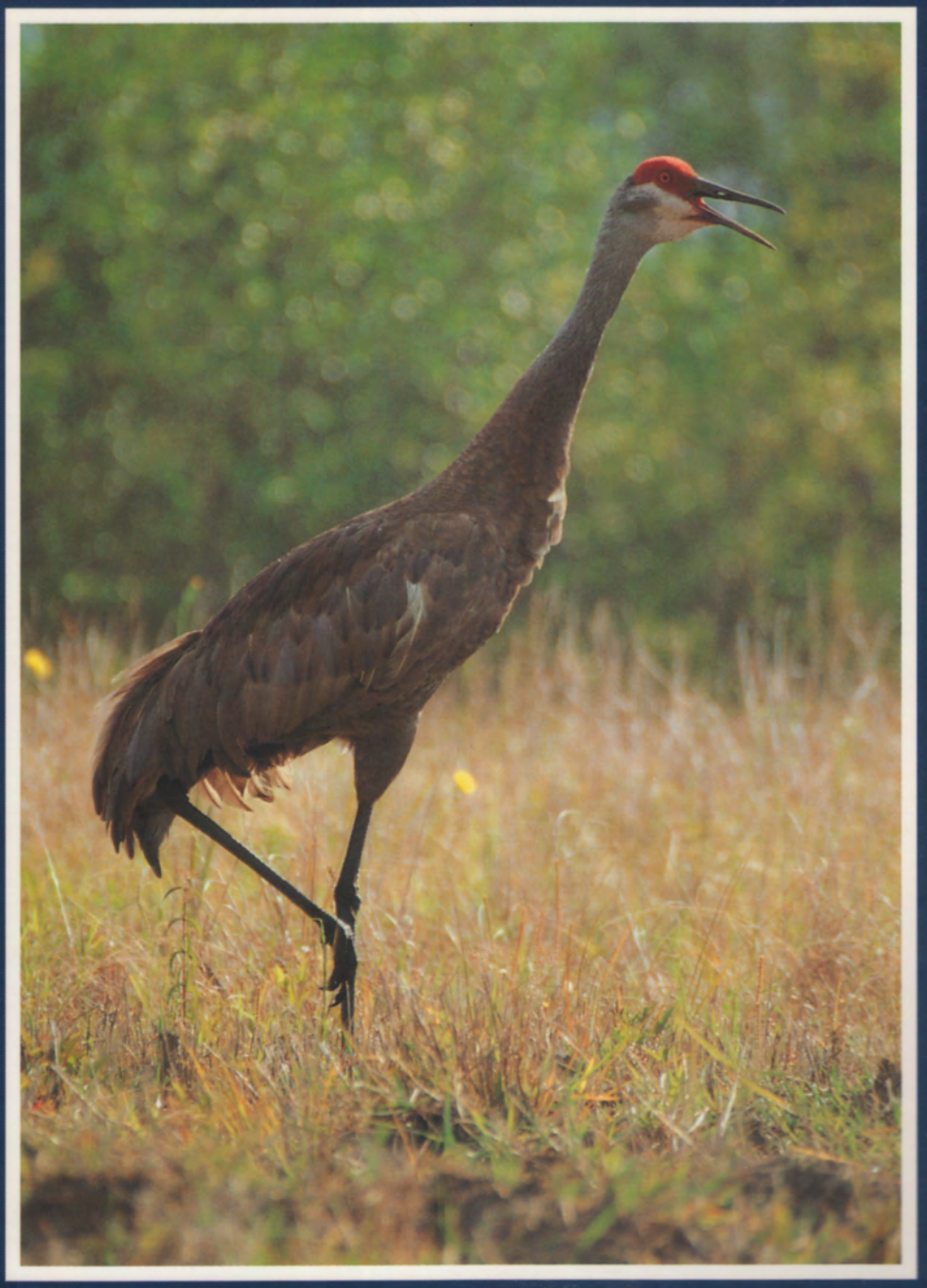
PROCEEDINGS OF THE SEVENTH NORTH AMERICAN CRANE WORKSHOP



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VOCALIZATIONS OF SANDHILL CRANES

STEPHEN A. NESBITT, Florida Game and Fresh Water Fish Commission, Wildlife Research Laboratory, 4005 South Main Street, Gainesville, FL 32601, USA
RICHARD A. BRADLEY, The Ohio State University, 1465 Mt. Vernon Avenue, Marion, OH 43302-5695, USA

Abstract: The structure and context of 20 vocalizations given by adult or juvenile sandhill cranes (*Grus canadensis*) are described. Purr calls were given under various circumstances (e.g., pre-flight, feeding, aggression) and communicated information over a short distance. Flight calls, guard calls, and unison calls were full-voiced calls that carried information over greater distances. Calls given in flight were distinguishable from other calls. Guard calls were given in several different circumstances and served multiple functions; other calls were given in very specific contexts. Beyond the basic communication of information to other cranes, vocalizations may function in mate selection and in synchronizing physiological condition of pair members.

