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USE OF SONG PATTERNS TO IDENTIFY INDIVIDUAL MALE CASSIN'S SPARROWS

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Abstract.—Audibly distinct variations in the primary song of Cassin's Sparrow (*Aimophila cassinii*) allow individual males to be identified in the field by their unique repertoires. Small repertoire size, primary song simplicity, and easy recognition of variation in the song pattern make this a useful technique to field observers studying the natural history of this secretive species.

UTILIZACIÓN DEL PATRÓN DE CANTOS PARA LA IDENTIFICACIÓN DE MACHOS DEL GORRIÓN DE CASSIN

Resumen.—El repertorio particular de la canción principal en machos de *Aimophila cassinii* permite la identificación de estos en el campo. Lo reducido del repertorio, la simplicidad del canto principal y el fácil reconocimiento de la variación en el patrón de la "canción" facilitaran estudios de la historia natural de esta especie.

Cassin's Sparrow (*Aimophila cassinii*) is a locally common breeding bird of mesquite-grasslands in west Texas (Williams and LeSassier 1968). Its ground-dwelling habit, unremarkable appearance, and secretive nature have been noted by many authors (Hubbard 1977, Wolf 1977). Even during the breeding season when birds may be present in large numbers, Cassin's Sparrows often remain undetected by experienced observers until males produce their distinctive song or become active in flight song performances (Hubbard 1977, Williams and LeSassier 1968). Such secretive behavior is of interest, but has hindered studies that might increase our understanding of the general biology of the species (Hubbard 1977). This paper provides additional information on Cassin's Sparrow vocalizations and suggests use of unique song repertoires as an aid to identifying individual males in the field.

METHODS

Vocalizations of unmarked, neighboring, territorial male Cassin's Sparrows were recorded from March through September, 1982 and 1983. The study was conducted 8 km northwest of San Angelo, Tom Green County, Texas, in an area covering approximately 100 ha where predominant vegetation consists of honey mesquite trees (*Prosopis glandulosa*), Texas prickly pear cactus (*Opuntia Lindheimeri*), and medium to short grasses. Most observations and recordings were made from 0600–1200 CST. By late March to early April, territorial boundaries were defined,

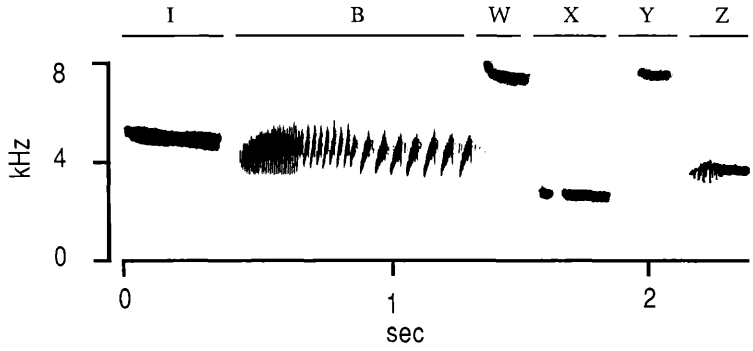

FIGURE 1. Sonogram of the primary song of a Cassin's Sparrow male identifying the I, B, W, X, Y, and Z phrases (after Borror 1971).

and males spent 3–4 h after sunrise singing from two or three favored perch locations. Recordings were made at 19 cps with a Uher 4000 Report IC tape recorder equipped with a Gibson EPM parabolic microphone and were analyzed with a Kay Elemetrics Company model 6061B Sona-Graph at the wide band-pass setting and by listening to playbacks at one quarter (4.7 cps) speed.

RESULTS

The primary song of Cassin's Sparrow is usually sung from exposed perches or during flight displays and appears to be an important element in territorial definition and courtship (Williams and LeSassier 1968, Wolf 1977). Borror (1971) has provided detailed sonographic analysis of the primary song, which is structurally simple and highly stereotyped. A complete song consists of six phrases, which Borror (1971) labeled I, B, W, X, Y, and Z (Fig. 1). I, B, X, and Z are relatively loud phrases, that are usually heard and recorded, whereas W and Y are of lower amplitude and often missed (Borror 1971, Wolf 1977). Primary songs sung from a perch appear similar to those produced during the flight song performance (Wolf 1977).

