.030	773 ± 28	1078 ± 23	305 ± 16	moderate	moderate	moderate	low to moderate
Nursing whine	0.373 ± 0.020	443 ± 39	629 ± 60	187 ± 36	high	high	high	low
Mating calls								
Tending grunt <sup>3</sup>	0.3 to 1.5	—	—	—	low	moderate	moderate	moderate
Flehmen-sniff	0.5 to 1.0	—	—	—	low	high	high	low
Contact call	0.820 ± 0.177	200	—	—	moderate	moderate	moderate	moderate

<sup>1</sup>Sonogram clarity did not allow measurement, or not applicable

<sup>2</sup>Wheeze portion only

<sup>3</sup>Estimation from field observation

The snort is used to express alarm and is given singly or in series. It was made rarely by members of either sex in our herd. In a natural environment, Hirth and McCullough (1977) found snorts were given primarily by members of doe groups, and concluded that they were low-cost forms of altruism.

*Bawl.*—The bawl was a very intense call of variable duration, heard only when deer were being traumatized. It was a voiced sound of high tonality (Fig. 1b) given with the mouth open. Its pitch generally decreased with age of the animal.

Bawls are given by deer of all ages in situations of extreme distress and may function as another alarm call. Badly frightened deer have been heard to make this sound (Hatt, 1937), but in our experience deer bawl only when injured or grasped. Deer, other than nursing does, generally respond to a bawl by fleeing.

Richardson *et al.* (1983) hypothesized that bawls might elicit defense of the fawn by the doe. They often were able to identify individual fawns by analysis of sonagrams of their bawls, and concluded that this call is sufficiently distinctive to permit individual recognition by the call alone. Maternal defense in response to vocalizations by fawns has been described by Smith (1987). In addition, the structure of these calls lends itself to precise location (Marler, 1955, 1959) which would seem a requisite for this function.

#### AGONISTIC CALLS

We identified three agonistic vocalizations. They consisted of the basic call with successive elements added as the intensity of the encounter escalated.

*Low grunt.*—The low grunt was used by both sexes throughout the year and represented the lowest intensity of agonistic interaction. Consisting of a low guttural grunt coupled with intention postures, it was used frequently by dominant animals of either sex to displace subordinates. Usually given singularly, it is a voiced sound of low pitch, tonality and intensity and of brief duration (Fig. 1c) given with the mouth open or closed. Often if the receiver hesitated, the encounter escalated into a rush and foreleg kick by the dominant.

*Grunt-snort.*—In more intense encounters by either sex, 1-4 rapid snorts were added to the basic grunt. The snorts were brief, atonal, fricative sounds of moderate intensity caused by expulsion of air through open nostrils (Fig. 1d). Occasionally given by does, this call was emitted most often by our bucks during the breeding season. Cowan and Geist (1961) and Geist (1981) also mentioned "snorts" or "rush snorts" in this context but did not make distinctions between the types of calls.

*Grunt-snort-wheeze.*—This most intense agonistic vocalization consisted of the grunt-snort followed by a drawn-out wheezing expulsion through pinched nostrils (Fig. 1e). Although technically an unvoiced fricative, the wheeze had some tonality because of its whistling quality.

Richardson *et al.* (1983) also recorded the grunt-snort (their aggressive-snort) and the grunt-snort-wheeze (their snort-wheeze), but differed in their interpretation of the relationship between these calls. They considered the grunt-snort more intense than the grunt-snort-wheeze. Since both studies used small, penned herds of deer, these contradictions may stem from individual differences between the deer, as we noted considerable variability in this regard.

#### MATERNAL-NEONATAL CALLS

*Maternal grunt.*—This call was a voiced sound of moderate pitch, low tonality and short duration (Fig. 2a) given at intervals of a few seconds as a doe approached the fawn's bedding area. It normally resulted in the fawn leaving its bed and approaching the doe. This call is of low intensity, audible to humans for only a few meters. If a fawn failed to respond, the doe called more loudly and could be heard for as far as 50 m. Faatz (1976) subdivided this call into "low grunt" and "high grunt" categories. Based on our sonographic analyses, we consider this distinction unwarranted.

*Mew.*—The primary sound of the neonate was the mew, a voiced sound of high

pitch and tonality, and low intensity (Fig. 2b). The mew appeared to solicit maternal attention and often was given in response to the maternal grunt. Bottle-raised fawns also gave this call in apparent response to the presence of the caretaker.

*Bleat.*—The bleat was a higher level care-soliciting vocalization of the fawn. It was a voiced sound of moderate pitch and high tonality (Fig. 2c). The intensity and duration of this call were proportional to the degree of deprivation of the fawn. Whereas the mew was inaudible at distances of a few meters, bleats carried as far as 100 m, as Hatt (1937) also observed.

Bleats also were heard when fawns were disturbed and usually resulted in investigations by nursing does. At feeding time, the hand-raised fawns would bleat upon the arrival of the caretaker and the bleats would increase in intensity until satisfied.

*Nursing whine.*—The nursing whine was a brief, low-intensity, voiced sound of high pitch and varying tonality (Fig. 2d). It usually was made repeatedly as the fawn was actively suckling or searching for the nipple.

Faatz (1976) described three neonatal calls: low whine, high whine and bleat. He ascribed the low whine to nursing as well as eliciting maternal care. Our sonographic analyses indicate that the sound made during nursing was distinct. His other categories were comparable to our mew and bleat. Our interpretation of the nursing whine concurs with Richardson *et al.* (1983). However, they made no distinction between the care-soliciting calls.

