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# VOCALIZATIONS OF BARN AND CLIFF SWALLOWS

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ABSTRACT.—Vocalizations of barn (*Hirundo rustica*) and cliff (*H. pyrrhonota*) swallows in north central Texas-south central Oklahoma are described. Eight vocalizations in barn swallows and four in cliff swallows were found. Barn swallows possess a greater vocal repertoire than cliff swallows, perhaps because barn swallows nest in smaller colonies where acoustics allow greater reliance on vocal communication. It is suggested that increasing barn swallow colony sizes and sound distortion of twitter songs may be partly responsible for hybridization within the genus *Hirundo* presently observed in parts of Texas.

The barn (*Hirundo rustica*) and cliff (*H. pyrrhonota*) swallows occur sympatrically throughout a large part of North America, including much of the Southwest. In many areas they forage together in similar habitats and nest together in mixed colonies. However, the vocalizations of these species have been little studied. Their vocalizations have special relevance in Texas, where Martin (1980, 1982) suggested auditory confusion as a possible cause of hybridization between barn and closely related cave (*H. fulva*) swallows. Samuel (1971a) described vocalizations of barn and cliff swallows from West Virginia, but his was the only published study of vocalizations in these species. In this study I describe vocalizations of barn and cliff swallows in north central Texas-south central Oklahoma. A basic understanding of vocal communication in swallows is a first step in assessing the possible role of auditory confusion in the hybridization presently widespread in parts of Texas.

STUDY SITES, METHODS, AND TERMINOLOGY.—I studied barn swallows at two sites: a culvert containing 15 nests under a county road near the north entrance of the Grayson Co. Airport, 2.0 km west of Highway 1417, in Grayson Co., Texas, and at a culvert containing about 30 nests under Highway 99, about 8.0 km north of the Willis Bridge, in Marshall Co., Oklahoma. Cliff swallows were studied at a 350-nest colony at the Willis Bridge, Lake Texoma, in Grayson Co. For barn swallows I recorded vocalizations from about 50 individuals at 24 nests, 4 July to 25 July 1980. For cliff swallows I recorded vocalizations from about 75 individuals at 50 nests, 2 July to 24 July 1980. No birds were color-marked. Field recordings were made with Uher 4000 Report L and Report 1C tape recorders and Uher M517 and Electrovoice Soundspot microphones, the former mounted in a 60-cm parabolic reflector. Tape speeds were 19 and 9.5 cps. Sonagrams were made on a Kay Elemetrics Sona-Graph Model 6061-B using wide band pass setting and linear scale.

A current problem in bioacoustical studies is lack of consistent terminology in describing sounds. Where possible, I avoided using names denoting functions, because I was unable to record these birds and their sounds under all conceivable behavioral circumstances and no playback experiments were done. Following Wolf (1977), *figure* was defined as a "continuous tracing on the sound spectrograph." The term "note" is avoided because of its established meaning as a sound of constant pitch. A *syllable* was defined as any single figure or any two figures lasting 50 msec or less. Whereas my selection of 50 msec was arbitrary, this definition of syllable was useful and seemed bioacoustically appropriate for swallow sounds. *Song* was defined as a series of sounds of more than one type, uttered in succession and forming a recognizable sequence or pattern in time (Thorpe, 1961). *Subsong* (Thorpe, 1961) was an irregular and ill-defined series of syllables of lower intensity than true song, but nevertheless with

a recognizable pattern. *Call* was defined as a discrete sound, usually not a component of a sequence within a song.

The total number of samples I recorded and analyzed for each vocalization follows the italicized name in the text.

RESULTS.—*Barn swallow.*—I distinguished eight total vocalizations in barn swallows. Samuel (1971a) described vocalizations similar to some of these from barn swallows in West Virginia. Apparently he and I also found vocalizations that the other did not.