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Key words: cranes, *Grus canadensis*, duetting, vocalizations, voice.

In many species, a specific vocalization is definitive of a particular behavior or display. An understanding of calls and their contextual relationships is often useful in defining social status and interpreting the behavior of individuals (Smith 1963). Sandhill cranes have a varied vocal repertoire, and many of their calls have been described, but with little or no contextual information; others have never been discussed. Archibald (1976) mentioned a number of calls but dealt in depth only with the *Unison* and *Guard Calls*. Walkinshaw (1949, 1973) identified several calls phonetically but provided little interpretation. Voss (1976) described and discussed the ontogeny of vocalizations in juvenile sandhill cranes and also provided some information on adult vocalizations. However, the majority of Voss' study involved captive individuals and consequently the contextual reference for many calls was incomplete. We recorded and described the context associated with the audible vocal repertoire of free-living sandhill cranes in Florida. Our purpose was a better understanding of the interaction of voice and behavior in sandhill cranes.

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METHODS

Recordings were made of both the migratory greater sandhill crane (*G. c. tabida*) and the non-migratory Florida sandhill crane (*G. c. pratensis*) in Florida under various circumstances between 1975 and 1985. Both subspecies associate freely during the winter and no attempt was made to differentiate between them since their voices are indistinguishable. Recordings were made with a Uher 4000 Report IC reel-to-reel recorder operating at 19 cm/sec and a Dan Gibson parabolic microphone or with a Technics RS-646DS cassette recorder and a Sennheiser ME 88 microphone. Most of the recordings were of free-ranging wild birds, though a few were of captured individuals. A Voice Ident UTI Audio Spectro Analyzer was used to evaluate vocalizations and generate sonographs. Original tapes and a composite tape used to produce the figures were deposited at the Bioacoustics Laboratory, Florida Museum of Natural History, Gainesville, Florida.

RESULTS

Purrs

Adult cranes produced a graded series of calls that are best described as *Purrs*. They were of low amplitude and communicated information within a flock or family group over short distances. The purr sound was produced as 4 to 12 muffled click-like sounds covering a wide frequency spectrum delivered at a rate of 12 to 20 notes per second. *Feeding Purrs* (Fig. 1A) were given almost constantly as birds fed. They had a relatively low fundamental frequency and were delivered more slowly than the slightly higher-pitched (rising inflection) *Flight Intention Purrs* (Fig. 1B). The *Flight Intention Purr* (Fig. 1B) consisted of 2 parts, the second half at a higher frequency than the first and with rising inflection. These calls were given by birds in flight intention posture (Voss 1976, Tacha 1984) and preceded unforced flight; they were not given if birds were startled, rushed to fly, or were following others to take off. A *Flight Intention Purr* often gradually changed into a full-voiced flight call. The highest-pitched, most rapidly delivered purrs were *Flight Purrs* (Fig. 1C) given by birds in flight.

The *Growl Purr* (Fig. 1E) was an aggressive signal given as a part of the *Low Bow* display (Voss 1976, Nesbitt and Archibald 1981). This low-frequency, low-volume call carried only a few meters. Voss (1976) identified 2 additional