Borror (1971) also reported song variation within populations of singing males. An examination of 263 songs from 23 birds in Texas and Arizona uncovered ten variations in the I phrase and three in the B (Borror 1971). Variations in the I phrase include: I_1—A relatively long whistled note of even amplitude, I_2—A note similar to I_1, but with the amplitude reduced in the middle and the note appearing two-parted, I_3—Two notes, the first similar to I_1 and the second shorter, I_4—Two notes, as in I_3, but the first like I_2, I_5—Two notes, similar to I_3, but slightly buzzy, I_6—Similar to I_5, but with two short buzzy notes at the end, I_7—Two short whistled notes, each less than half as long as I_1, I_8—Three notes like those in I_7, I_9—Three whistled notes, the last two short, I_{10}—A buzzy note plus four short notes at a lower pitch (Fig. 2) (Borror 1971). The B-phrase variations result primarily from differences in the

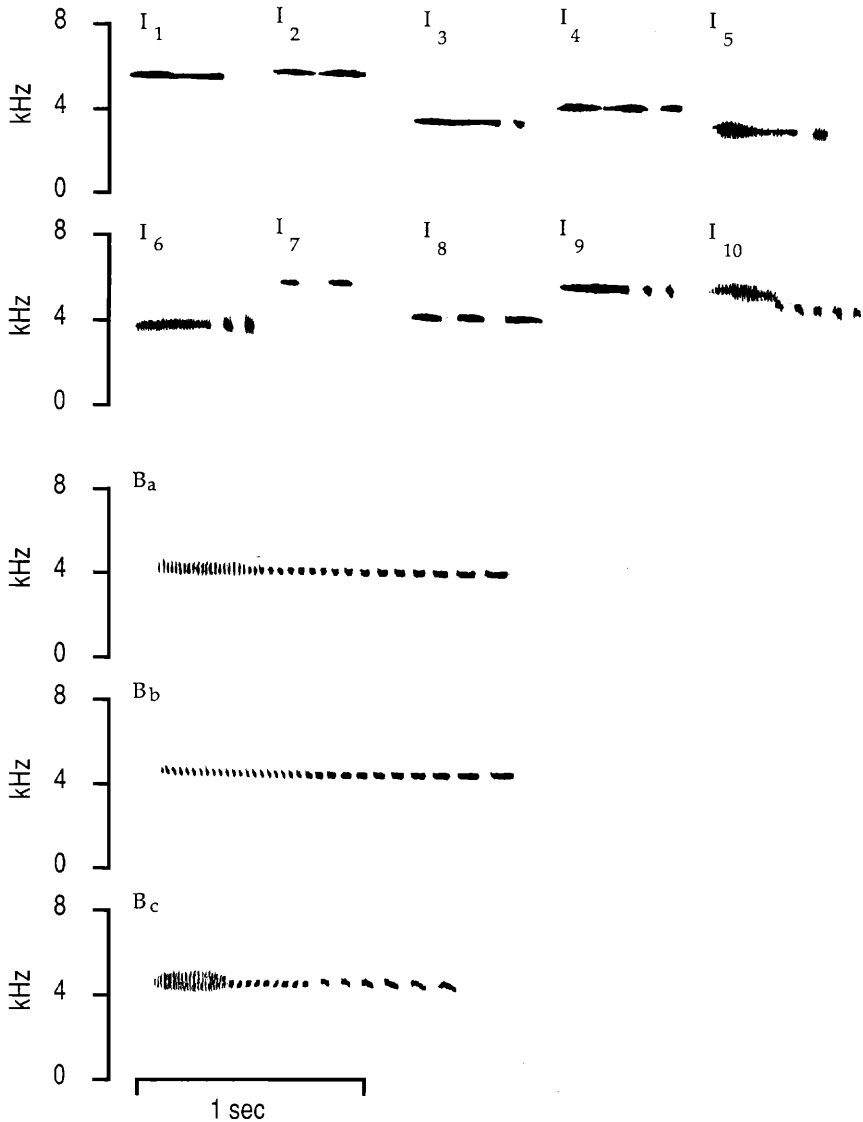

FIGURE 2. Sonograms of Cassin's Sparrow songs showing previously reported variations in the I and B phrases (I_1–I_{10}, B_a–B_c). Reproduced from Borror (1971).

