

VOCAL REPERTOIRE OF THE MEXICAN CHICKADEE II. SONG AND SONG-LIKE VOCALIZATIONS

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Abstract.—The song and song-like vocalizations of the Mexican Chickadee (*Parus sclateri*) are described with sonograms, and the use of each vocalization is discussed. As is the case with many parids, there are two major categories of these vocalizations. “Gargles” are complex vocalizations often used in close range agonistic encounters, whereas “song” in this species apparently has two different major patterns. An unusual feature of “Gargles” and the more complex type of song is that they consist of note-types used in a combinatorial way, generating many variants. Although closely related to other gray-backed North American chickadees, the Mexican Chickadee is markedly different in some vocalizations.

REPERTORIO VOCAL DE *PARUS SCLATERI* II. CANCIONES Y VOCALIZACIONES PARECIDAS A CANTOS

Sinopsis.—Las canciones y vocalizaciones parecidas a cantos de *Parus sclateri* son descritas con sonogramas, y se discute el uso de cada vocalización. Al igual que en otros páridos, el repertorio se puede dividir en dos categorías mayores como lo son las canciones y vocalizaciones parecidas a cantos. Los gorjeos son vocalizaciones complejas usualmente utilizadas en encuentros agresivos, mientras que las canciones, en esta especie, aparentemente muestran dos patrones diferentes. Particularidad poco usual de los gorjeos y de el tipo de canción más compleja, es que consisten de tipos de notas utilizados en forma combinada, que generan una gran cantidad de variantes. Aunque muy parecida en su canción a sus congéneres, ésta ave tiene vocalizaciones marcadamente diferente a las demás.

Avian vocalizations are often divided into two categories: songs and calls. Usually songs are acoustically more complex than calls and are used in territorial advertisement and pair formation. In chickadees, however, such a division is often not clear-cut (Ficken 1981, Hailman 1989). Some parids have acoustically simple songs, apparently involved with territorial advertising, and use a category of vocalizations that is structurally more complex in close range agonistic encounters; these we termed “Gargles” in the Black-capped Chickadee (*Parus atricapillus*, Ficken et al. 1978). Here I consider only those vocalizations of the Mexican Chickadee (*P. sclateri*) that are song-like, both in some functional aspects and in acoustic structure. Finally, I compare the vocalizations with those of some other North American chickadees.

METHODS

The methods and study site are described in more detail in Ficken (1990). The study site was Rustler Park in the Chiricahua Mountains of Arizona, and recordings were made in two trips on October and one in May. In the fall I followed flocks of chickadees and in the spring recorded several territorial pairs, with emphasis on one pair whose nest I located. I used a Sony Walkman Professional cassette tape recorder and

analyzed vocalizations with a Kay 7800 Digital Sona-Graph (150 Hz band width).

RESULTS

“Gargles.”—Dixon and Martin (1979) noted a variety of vocalizations (their Fig. 2, excluding b) that I designate as one vocal category, the “Gargle,” because sharing of note-types occurs among the variants and they occur in similar contexts. “Gargles” are the most structurally complex of all the vocalizations of this species. Figure 1a–c shows three “Gargle” types (each unique combination of note-types is classified as a different type), with a different letter or letter-number combination indicating each note-type. For this purpose, a note is defined as a discrete tracing on a sonagram. Note-types were quite distinctive and “intermediates” very rare; however, some slight individual variation occurred. Some note-types are very brief transients, others show some frequency modulation, and often there are trills of several types (differing markedly in pitch, number of oscillations per unit time, and duration). As many combinations of note-types occur, the overall frequency of the calls was only estimated and ranged from about 1.7 kHz to 8 kHz, each call typically covering a wide frequency range. The duration of “Gargles” is highly variable and dependent on the number and type of notes in the call (2–20).

Although considerable differences occur in the note-types composing “Gargles,” many “Gargles” differ from each other in the addition or deletion of only one note, and only a few basic patterns occur in this population: MEFNI, MEFGHIJ, or rarer ones starting with $H_1H_2H_3$. Even these basic patterns exhibit extensive sharing of note-types (Fig. 1a–c). All others are minor variants of these basic patterns. Table 1 shows the “Gargle” types in the population sampled and the contexts of their occurrence. “Gargles” designated as following “Variable Sees” (see Ficken 1990) and “at nest hole” were involved in intrapair interactions; “alone” indicates no other bird visible in the vicinity, and those associated with territorial boundary encounters between males are divided into those given during or immediately following interactions.

