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ANALYSIS OF SONAGRAMS OF AMERICAN BISON
(*BISON BISON*)

The sound made by adult male American bison (*Bison bison*) during agonistic behavior has been described as a "roar" because of its similarity to the roar of an African lion (Shult, 1972). Bulls roar any time of the year, but more commonly and most intensively during the rut when there are many agonistic confrontations between competing males. McHugh (1958), Shult (1972), and Petersburg (1973) have described this roaring and under what circumstances it occurs.

While the bull is roaring, its tongue is protruded and the sound is produced by forceful expiration of air over the vocal cords. In contrast, the "mooing" and loud "bawling" or "bellowing" of domestic cows and bulls (*Bos taurus*) are produced by both expiration and inspiration of air over the vocal cords (Kelemen, 1963).

The basic sound made by bison is a grunt. This varies from the barely audible vocalization of young calves to the loud roaring of the bulls. Although more common among bison bulls, cows protecting their newborn calves also roar (Mahan, 1978), but not as loudly as bulls. Sounds usually made by bison cows consist of soft guttural grunts. Calves produce higher pitched grunts, often in response to their dam's somewhat louder grunting. Calves also bleat loudly, usually during active chases and play fights with other calves. Grunting occurs at all times of the year, but more frequently when the calves are very young and again when the calves begin leaving the cow and forming subgroups within the herd. McHugh (1958) discussed the function and occurrence of the sounds made by bison cows and calves. In general, their vocalizations are comparable in sound and function to that of domestic cows and calves.

Except for Tembrock's (1963:759) report listing the principal frequencies of "bleating calls" of an American bison cow and a European bison (*Bison bonasus*) cow, each with a calf, there are no published descriptions of bison vocalizations based on the analysis of sound spectrographs (sonagrams). The objective of this paper is to describe quantitatively vocalizations of bison, in particular the roar of the adult males.

Materials and methods.—Tape recordings of vocalizations were made in a bison herd of approximately 300 animals at Fort Niobrara National Wildlife Refuge, Valentine, Nebraska on 30 July 1967, 29 October 1970, and 30 July–1 August 1973. Vocalizations were recorded on a Sony Tape recorder Model TC-800 at 19 cm/s with an Electro-Voice Model 674 microphone. In those made in July 1967 and October 1970, the microphone was mounted in a parabolic reflector. No reflector was used for those recorded in 1973. Distances from the subjects ranged from 5 to 20 m. Sonagrams were made on a Kay Electric Company 6061B Sona-graph using the narrow band filter, with the reproduce circuit set at 80–8000 Hz.

Results and discussion.—The duration, fundamental and dominant frequencies, and approximate highest harmonic of two calf and two cow grunts, and 21 roars by bulls are given in Table 1. Sonagrams of the calves, cows, and six of the bulls are shown in Figure 1.

Vocalizations of cows and calves were considerably shorter in duration and of higher frequency overall than the roars of the bulls. The roars ranged in duration from 0.5 to 5.8 s (Table 1). It appeared that the duration of a roar was dependent on the intensity of the confrontation. Other researchers have reported that the roars of bulls lasted 1 to 10 s, generally 5 or 6 s (McHugh, 1958; Shult, 1972; Petersburg, 1973). Although the beginning of a roar was easily determined, the ending was not because the roar often diminished in volume, as can be seen on some of the

TABLE 1.—Duration, fundamental and dominant frequencies, and highest harmonic of bison vocalizations.