*Juvenile call (12).*—The frequency range of this call, given only by fledged juveniles, is 5 to 6 kHz with a duration of 75 msec (Fig. 1A). Juveniles giving these sounds perched with nest mates in willow (*Salix* sp.) trees near the Grayson Co. Airport colony. These birds were fledged juveniles that had been out of the nest only a short time. The juveniles called whenever a parent fed them and whenever other swallows flew near. They fluttered their wings when calling. Parents typically hovered and dropped food into the juveniles' mouths from above. Barn swallow juvenile calls may serve as locational cues to enable parents to locate fledged juveniles amidst foliage, as suggested also for juvenile calls of violet-green swallows (*Tachycineta thalassina*) (Brown, 1983). Samuel (1971a) found juvenile calls ("light chirp calls") in West Virginia and stated that they were given by birds in the nest being fed by parents, but he did not state if he recorded birds after they left the nest.

*Cheep call (30).*—This call, given by adult birds, is used to indicate low to moderate intensity alarm (Fig. 1B). The frequency range is 3 to 7 kHz. Some slight harmonic separation is apparent within some of the syllables, but harmonics are not pronounced. Cheep calls were uttered singly or in sequences with approximately 1 sec intervals between calls. The cheep call was given when people approached entrances of culverts containing barn swallow nests. The frequency with which the birds uttered the call increased the nearer a person approached a culvert entrance. When persons stood in the entrance, churee whistles (see below) were used with the cheep calls. Cheep calls ceased when people withdrew and hid nearby. These calls were never given by birds in any other situations.

Samuel (1971a) described two alarm calls from West Virginia, the plain sharp and high sharp calls. These vocalizations were thought to indicate low and high intensity alarm, respectively. I, too, found two calls that seemed to indicate two classes of alarm (the cheep call and churee whistle). However, there seem to be structural differences between the alarm calls I describe here and Samuel's, and for this reason I use different phonetic names.

*Churee whistle (16).*—This vocalization indicates high intensity alarm (Fig. 1C). This call contains a frequency range of 2.5 to 5 kHz and has a duration of 160 to 330 msec. Churee whistles were uttered either singly or (most often) in series with 40 msec to 1 sec intervals between calls. Cheep calls were often interspersed with churee whistles (Fig. 1C). The terminal figure of the churee whistle appears to be a fragment of the cheep call. Churee whistles were given by flying barn swallows when people closely approached nests. When people withdrew from culverts, utterance of churee

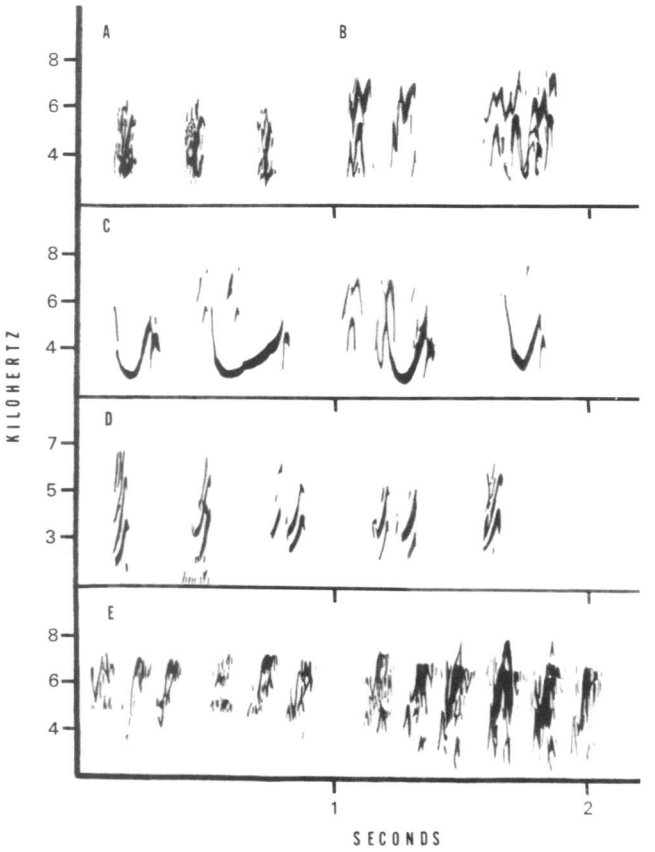


FIG. 1. Sonagrams of barn swallow vocalizations: A, three juvenile calls from the same individual; B, three cheep calls, each from a different individual; C, four churee whistles, each from a different individual; D, five chirp calls, each from a different individual; E, sequence of cheet calls from the same individual.

whistles ceased. Churee whistles were given only when adults were extremely agitated or alarmed.