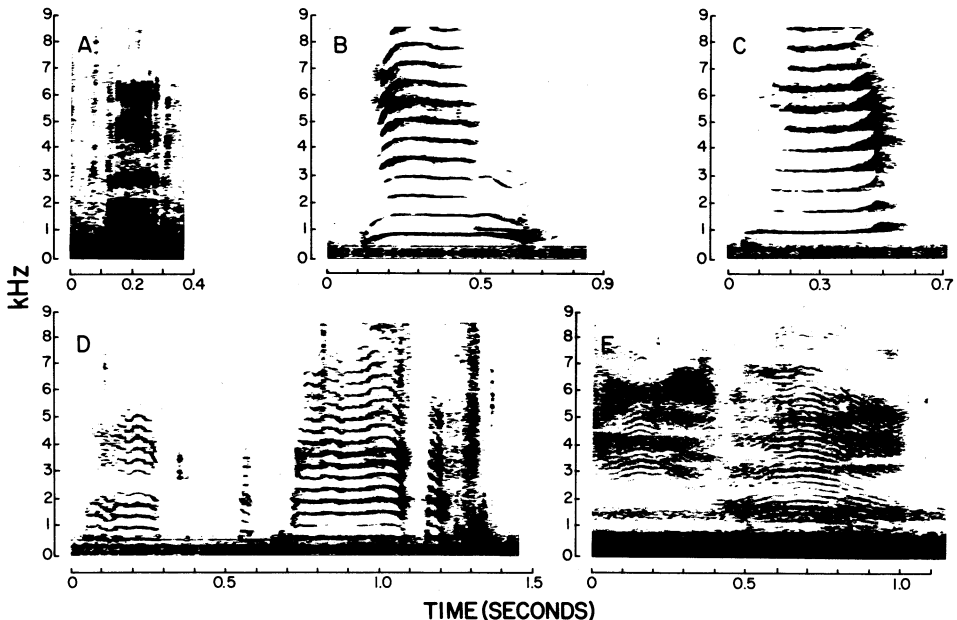


Fig. 2—Maternal-neonatal and contact calls of white-tailed deer (The broken and unbroken dark areas below 2000 Hz in a and e and below 500 Hz in b-d represent noise.): A. Maternal grunt—a brief, soft, atonal grunt represented by a series of vertical bars. B. Mew and C. Bleat—high tonality calls represented on the graph by horizontal bars of rising and falling inflection. D. Nursing whine—a call of varying length and tonality shown here 4 times (0 to 0.3, 0.6, 0.7 to 1.1, and 1.2 s). The vertical bar at 1.3 to 1.4 s was caused by suckling. E. Contact call—a call of moderate tonality represented by indistinct curved lines of fluctuating inflection

## MATING CALLS

*Tending grunt.*—The tending grunt was given by males during courtship of an estrous doe. It was a voiced sound of moderate intensity, low tonality, moderate pitch and longer duration than the other grunts described. We have heard this sound on numerous occasions but were unable to obtain recordings suitable for sonographic analysis.

*Flehmen-sniff.*—An unvoiced, fricative sound made by inspiring through pinched nostrils, the flehmen-sniff was a sound of low intensity and high tonality. This sound was made infrequently when flehmen was performed and marked individual differences in its occurrence were noted among bucks. Flehmen is associated with the investigation of urine and may be a specialized olfactory behavior whereby pheromonal constituents of urine are assessed. The flehmen-sniff may have no communicative function. However, it is included here as it is often made when the doe is within hearing.

## CONTACT CALL

The contact call has not been previously reported in white-tailed deer. It was heard on several occasions when a member of a group was segregated into a separate paddock. Only females were observed to make this call. Sawyer (1981) reported that members of a free-ranging family group of semitame deer made this call when they became separated over distances of 30-100 m. It apparently enabled the deer to maintain contact with one another when visual contact was lost.

This call was a voiced grunt of moderate pitch, intensity and tonality (Fig. 2e). It was longer than the low grunt or maternal grunt but shorter than the tending grunt. Contact calls are common among social animals and have been described in a variety of Artiodactyls (Kiley, 1972; Walther, 1977).

## CONCLUSIONS

We describe 12 different sounds that may have social and communicative significance. This is more than previous observers have noted but in our opinion is probably a minimal number. Richardson *et al.* (1983) distinguished seven vocalizations. The difference in the number of vocalizations discriminated in each study was the result of two factors. First, we described two sounds that they did not record or ascribed no significance to. The flehmen-sniff may not fit their criteria of a vocalization with social significance while the contact call was apparently not heard by them. Second, the studies differ in interpretation, particularly with respect to neonatal calls and grunts. Richardson *et al.* (1983) recognized only one care solicitation call by the fawn, whereas Faatz (1976) distinguished three. Based on our sonographic analyses, we believe that two subdivisions are the minimum. Resolution of this difference in interpretation must await intensive study of doe-fawn interactions and vocalizations.

Richardson *et al.* (1983) categorized all grunts together, but in their discussion distinguished between dominant-subordinate grunts made by both sexes and cohesive grunts given by females and directed toward fawns. These correspond to our low grunt and maternal grunt. Although they add that grunts may be used to solicit the attention of estrous females, we believe this call is distinct from the other types of grunts, despite our inability to record it.

In this study we preferred, when uncertain, to split the calls we heard into distinct categories. We are aware of the difficulties inherent in classifying sounds that may form a graded series and may rely on context for much of their meaning. Kiley (1972) interpreted the sounds of the Artiodactyls she studied as a continuum correlated with the level of excitement of the animal, whereas Klingholz and Meynhardt (1979) found specificity in some of the very same calls.

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