	N		Duration(s)	Fundamental frequency (Hz)	Dominant frequency (Hz)	Approximate highest harmonic (Hz)
Bulls	21	Mean	2.05	230	(same as	3,590
		Range	0.5–5.8	155–330	fundamental)	1,500–7,500
Cows	2	Mean	0.55	270	2,040	5,250
		Range	0.5–0.6	230–345	1,925–2,156	3,500–7,000
Calves	2	Mean	0.2	250	1,155	3,500
		Range	0.2	230–270	1,155	both 3,500

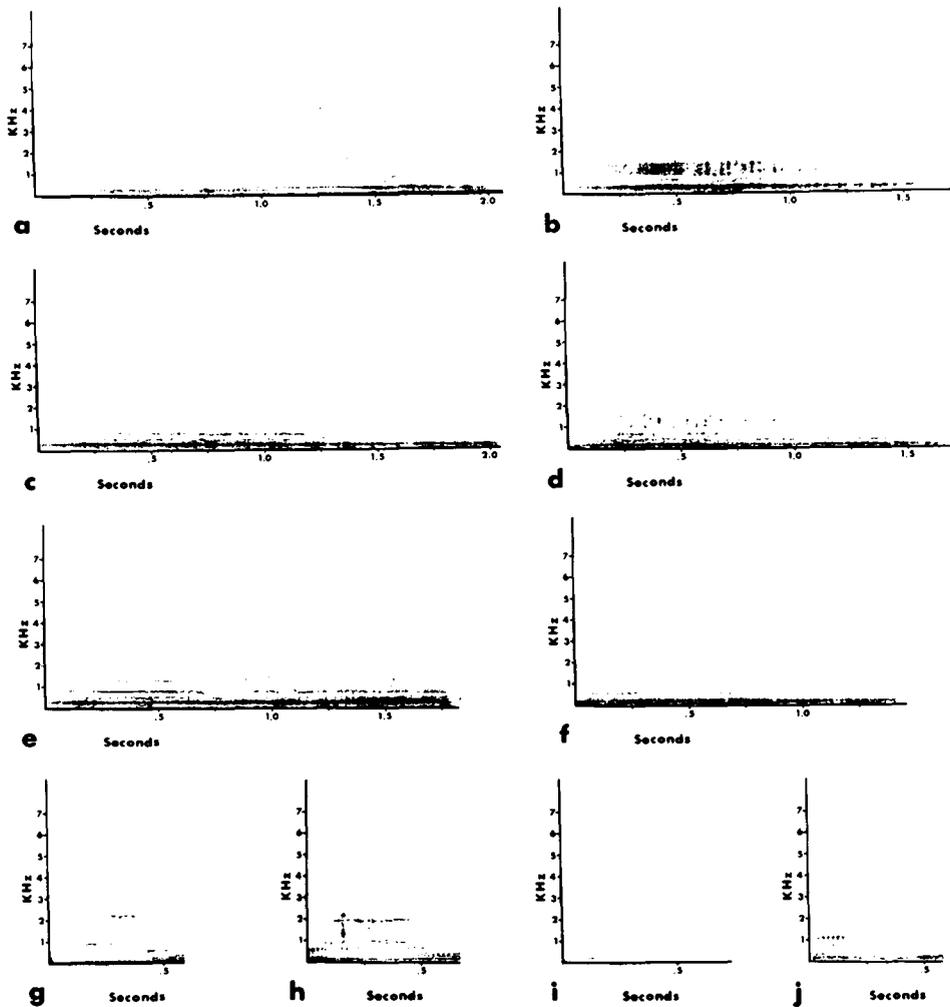


FIG. 1.—Sonograms of bison vocalizations: six bulls (a–f), two cows (g, h), and two calves (i, j). (Due to photographic reproduction, several additional harmonics in a are not visible.)

sonograms (Fig. 1). Harmonics were detected on the cow, calf, and several of the bull sonograms (Fig. 1). Generally, the harmonics of the roars were of short duration and low frequency; however, Fig. 1a illustrates a roar unusually rich in harmonics.

Numerous histological and genetic studies of domestic cattle \times bison hybrids have been studied to determine the taxonomic status of the two genera (Basrur and Moon, 1967; Fedyk and Sysa, 1971; Dziurdzik, 1978). Differences in morphological characters have been used to separate the genus *Bos* from *Bison*. However, similarities of blood group characters have been used as evidence for combining the genera (Stormont et al., 1961). Further investigation and comparisons of vocalizations plus study of the comparative anatomy of the larynx might be profitable in illuminating the relationships and evolution of these two taxa.

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