The notes in “Gargles” are not arranged randomly, and some general trends of syntax are apparent. Notes that are transients, or only slightly frequency modulated are at the beginning of the call, whereas trilled notes (if they occur) are usually at or near the end of the call. The same rules occur in Black-capped Chickadees, the only other species in which the fine structure of “Gargles” has been studied (Ficken and Weise 1984, Ficken et al. 1987).

The birds were unbanded, but series of calls were obtained from some known individuals (Table 2). The birds with the largest sample sizes had about 3–10 different types in their repertoires, but larger samples would probably have produced many more. Extensive sharing of “Gargle” types occurs among individuals, even those belonging to different flocks.

“Gargles” occurred in a wide variety of contexts in both spring and fall (Table 1). Some calls were given by a bird that had no close flock

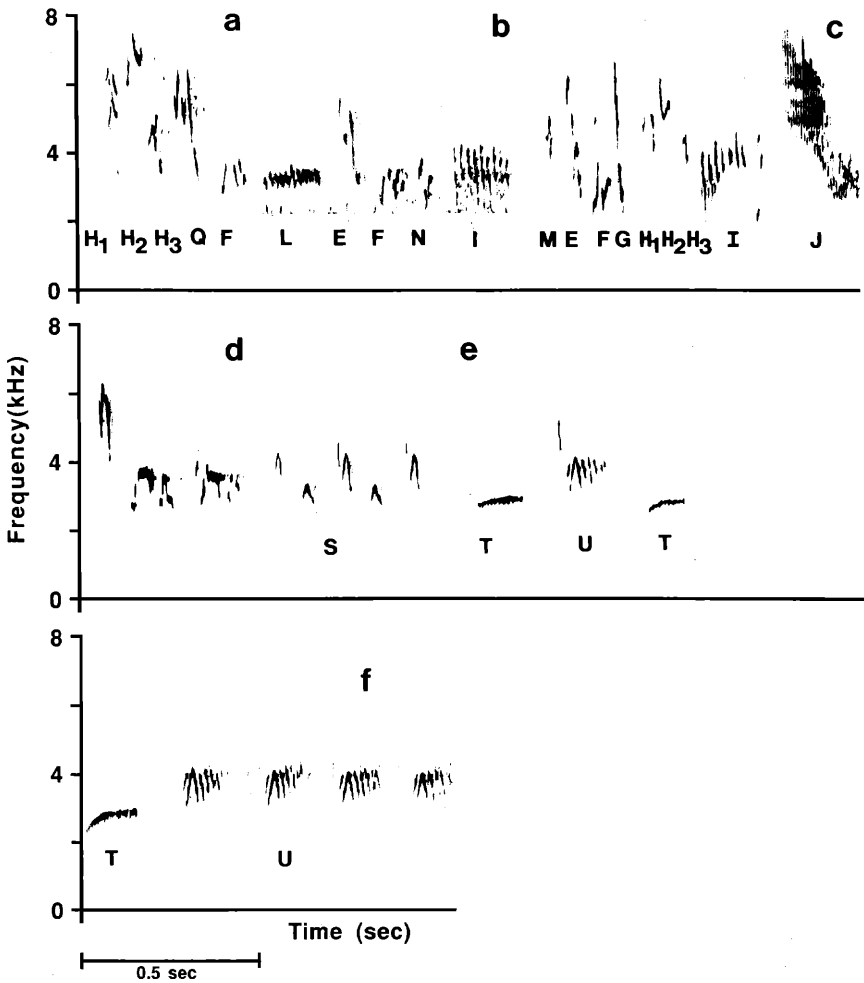


FIGURE 1. a. Gargle type $H_1H_2H_3QF$. b. Gargle type $LEFNI$ (a rare type). c. Gargle type $MEFGH_1H_2H_3IJ$. d. "Peeta-peeta" song (introductory note followed by two identical units). e. and f. 2 song types from same male in spring showing the 3 note-types in his repertoire (S, T, U) (see Table 3 for details).

associates in the fall, but calls were more common when two birds were foraging less than 1 m apart. In these cases, one bird sometimes produced long bouts of calling, while the other was silent or uttered an occasional "Hiss." Birds sometimes sang just before giving "Gargles," perhaps indicating some motivational linkage between the two vocalizations. In spring, "Gargles" occurred in several contexts. The male gave them frequently near the nest hole just after he arrived with food, and the female usually then exited. This male gave a variety of different "Gargle"

TABLE 1. All Gargle types and their contexts.