*Chirp call (42).*—Contextually this was the most generalized vocalization of the barn swallow (Fig. 1D). It is similar in structure and contextual usage to Samuel's (1971a) chirp call. It is about 75 msec in duration, monosyllabic, and possesses a frequency range of 2 to 6 kHz. Harmonics are evident in all of the calls. Chirp calls were used singly or in sequences with 150 msec to over 1 sec between calls. Chirp calls were used by barn swallows in virtually all situations. They were given by seemingly contented birds flying to and from nests and by foraging swallows, uttered by preening birds on wires, interspersed with cheep calls and churee whistles in alarm situations, used before and after songs and as components of subsongs, incorporated into stutter sequences (see below), and given by adults as they fed fledged juveniles.

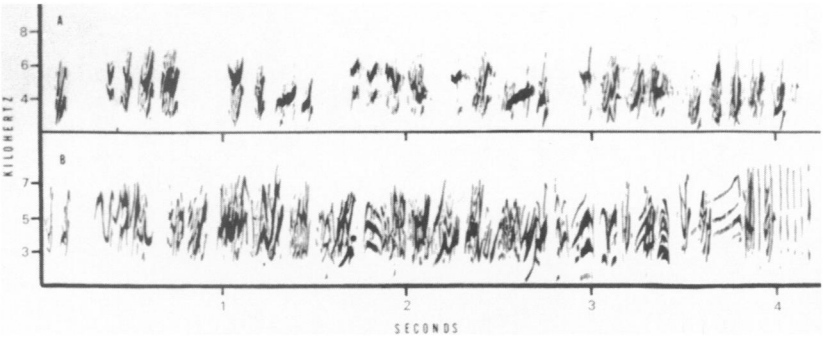


FIG. 2. Sonagrams of barn swallow vocalizations: A, sequences of stutter calls from two individuals, first four sets of calls from one individual, latter sets from another; B, a twitter-warble song.

*Cheet call (8).*—This was a specialized vocalization given by parents while feeding fledged juveniles (Fig. 1E), and it was not mentioned by Samuel (1971a). Cheet calls range from 3 to 7 kHz, are monosyllabic, and are about 125 msec in duration. A typical sequence of cheet calls (Fig. 1E) has a duration of about 2 sec. Adult swallows gave cheet calls as they approached fledged juveniles sitting in trees. The parents uttered the calls before, during, and after feeding a juvenile, often giving a more rapid and intense sequence as they flew away after feeding the young bird. Juveniles began vocalizing and fluttering their wings when a parent approached. The juveniles' responses may have been brought about partly by the sequence of cheet calls given by the approaching adults. Cheet calls were not recorded in any other situations or contexts.

*Stutter call (18).*—This call (Fig. 2A) was given in aggressive intraspecific interactions. Samuel (1971a) found stutter calls in West Virginia birds and separated them into two types, but such a distinction was not evident in my data. Stutter calls are monosyllabic, range from almost 2 to 7 kHz, and have a duration of 75 to 125 msec. There are no pronounced harmonics. Often these calls were given in sequences with variable intervals between calls (Fig. 2A). Chirp calls occasionally preceded a series of stutter calls. Stutter calls were given most often by barn swallows engaged in intraspecific fights. Short in-flight chases of one bird by another were common, but the reasons for these chases were not clear. Chasers, and perhaps birds being chased, gave stutter calls as long as a chase continued, the chase and the vocalizations terminating simultaneously. Most often these chases occurred as foraging birds passed near each other. Such chases appeared to originate spontaneously and lasted up to 4 to 5 sec, much as in violet-green swallows (Brown, 1983). Occasionally short chases developed as two or more barn swallows departed simultaneously from a perch. Stutter calls were also given by parents as they chased other swallows away from their fledged offspring.