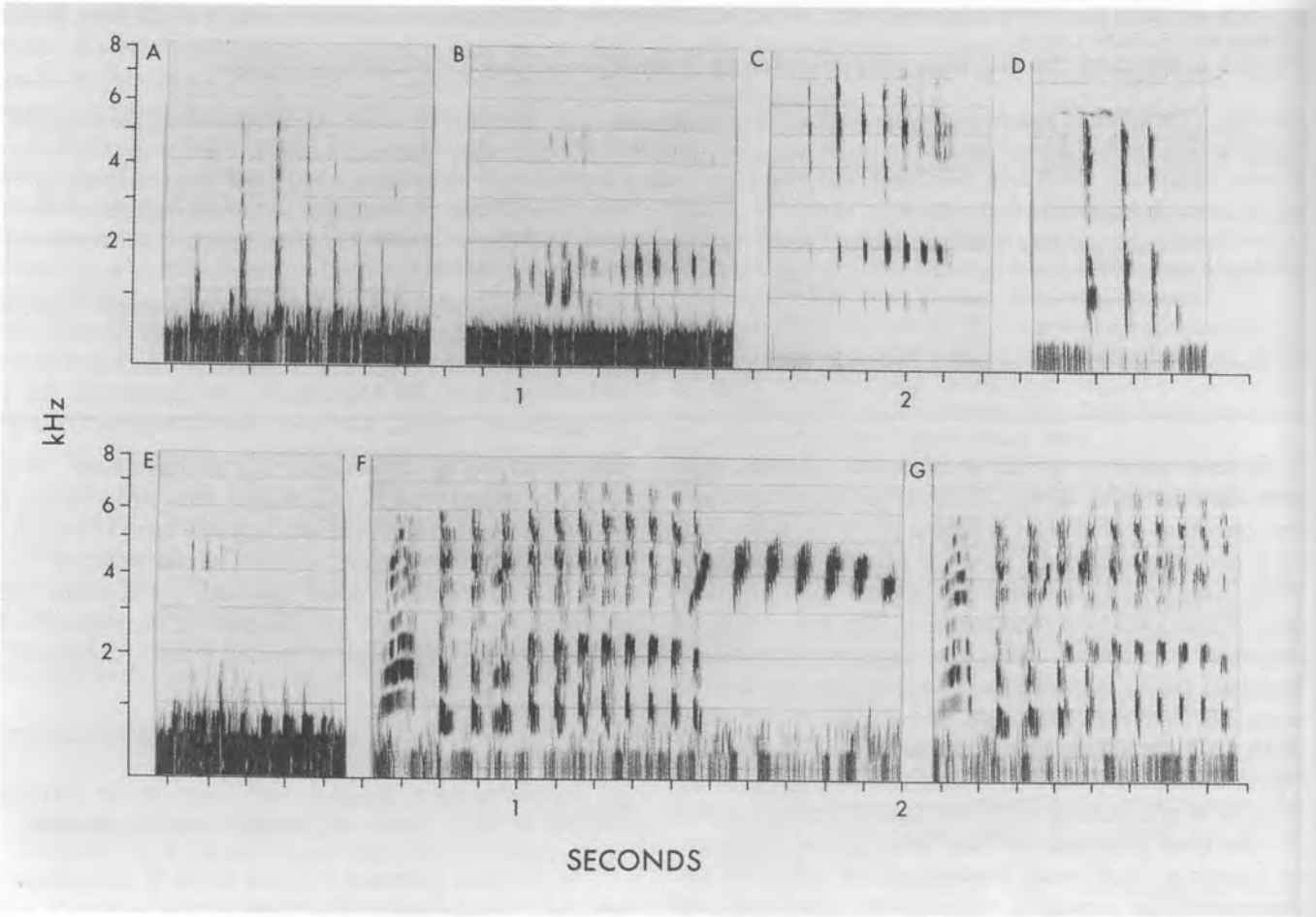


Fig. 1. ***Purr Calls*** **and** ***Guard Calls*** **of sandhill cranes recorded in Florida, 1975–85: (A)** ***Feeding Purr*****–artifact @ 1 KHz; (B)** ***Flight Intention Purr*****–artifact @ 1 KHz; (C) Flight Purr; (D)** ***Perrt Call;*** **(E)** ***Growl Purr;*** **(F)** ***Guard Calls,*** **male and female calling together with juvenile voice following; (G)** ***Guard Calls,*** **male, female, and juvenile calling simultaneously.**

vocalizations that we did not record; these calls could be considered with the purr calls. The *Pre-copulation Call* was "a regular series of purr-like calls, gradually swelling in volume," and the *Nesting Call* was "a low moan-like call" given at or near the nest site while birds were building the nest, incubating, or brooding young.