Gargle type (single units)	Context					
	Follows "Variable Sees"	At nest hole	Alone	Boundary encounter		Unknown context
				Follows	During	
EFGH ₁ H ₂ H ₃ IJ				1		
EFN				1		
H ₁ H ₂ H ₃ I						25
H ₁ H ₂ H ₃ J						8
H ₁ H ₂ H ₃ Q						1
H ₁ H ₂ H ₃ QF					3	5
H ₁ H ₂ QFN						1
H ₁ H ₂ QFNI					2	
LEFNI		5				
ME						2
MEF	1					17
MEFG			16			8
MEFN	1	2				18
MEFNI	2	18	1	8		30
MEFNIE						2
MEFGH ₁ H ₂ H ₃ I			11			4
MEFGH ₁ H ₂ H ₃ IJ			11	5		25
MEFH ₁ H ₂ H ₃ I						1
EFNI (triple)		3				
H ₁ H ₂ H ₃ QIQI				1		
MEFNEFNI					1	7
MEFNIME		2				
MEFGH ₁ H ₂ H ₃			5			
MEFNI (double)		2		3	10	1
MEFNI (triple)				2	5	
MEFNI (quadruple)				1	3	
MEFNI (double) + ME					1	
MEFNI (triple) + ME					1	
MEFNI (double) + EFNI					2	
MEFNIEFNEFNI		1				
MEFNIMEFN		2		1		1
MEFNMEF						2
MEIEFNI		1				

types near the nest hole (Table 1); most were also given by other individuals in other contexts. "Gargles" that terminated "Variable See" series were also of types occurring in other contexts as well.

Particular "Gargle" types did not seem to be associated with specific contexts, except possibly for one unusual type given only near the nest hole (LEFNI), the only "Gargle" type to incorporate L, a trill (Fig. 1b). However, "Gargles" associated with territorial boundary encounters were often different from those occurring in other situations. As Dixon and Martin (1979) noted, "Gargles" rather than song occurred during these encounters. A variety of different "Gargle" types was given in this context, but most began with MEF. "Gargles" given during territorial encounters

TABLE 2. Repertoires of Gargle types of five different individuals.

Gargle type	Individual				
	1 ^a	2 ^a	3 ^b	4 ^c	5 ^c
EFNI (Triple)			3		
H ₁ H ₂ H ₃ I				1	12
H ₁ H ₂ H ₃ J					8
LEFNI			5		
ME					1
MEF				1	1
MEFG	1	18			1
MEFGH ₁ H ₂ H ₃ I		14			1
MEFGH ₁ H ₂ H ₃ IJ	8	3	6		2
MEFN				6	3
MEFNEFNI					1
MEFNI	1		18	12	4
MEFNIE				1	
MEFNIEFN				3	
MEFNIEFNEFNI			1		
MEFNIME			2		
MEFNIMEFN			2	1	
MEFNI (double)			2	1	
MEIEFNIE			1		
Total No. Gargles	10	35	40	26	34
No. of Gargle types	3	3	9	8	10

^a Fall 1985.^b Spring 1986.^c Fall 1986.

used multiple repeated units significantly more often (Table 1) than those in other situations ($\chi^2 = 80.0$, $df = 1$, $P < 0.001$). In some cases "Gargles" were doubled, tripled, or even quadrupled, creating individual calls that lasted more than 2 s. Also, repetitions could consist of only part of another unit, e.g., MEFNIME. As the confrontations ended, and the two birds moved back toward the centers of their territories, birds might still "Gargle," but returned to the more typical forms lacking the repetitive units. Despite large sample sizes of "Gargles" in territorial encounters in Black-capped Chickadees, "Gargles" were no different from those occurring in other situations (Ficken et al. 1987), unlike the repetitions of blocks of notes in the Mexican Chickadee.

Extensive sharing of "Gargle" types among individuals occurs in both species, but the basis for this sharing is different. In Black-capped Chickadees different note-types are combined in many different ways generating hundreds of different "Gargle" types within a population (Ficken and Weise 1984, Ficken et al. 1987), while the "Gargles" of Mexican Chickadees seem to be organized in a simpler way. Both species have 14 to 20 note-types in a population. Recombination of note-types is much reduced in the Mexican Chickadee, and there are probably fewer "Gargle" types in a given population because many note-types seem to be tightly linked, e.g., H₁, H₂ and H₃.