way the modulation rate decreases throughout the phrase: B_a—Modulation rate decreases abrutly near the middle of the phrase, B_b—The rate decreases gradually throughout the phrase, and B_c—Modulation rate decreases in two relatively abrupt steps, the phrase appearing three-parted (Fig. 2) (Borror 1971).

TABLE 1. Summary of the unique song patterns present in the repertoires of 14 Cassin's Sparrow males.

Bird	Total songs recorded	No. of songs in repertoire	No. of song patterns[a]		No. of unique repertoires
			So	Au	
82–4	300	2	2	2	
82–5	250	2	2	2	
82–6	95	2	2	2	
82–7	350	3	3	3	
82–8	120	3	3	3	
82–9	175	2	2	2	
82–10	300	4	4	4	
			18	18	7
83–1	250	3	3	3	
83–2	41	2	2	2	
83–3	62	4	4	4	
83–5	48	3	3	3	
83–6	35	5	5	3[b,c]	
83–7	53	2	2	2	
83–9	27	3	3	2[b]	
			22	19	7
n	2106	40	40	37	14
Mean		2.9			
SD		0.9			

[a] So—sonographically distinct; Au—audibly distinct patterns.

[b] Repertoire contains 1 song pattern that is audibly indistinguishable from a pattern present in the repertoire of Male 83-5.

[c] Repertoire contains 1 song pattern that is audibly indistinguishable from a pattern present in the repertoire of Male 82-10.

Additional variations in the basic song pattern resulted from deletion, repetition, or differences in pitch, duration, and modulation rate of the shorter W, X, Y, and Z phrases (Borror 1971). Some variations were resolved only by sonographic analysis (Borror 1971). In summary, Borror (1971) demonstrated that the number of variations in primary song pattern present in the individual repertoires of singing males was low (maximum of three), and identical song patterns sung by different males occurred rarely in Cassin's Sparrow.

In the present study, the number of variations in primary song pattern in the repertoires of 14 males were examined, seven from each breeding season. Forty sonographically distinct variations in overall song pattern were identified from a total of 2106 recorded songs (Table 1). The average number of different song patterns produced by singing males was 2.9. During singing bouts, birds produced two to four songs of one pattern, then switched to another pattern. The distinct song pattern variations comprising a bird's entire repertoire were usually revealed in 15 or fewer successive performances of their song.

Of the 40 sonographically distinct variations in song pattern, all but three were also audibly distinct. The repertoires of birds 83-6 and 83-9