*Twitter-warble song (28).*—A distinctive vocalization of the barn swallow, used in sexual or courtship contexts, was the twitter-warble song (Fig. 2B). Samuel (1971a) also found this song used in courtship contexts. Songs

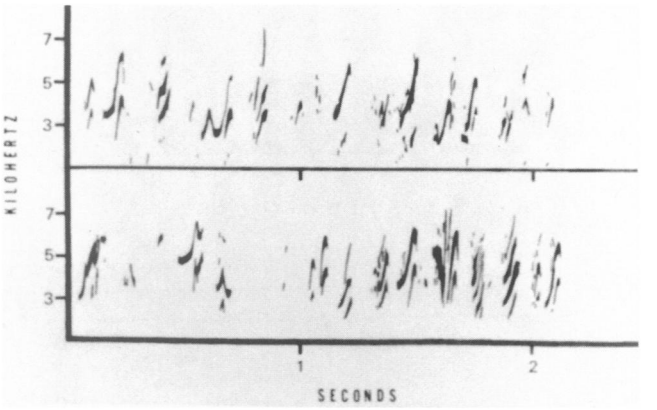


FIG. 3. Sonagrams of barn swallow subsongs from two individuals, upper and lower, respectively.

possess a frequency range of 2 to 7 kHz and a duration of 4 to 20 sec or longer. Like the twitter-squeak song of the cliff swallow (see below), barn swallow twitter-warble songs consisted of two main parts—a long series of continuous warbling polysyllabic sounds constituting about 85% of the song, followed by 9 to 12 rapid, guttural gratings. The frequency range of the gratings was similar to the rest of the song. Extended songs were often composed by alternately repeating these two parts (warbles, gratings, warbles, gratings). Both barn and cliff swallows used gratings in their songs, but those of the barn swallow were less intense and of much shorter duration than those of the cliff swallow, and sometimes barn swallows sang songs that entirely lacked gratings. A long syllable, lasting about 300 msec and showing definite harmonics, was evident immediately prior to most barn swallow grating sequences. Chirp calls often preceded (Fig. 2B) and followed songs and were sometimes incorporated into them. Most of the syllables of the twitter-warble song were distinct from other barn swallow vocalizations. All recorded songs resembled the one in Fig. 2B.

Twitter-warble songs were recorded from presumed male barn swallows with dark orange breasts and long forked tails, although Samuel (1971b) indicated that breast color and tail shape are not completely reliable markers of sex. Males perched and sang near colonies. They seemed to direct their songs toward lighter-breasted birds (females?) sitting with them, but they also gave these songs while sitting on nests. Abortive copulation attempts often accompanied singing. Most singing occurred as birds were establishing pair bonds in spring, although there was a slight resurgence of song in late summer brought about possibly by autumnal gonadal recrudescence (Lofts and Murton, 1968; Ligon, 1978). In late summer presumed males directed songs toward independent juveniles (juvenile females?). Songs were not heard in flight. Samuel (1971a) also reported that female barn swallows give these songs.

*Subsong (20).*—Subsongs (Fig. 3) were recorded from independent juveniles and from birds of unknown age. Frequency range of subsongs was 2.5 to 6 kHz. They were constructed mainly of monosyllabic sounds and

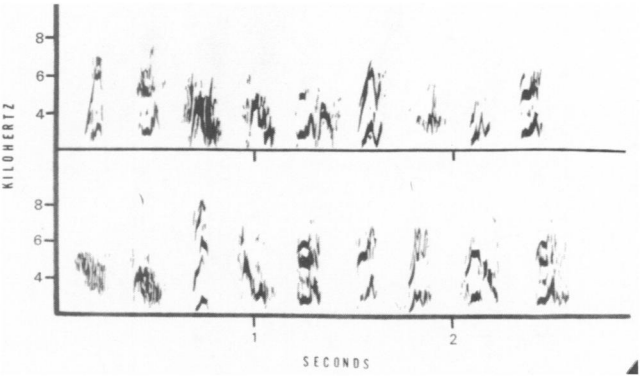


FIG. 4. Sonagrams of cliff swallow juvenile calls, each from an individual of a different brood.

had variable duration (1.5 to 10 sec). Subsongs were generally of lower intensity and lesser complexity than twitter-warble songs but still formed partially recognizable sequences. Chirp calls were incorporated into some subsongs (Fig. 3, lower). Independent juveniles often gave subsongs in late summer as they perched in trees near colonies with presumed adult males who were singing twitter-warble songs. Subsongs were not accompanied by any behavioral interactions, and hence the context of this vocalization is not clear. Subsongs were also recorded from other birds of unknown age in late summer.