Song.—Chapman (1898) described song as “a rapid, vigorous double-noted whistle repeated three times, and not at all like that of the Black-capped Chickadee.” Dixon and Martin (1979) provided a sonagram of this “peeta-peeta” vocalization that they concluded was the Mexican Chickadee’s song because it functioned both in attracting a rival to a boundary and in territorial advertisement from a distance. I noted marked differences between song in fall and spring, the fall vocalizations being all of the “peeta-peeta” type, while more complex songs were noted in May (when at least some birds had young).

In the fall, “peeta-peeta” songs were uttered by chickadees in mixed species flocks and did not appear to be associated with aggression or any other specific context. Sometimes they were preceded or followed by “Chick-a-dee” calls or “Gargles.” Fall song is stereotyped (Fig. 1d), and those of at least 8 different individuals over a two year period were all of one basic pattern. A higher pitched note preceded a variable number (1–5) of identical lower pitched ones. The frequency ranged from about 4 kHz to 6.2 kHz. The general pattern is similar to the organization of other parid calls such as the “Chick-a-dee” call of the Black-capped Chickadee in which a higher pitched introductory note is often followed by repetitions of identical notes, particularly the D note (Hailman et al. 1985).

In the early spring, bouts of songs (apparently of the “peeta-peeta” type) are particularly frequent at dawn (Dixon and Martin 1979). Song was very infrequent in my May study and dawn bouts were absent, song occurring in short bouts at any time in the morning. Occasionally song immediately preceded territorial interactions, but never occurred during the boundary disputes when “Gargles” were common. However, songs sometimes occurred as a male returned nearer the center of his territory at the end of the encounter.

Spring songs ($n = 63$) were more elaborate than fall songs, and ranged in frequency from about 3 kHz to 5.5 kHz. Figure 1e and f indicates examples of two different songs from one individual. This individual had three different note-types (S, T and U in Fig. 1e and f), that were arranged in different ways, generating many different song types (Table 3). Thus, individuals have repertoires of several different song types as Dixon and Martin (1979) also noted. On another occasion this individual gave a few “peeta-peeta” songs (the only time I recorded them in the spring), but usually his songs were much more complex. The songs of this male given near the nest hole showed combinatorial features, as several note-types were combined in different ways to generate different song types. Songs of different individuals may differ somewhat, as indicated by my very small sample of songs from other males.

DISCUSSION

The genus *Parus* is ideal for comparative analysis of vocal repertoires because of the large number of species, wide range of habitats utilized, and vocal diversity (Hailman 1989). Here I make a preliminary com-

TABLE 3. Song repertoire of one male. (Letters designate note-types in Fig. 1e and f.)

Song type	No. of occurrences
S (5)*	1
S (6)	1
S (4)	3
S (2) U	1
S (3) TUT	1 (Fig. 1e)
T U (4)	2 (Fig. 1f)
UTUT	1
TUT	5
TUTU	1
UTU (3)	1
TUTU (3)	2
UTUTU	1
TUTUT	3
23 Songs (13 song types)	

* No. in parentheses indicates no. of repetitions, i.e., S given 5 times sequentially, comprising total song.

parison of the song and song-like vocalizations of the Mexican Chickadee with those of some other North American chickadees.

In some parids, song is a long distance signal and "Gargles" are short-range signals used in agonistic contests. Do chickadees with complex songs have simpler "Gargles"? In the Mexican Chickadee songs are more complex than in other North American chickadees. "Gargles," on the other hand, are somewhat simpler in this species, and individuals have repertoires that may be smaller than those of well-studied congeners. However, complex song-like "Gargles" consisting of repeated units occur during territorial disputes in this species, but not in the others as far as is known. In addition, Mexican Chickadees may have two major types of songs: the simpler "peeta-peeta" type and the more complex combinatorial kind. Thus the relationship between "Gargles" and song is a complex one.

Compared with other North American chickadees, the Mexican Chickadee is unusual in its song complexity. The Mountain Chickadee (Gaddis 1985) and the Black-capped Chickadee use simple whistles (Ficken et al. 1978). Songs of the Carolina Chickadee are a little more elaborate, individuals having repertoires of several different patterns of high and low whistles (Smith 1972). Only in the Mexican Chickadee, however, is there any elaboration of individual repertoires, as well as a departure from simple whistles.

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