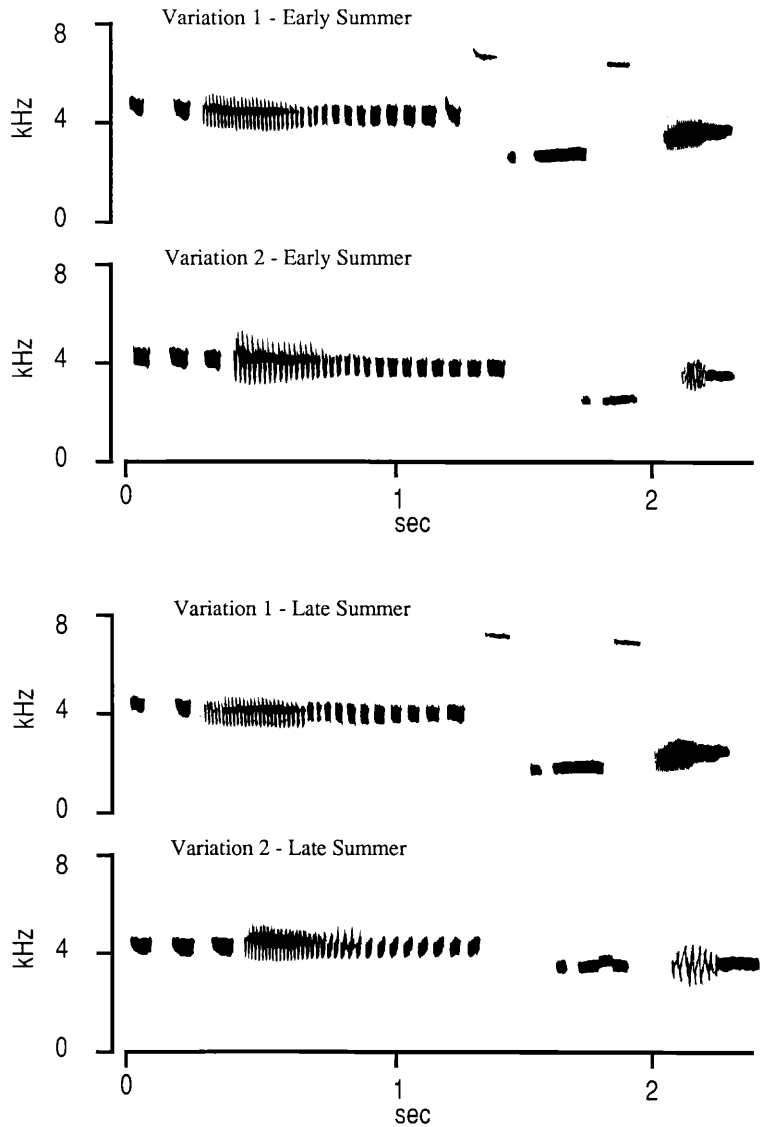

FIGURE 3. Sonograms showing two stable variations in primary song pattern present in the repertoire of Cassin's Sparrow male 83-7 early and late in the breeding season.

contained a song variation that could not be distinguished by ear from a variation produced by male 83-5 (Table 1). In addition, male 83-6 produced a song variation nearly identical to one in the repertoire of the 1982 bird 82-10. This resulted in a total of 37 primary song variations that could be distinguished by ear. Despite these few similarities in pat-

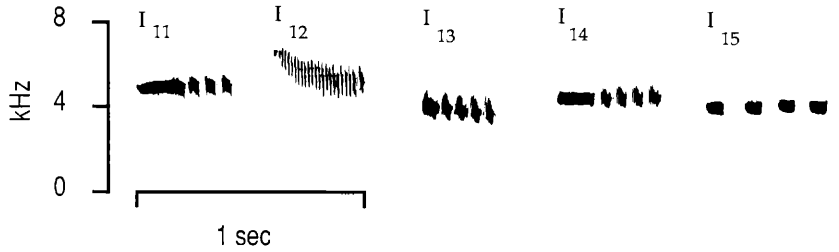

FIGURE 4. Sonograms of five additional variations in the I phrase of Cassin's Sparrow song observed in the present study (I_{11}–I_{15}).

tern, when all variations comprising an individual's repertoire were considered, each set of songs was unique. Audible differences in song patterns allowed all 14 males to be identified individually once their repertoires were known.

The ability to discriminate among song variations was due principally to dissimilarities in structure or pitch of I and B phrases. Daily observations of males throughout the breeding season showed that differences in song pattern were stable and easily detected in the field. The sonograms in Figure 3 provide an example of the complete repertoire for one male early and late in the breeding season. Variability in W, X, Y, and Z phrases is less well understood since they were not consistently detected and often distinguishable only on sonograms.

Table 2, Figure 2, and Figure 4 summarize variations in the I and B phrases reported to date. Borror's (1971) three B-phrase variations were present among birds in this study. However, three I-phrase variations were not found, and five variations were present that have not previously been reported. These consisted of notes of the following type: I_{11}—A long, whistled note followed by three short, slightly buzzy notes, all of the same pitch and amplitude, I_{12}—A descending warble without any whistled notes, I_{13}—Five whistled notes of equal duration and pitch, increasing in amplitude, I_{14}—Similar to I_{11} but having four distinct, short buzzy notes, and I_{15}—Four clear, whistled notes all of the same amplitude, pitch, and duration (Fig. 4).