Flight Calls, Guard Calls, and Unison Calls

The loud, full-voiced calls (*Flight Call, Guard Call, Unison Call*) of the sandhill crane have been described as a rattling, bugling, or trumpeting. They consisted of 7 to 20 notes delivered at a rate of about 15 notes per second. The fundamental frequency was about 0.73 KHz for males and 1.0 KHz for females (Weekley 1985). The individual notes were usually brief, often less than 0.05 seconds; occasionally the introductory or terminal note may last 0.1 or 0.2 seconds. Under optimum conditions these calls, especially a male's, carried for 2–3 km.

The predominant vocalization given by cranes on the ground were 2 duet calls, typically given in unison, by pairs or family groups. The *Guard Call* was given when "the bird is afraid but not afraid enough to flee" (Archibald 1976) or as part of aggressive displays. It was given in unison by a pair, and juveniles (when present), during "Directed Walk Threats" (Nesbitt and Archibald 1981, Tacha 1988). The male call began with 1 sustained note (0.2 sec) that was followed by 6–8 shorter notes, somewhat lower in pitch (Figs. 1F, 1G). The female call typically did not have the sustained first note but consisted of a series of 8–10 evenly-spaced short notes. A sequence usually began with the male, joined 0.2–0.4 seconds later by the female, then in another brief interval by the juvenile. The vocalization was often repeated many times a minute with little variation, the