*Cliff swallow.*—I distinguished four vocalizations in cliff swallows, which apparently were the same ones described by Samuel (1971a) from West Virginia.

*Juvenile call (56).*—This call (Fig. 4) was given by juveniles still in the nest and being fed by their parents. Juvenile calls are generally mono- or disyllabic, possess a frequency range of 2 to 8 kHz, and typically have a duration of 80 to 175 msec. Many of these calls have harmonics. Juvenile calls were given by juveniles that were as large and as well-feathered as adults. Typically one juvenile at a time sat in the nest entrance, head protruding, and called repeatedly even when no adults were present. The frequency of their vocalization increased whenever a parent arrived with food, or when any swallow approached their nest and tried to perch there. There is considerable structural variation among calls of individuals from different broods of the same age (Fig. 4), and this variation provides a mechanism for parent-offspring recognition in cliff swallows (Stoddard and Beecher, 1983).

*Purr call (22).*—This call was used strictly in alarm contexts (Fig. 5A). It is essentially monosyllabic, has a duration of about 140 msec, and has a frequency range of about 1.5 to 7 kHz. Harmonics are pronounced, numbering 3 to 5. Purr calls, though occasionally occuring singly, generally occurred in sequences of three or more, each separated by 250 to 450 msec. Adult cliff swallows circled overhead and gave barrages of purr calls whenever predators such as American kestrels (*Falco sparverius*), snakes, or people approached their bridge nesting site. The purr call was used in both low and high intensity alarm situations.

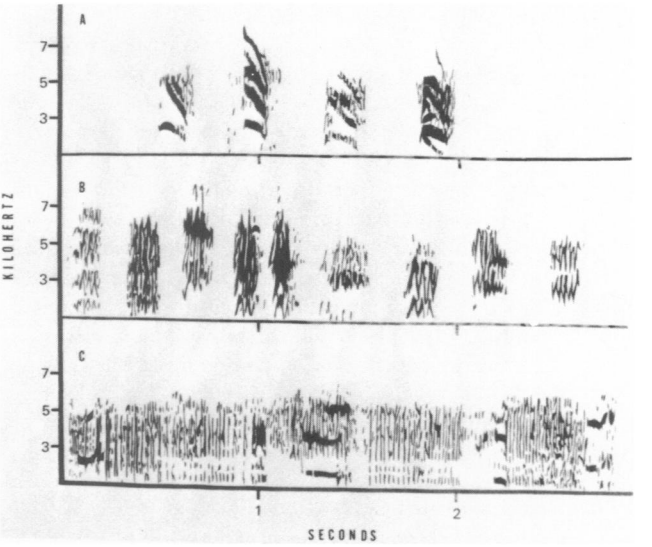


FIG. 5. Sonagrams of cliff swallow vocalizations: A, four purr calls, each from a different individual; B, nine chur calls, each from a different individual; C, a twitter-squeak song.

*Chur call (60).*—This call was used widely in several contexts (Fig. 5B). It is generally monosyllabic, 125 to 230 msec in duration, and 1 to 7 kHz with considerable variation in frequency range and energy. Chur calls were most often used singly or in pairs, but sequences containing three or more calls at intervals of 125 to 375 msec (or more) between calls were known. Chur calls were used by cliff swallows flying to and from nesting sites and by parents feeding young in nests, interspersed with purr calls in alarm situations, used by foraging swallows and birds chasing others in nest defense, occasionally used as beginning components of twitter-squeak songs (see below), uttered by seemingly contented birds around their nests, used in sexual interactions such as pair formation in spring, and given by cliff swallows in large loafing and premigratory flocks.