A secondary pattern, the "chitter" flight song, is produced by males in the presence of females and appears to be associated with courtship or maintenance of the pair bond (Williams and LeSassier 1968, Wolf 1977). It has been characterized as a rapid series of chips that change to a warbled sound near the end (Wolf 1977). The secondary song is usually performed in low, horizontal flight during male-female pursuits or during skylark displays and often terminates in an incomplete primary song (Williams and LeSassier 1968).

Figure 5 shows the sonogram of a complete secondary song. Since these songs were performed during flight, they were seldom recorded in their entirety. The "chitter" component was of variable duration and consisted of chips and trills resembling the scolding notes of a wren. Approximately half ended in a fragmented or complete primary song.

TABLE 2. Characteristics of I and B phrases in Cassin's Sparrow primary song. The table compares results of the present study with earlier work by Borror (1971). See Figure 2 and Figure 4.

Phrase	Characteristic		JLS*	DJB* TX	DJB* AZ
I	Number of songs with I of type:	I_1	4	5	12
		I_2	6	8	1
		I_3	1	1	2
		I_4	1	5	0
		I_5	0	1	0
		I_6	0	0	3
		I_7	7	6	4
		I_8	3	3	2
		I_9	1	1	0
		I_{10}	0	1	0
		I_{11}	3	—	—
		I_{12}	1	—	—
		I_{13}	1	—	—
		I_{14}	4	—	—
		I_{15}	1	—	—
	N		33	31	24
	Duration (s)				
	Mean		0.32	0.32	0.30
	Range		0.18–0.57	0.24–0.49	0.21–0.49
	Pitch (kHz)				
	Mean		5.4	5.5	5.5
	Range		3.7–7.8	3.9–7.5	3.0–8.1
B	Number of songs with B of type:	B_a	25	18	12
		B_b	6	12	8
		B_c	6	1	4
	N		37	31	24
	Duration (s)				
	Mean		0.96	0.91	0.87
	Range		0.66–1.29	0.68–1.19	0.45–1.04
	Pitch (kHz)				
	Mean		5.0	5.0	5.0
	Range		3.7–7.9	3.6–7.1	3.0–7.7

* JLS—author's data; DJB—data from Borror (1971).

DISCUSSION

Sonographic analysis of primary songs produced by Cassin's Sparrow males in this study are, for the most part, consistent with Borror's (1971) earlier work. However, increased number of I-phrase variations and generally larger repertoire size suggest greater variability than previously thought. Further study of song variation, especially with respect to time of nesting cycle and intra- vs. intersexual contexts, is indicated.

Perhaps the most useful information to come from the present work concerns identifying individual males in the field by their unique repertoires. There are few changes in the general location of territories once primary song is produced from exposed perch sites in early spring. In

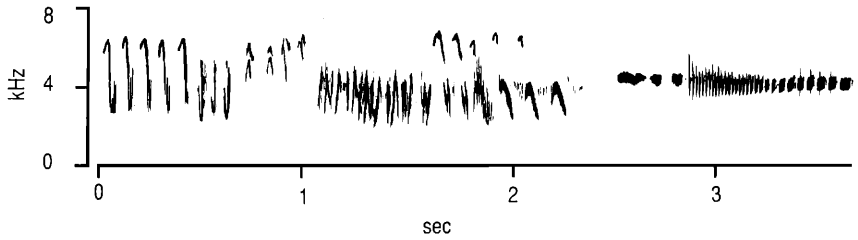

FIGURE 5. Sonogram of the secondary song ("chitter" flight song) of a Cassin's Sparrow male. This particular song ends with an incomplete primary song (only I and B phrases present).

addition, each male selects a limited number of perches that are used consistently throughout the breeding season (Williams and LeSassier 1968). As a practical matter, field identification of individual birds is not difficult when frequent visits are made to a study site and favored perch locations and basic song patterns are learned. Since repertoires consist of relatively few songs, most may be learned quickly. Playback of recorded songs at reduced speed and sonograms are occasionally helpful. This technique should be useful to field observers studying the natural history of Cassin's Sparrow.

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