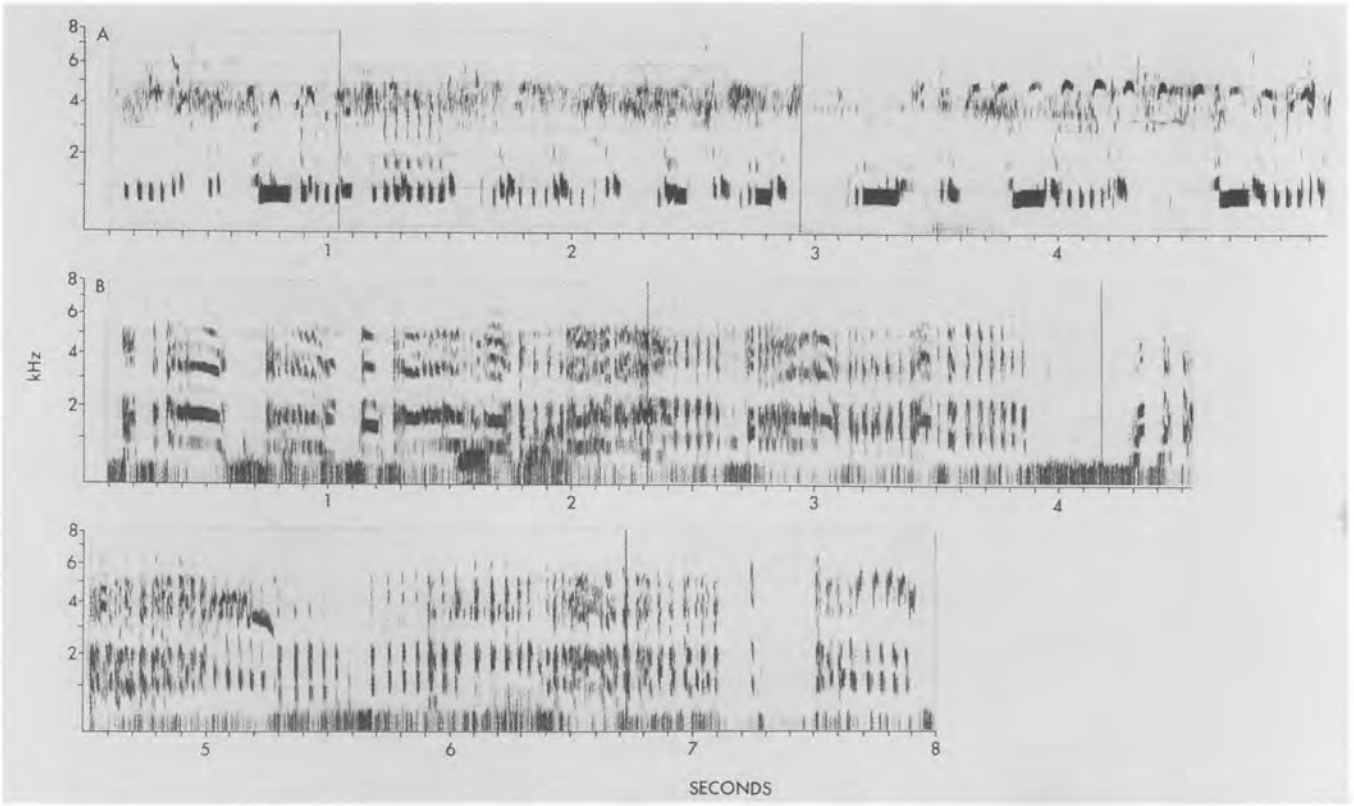


Fig. 2. *Unison Calls* and *Bill Sparring Calls* of sandhill cranes recorded in Florida, 1975–85: (A) *Unison Call*, female part above male part below; (B) *Bill Sparring Call*, in 2 parts.

male, female, and juvenile overlapping their calling. A pair usually alternated their individual parts, giving the vocalization a pronounced antiphonal quality. Detection of a mammalian predator, such as a bobcat (*Lynx rufus*) or dog, usually elicited vociferous *Guard Calling* and vaulting and often included approaching the predator by a flock or family group, as if mobbing. *Guard Calls* were also given in flight by a pair or by individuals when flying near a nesting territory.

The *Unison Call* (Fig. 2A), a duet call characteristic of a bonded pair, was sexually differentiated by voice and posture (Archibald 1976). The male's part was lower pitched and more legato than the staccato, higher-pitched female part (Fig. 2A). The call was initiated by either member of the pair. In agonistic encounters with other cranes, the *Unison Call* became a threat display and a triumph ceremony which followed the successful domination of another individual or family group. Juveniles ≥8 months old participated in the *Unison Call* during familial agonistic encounters. When excited, as during aggressive encounters or migration departure, *Unison Calls* were sometimes given in flight. Single birds separated by some distance from their mates (e.g., during incubation or territorial defense) occasionally gave their respective part of the *Guard Call* or *Unison Call*.

Cranes called more frequently in flight than they did on the ground. *Flight Calls* (Fig. 3A) were given when birds flew to and from feeding, loafing, or roosting locations, particularly as flocks took flight and perhaps served to avoid collisions during the confusion of group departures. *Flight Calls* were quite variable in inflection, either rising or falling in pitch, but were more rapidly delivered and higher in basal frequency than ground calls. These latter features made *Flight Calls* distinguishable from ground calls.

Limited-Context Calls

Perrt Calls (Fig. 1D) were often given when birds landed and took flight. The call consisted of 4 notes rising in pitch, separated by unequal intervals. *Alarm Perrts* (Fig. 4A), higher pitched and of shorter duration, were given to alert others in the flock. "Bill Sparring" (Nesbitt and Archibald 1981) or "Bill Duel" (Tacha 1988), a ritualized aggressive display, had an associated vocalization, *Bill Sparring Call* (Fig. 2B), that consisted of a loud series of rapid slurred notes covering a wide frequency range lasting up to 5