*Twitter-squeak song (28).*—The cliff swallow's distinctive song is shown in Fig. 5C. Samuel (1971a) also described this vocalization and termed it a defiance song. The frequency range of the song is 1 to 6 kHz. Songs typically have a duration of 1 to 6 sec and are made up of two basic elements. As in barn swallows, a song usually began with a syllable showing harmonics and lasting 125 to 175 msec, and then was followed with a series of rapid, guttural gratings 0.50 to 0.75 sec in duration. A song was constructed by repeating sequences of these basic elements alternately (syllable, gratings, syllable, gratings), again as in barn swallows. Very short songs contained only one harmonic syllable and one sequence of gratings. There was little difference in frequency range between gratings and harmonic syllables. Chur calls frequently preceded and immediately followed songs.

Twitter-squeak songs were recorded from adult cliff swallows perched in the entrances of nests. Songs were occasionally given by birds clinging to

entrances of nests. These vocalizations appeared to be used in sexual contexts only while birds were courting and establishing pair bonds. One bird, presumably a female, would cling to a nest entrance while another bird, presumably a male, sat in the nest and sang. Pairs are formed when a male finally allows a female to occupy his nest or partially constructed nest base after repeatedly driving her away (Emlen, 1954). The twitter-squeak song is probably used to initially attract females to a male's site, and may also play a role in maintaining the rather loose pair bond in cliff swallows. I did not record any twitter-squeak songs from swallows feeding young. As in barn swallows, there was a slight resurgence in cliff swallow twitter-squeak songs in late summer after nesting was completed. Subsongs were not recorded from cliff swallows in this study. All twitter-squeak songs, even those given in late summer, appeared to be full songs.

DISCUSSION.—Barn swallows possess twice as many vocalizations as do cliff swallows: in this study, eight versus four, and in Samuel's (1971a), 10 versus four. Thus, barn swallows apparently rely on vocal communication to a greater degree than do cliff swallows.

Another pronounced difference between these closely related species lies in their degree of sociality. Cliff swallows are among the most colonial of all passerines. Even prior to man's construction of bridges, buildings, and culverts (which often harbor large swallow colonies), cliff swallows nested in huge colonies at sites remote from and unaffected by people. Bent (1942) reported cliff swallow colonies containing "thousands" of nests on walls of deep gorges in mountainous regions and stated that isolated nests were exceptional. Barn swallows, on the other hand, nest in much smaller colonies, and even on a large bridge or culvert it is rare to find colonies greater than 50 pairs (Snapp, 1976; Erskine, 1979; Martin, 1980; Brown, pers. obs.). Historically, before the advent of artificial structures, barn swallows nested singly or in small aggregations (Dawson, 1897; Betts, 1916). Thus, it is likely that barn swallows have always been much less social than cliff swallows.

The difference in vocal repertoire size between barn and cliff swallows may directly reflect the difference in their sociality. Several workers have suggested that vocal signalling may be inefficient in large or dense colonies of birds owing to noise produced by many individuals, leading to reduced vocal repertoire size in colonial birds (see Brown, 1983). Vocal communication in large cliff swallow colonies may be inefficient and useful only in close-range interactions, whereas in small barn swallow colonies vocal communication is probably useful in a wider variety of situations and over longer distances.

In recent years swallows in central Texas have begun nesting commonly in highway culverts, leading to increased association and hybridization between barn and cave swallows in particular (Martin, 1980). Presently, barn swallow colonies in these areas probably exceed the small sizes under which this species' vocal repertoire evolved. With up to 8 vocalizations used by barn swallows in Texas, four used by cliff swallows, and an unknown number used by cave swallows, it seems possible that auditory confusion

may occur in the large mixed-species colonies that now are common. The twitter songs of barns and cliffs are used in nearly identical courtship and pair bonding situations. These songs also closely resemble each other structurally. Sounds in general in culverts are distorted (Martin, 1980), and therefore these songs are likely distorted, especially the low frequency gratings. I suggest that heterospecific pairings may be partly attributed to confusion stemming from the distorted sounds of the twitter songs in particular and from the unusually large numbers of birds now using many of these colonies. Playback experiments within culverts may help assess whether other vocalizations described here may also be involved in promoting hybridization among these swallows.

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