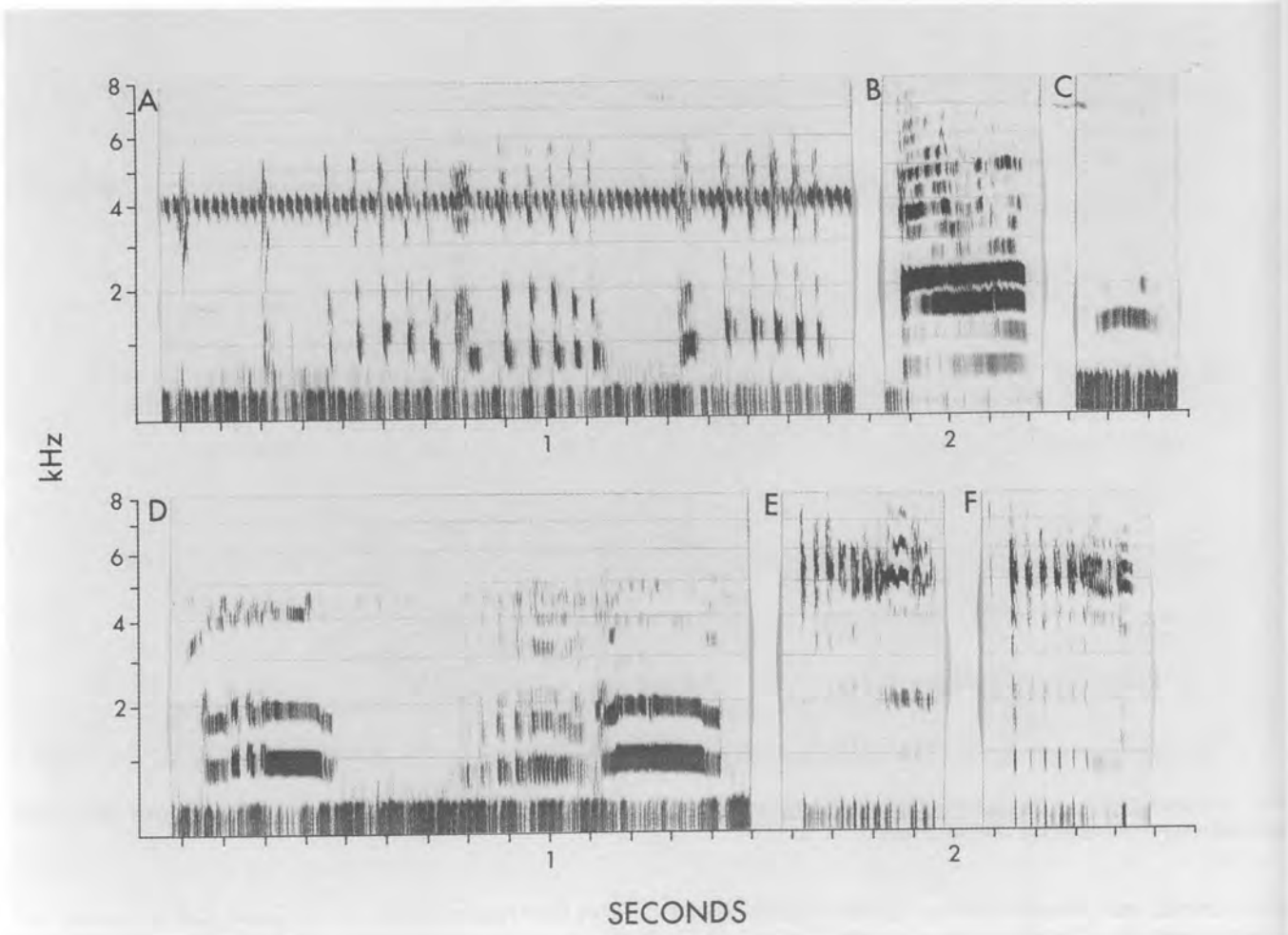


Fig. 3. Calls of sandhill cranes recorded in Florida, 1975–85: (A) *Flight Calls*–artifact @ 4 KHz; (B) *Honk*; (C) *Moan*; (D) *Yelp* "location call"–3 examples with artifact below 1 KHz; (E) and (F) cranes migrating.

seconds. "Bill Sparring" most commonly occurs among cranes in large wintering flocks. In Florida cranes, "Bill Sparring" was most frequent between birds that had not associated previously. This display seems to establish social order. The *Bill Sparring Call* was rarely heard from a flock with a well established dominance hierarchy.

During actual attacks and sometimes during "Bill Sparring" and dancing episodes, cranes gave a loud *Hiss* (Fig. 4B). This broad-band frequency sound was produced by the rapid exhalation of air seemingly without involving the syrinx. A shrill *Tremolo* (no example) with a descending inflection was given by a bird in great distress, as when a wild crane was captured.

Goose-like *Honks* (Fig. 3B) and *Moans* (Fig. 3C) were often part of a *Flight Call* sequence. A *Moan* lacked the 2-syllable yodel-like quality of a *Honk*, otherwise they were similar. These 2 rapidly delivered calls were intermediate between the *Flight Purr* and the full voiced *Flight Call*. *Honks* and *Moans* were used frequently by cranes during migration or when departing from feeding or roosting areas. Perhaps they served to encourage others to join the flock or to maintain contact within a large flock of birds in flight.

A *Yelp* (Fig. 3D) or "location call" (Voss 1976) was given to locate other individuals or flocks. *Yelps* consisted of 3 or more high pitched, broken notes, followed by a sustained note. *Yelps* were given from the ground in answer to those given in flight, especially during migration when yelps may be used to maintain contact between flocks.

Juvenile Voice

The vocal repertoire of young sandhill cranes consisted

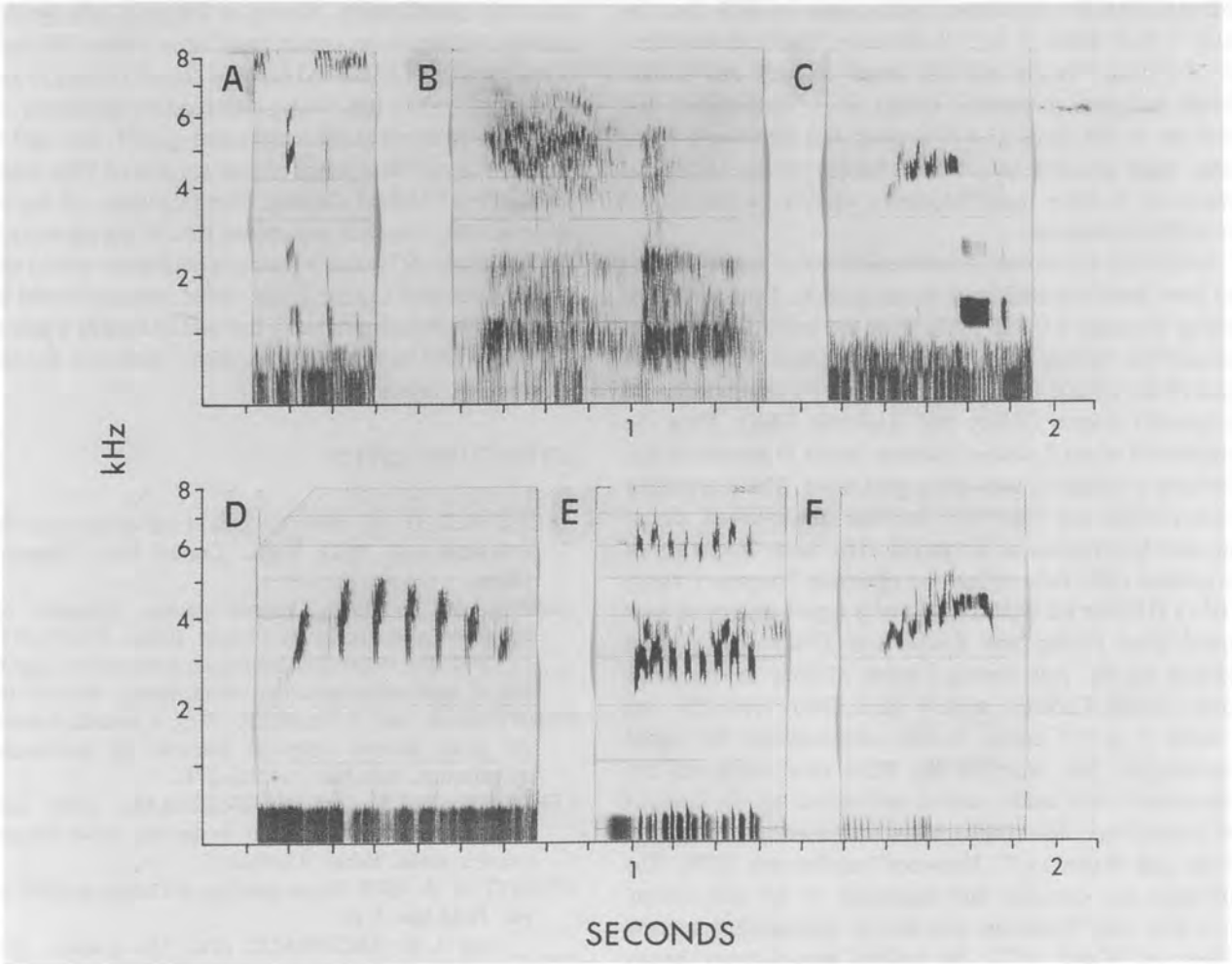


Fig. 4. Limited context calls and chick calls of sandhill cranes recorded in Florida, 1975–85: (A) *Alarm Perrt*-artifact @ 1 KHz; (B) *Hiss*; (C) Juvenile voice change-artifact @ 1 KHz; (D) *Juvenile Flight Call*-artifact @ 1 KHz; (E) *Juvenile Purr Call*-artifact @ 1 KHz; (F) *Juvenile Stress Call*.

of 6–8 distinct calls (Voss 1976). The typical juvenile voice was a whistle or high-pitched trill.

The *Juvenile Guard Call* (Fig. 1G) and *Juvenile Flight Calls* (Fig. 4D) varied little with context, except for inflection, over a frequency range of 3–5 KHz. *Juvenile Flight Calls* were more rapid but otherwise similar in quality to the other juvenile calls. The *Juvenile Stress Call* had a rising inflection (Fig. 4F) given in stressful situations as when young became separated from their parents. *Food-begging Calls* (Archibald 1976) were loud emphatic calls similar to *Stress Calls* but given repeatedly to "stimulate the adults to offer food to the chick."

Juvenile Purr Calls (Fig. 4E) were also less variable than those of the adults, and were given in a variety of contexts (e.g., feeding, contact). Between 9 and 10 months of age, the juvenile voice in the Florida sandhill crane changes to the adult voice (Nesbitt 1975). A recording of a bird in flight made 2 December 1977 (Fig. 4C) was of a juvenile undergoing voice change. The call begins with a typical juvenile whistle but ends with a distinctly adult sound, similar to a *Yelp*.

DISCUSSION

Unique vocal characteristics may be an important aspect of individual and sexual recognition among sandhill cranes. There was a considerable range of variation among the voices of individual cranes irrespective of gender. Sexual dimorphism was apparent in the vocal repertoire; the mean basal frequency of the male sandhill crane voice during *Guard*

Calling (0.58 KHz) was lower in frequency by 33% than the female's (0.87 KHz [n = 57]) (Weekley 1985). A comparison of average weight and bill length of male and female Florida and greater sandhill cranes (n = 114) shows that males (n = 64) were 13.6% heavier and bills were 6.8% longer than females (n = 50) (Nesbitt et al. 1992), so differences in voice basal frequency were not a function of size differences alone.

Individual and sexual differences in voice among cranes may have functions additional to recognition. During *Unison Calling* the male's lower pitch gives the call a better sound transmission quality while the higher pitched, more pulsed signal of the female increases the receiver's ability to locate the sound's source (Wiley and Richards 1982). Thus the combination of the 2 voices functions better to announce that a territory is occupied than either part alone. There are other features of the full voice that facilitate transmission, detection, and localization of the signal. The mean frequency of the ground calls falls within the optimum frequency range (0.05–1.0 KHz) for transmission of a signal generated near ground level (Wiley and Richardson 1982). The posture assumed by the pair during *Unison Calling* and to some extent *Guard Calling*, male's head held vertically and female's at a 45° angle, is also advantageous for signal transmission. The times of day when most territorial announcements were made, sunrise and sunset, are the times of least atmospheric disturbance when sound will carry farthest (Waser and Waser 1977, Henwood and Fabrick 1979). The prolonged call duration and repetition of the call several times with little variation also add to transmission success (Waser and Waser 1977). By making long-distance threats more effective, these calls serve to reduce the necessity for direct agonistic interactions with other territorial conspecifics, reducing the frequency of unnecessary and possible injurious agonistic encounters.

Detection by predators or potential competitors is best avoided if some information is transmitted within the pair or family structure over just a few meters. This information is passed with *Purrs* or, in the case of juvenile cranes, a high pitched *trill* or *whistle*. These signals do not have enough volume to carry well and are pitched above 2 KHz, making them subject to attenuation from vegetation and reducing detection and source location (Wiley and Richards 1982) over more than a few meters.

Beyond the simple transfer of information, some calling in sandhill cranes may function to alter the physiological condition of sender and receiver alike. Vocalizing of pair members can bring about sexual readiness in a mate (Lehrman and Friedman 1969) and promote reproductive synchrony. Such calling may play a part in initiating egg production. In ring doves (*Streptopelia risoria*) the female courtship vocalization altered a female's neuroendocrine state, preparing it for ovulation (Cheng 1986, 1991). There is evidence that *Unison* and perhaps *Guard Calling* in sandhill cranes may induce and sustain reproductive synchrony. Tacha (1988) demonstrated that increased gonad size and blood hormone levels in sandhill cranes correlated with increased frequency of *Unison Calling*. The amplitude of the male's voice at 3 m, a typical separation for calling partners, is 78 db (Archibald 1976) and a female's own voice would be even louder. Frequent calling at this sound intensity could have a hormonal stimulating capacity that would benefit a pair trying to achieve and maintain reproductive synchrony for copulation and egg laying.

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