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### Intersong Interval and Song Pattern Variability of the Five-striped Sparrow

KATHLEEN GROSCHUPF<sup>1</sup> AND G. SCOTT MILLS<sup>2</sup>

<sup>1</sup> P. O. Box 396, Green Valley, Arizona 85614 USA and <sup>2</sup>Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, Arizona 85721 USA

Hartshorne (1973) has recognized two major types of singing patterns in birds, one in which the same song is repeated with relatively long time intervals between each song, and one in which successive songs are different with relatively short time intervals between each song. He has postulated that these patterns result from a tendency to avoid monotony when singing. Individuals within a species may all sing with the same pattern, or in some species individuals may sing both patterns. Verner (1975) has described the latter situation for the Long-billed Marsh Wren (*Cistothorus palustris*) where the intersong interval between two successive songs was longer when the songs were the same.

The songs of the Five-striped Sparrow (*Aimophila quinquestrata*) are well suited to study this aspect of bird song. A typical song consists of an introductory note and 1–6, usually 2, note complexes (a manuscript describing the songs is in preparation). Songs are delivered in a variety of sequencing behaviors at an average rate of 15–16 songs per min. On occasion, singing patterns with recurrence numbers of 0, 1, and 2 occur. A singing pattern with a recurrence number of 0 consists of identical transitions (AAAAA...), a recurrence number of 1 denotes alternating transitions (ABABAB...), while a recurrence number of 2 designates songs occurring in a triplet fashion (ABCABC...). The anti-monotony hypothesis suggests that the intersong interval should decrease with the increase in the number of different songs comprising a singing pattern. Thus, the intersong intervals of identical transitions should be greater than the intersong intervals of alternating songs, which in turn should be greater than the intersong intervals of songs occurring in a triplet fashion.

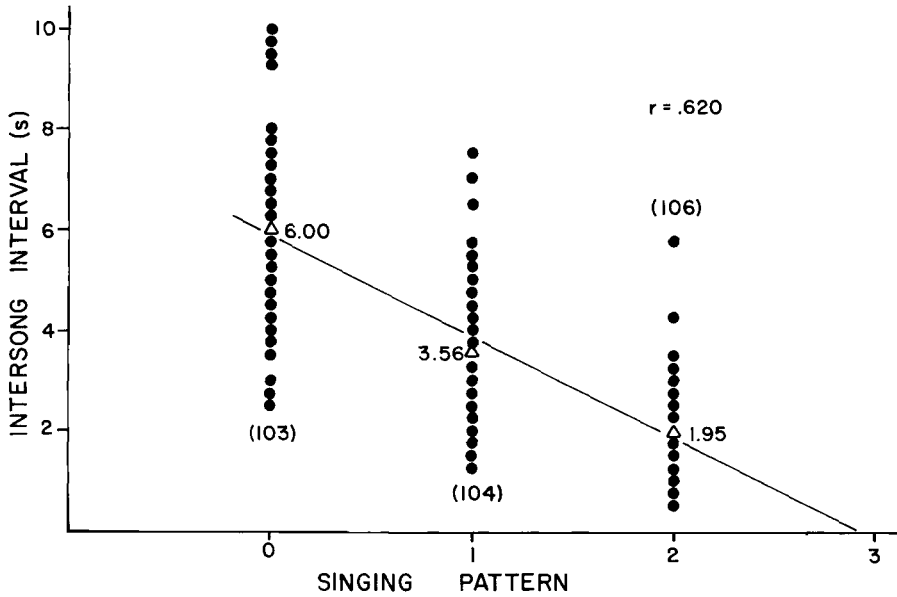


Fig. 1. Regression of intersong interval on the number of different songs in three singing patterns.  $Y = 7.88 - 2.02 X$ ,  $P < .001$ . The numerals on the abscissa represent recurrence numbers. Numbers in parentheses are the number of intersong intervals timed for that particular singing pattern, and the triangles are the average lengths of the intersong intervals. Eight points are not shown for singing pattern 0; their numerical values are 10.75, 11.75, 13.00, 13.75, 15.75, 16.25, 17.75, and 23.75 s.

We tested this relationship using the songs of four Five-striped Sparrows recorded in Arizona and Mexico in 1975 and 1976 by timing the intersong intervals and song lengths of the songs composing these three types of singing patterns. These singing patterns were scattered throughout each individual's repertoire of recorded songs. Thus, the performances analyzed were contained within longer performances consisting of various and irregular sequences. The identical transitions which we measured were from 21 performances averaging 5.5 songs per performance; the alternating songs were from 14 performances averaging 9.1 songs per performance; and the songs occurring in a triplet fashion were from 14 performances averaging 8.6 songs per performance. Songs contained within a singing pattern were not unique to that particular pattern—they occurred in other types of singing patterns as well. Figure 1 shows that as the number of different songs in a singing pattern increased, the rate of singing increased, as predicted. Although the rate of singing increased with increasing singing pattern complexity, percent performance time could remain the same if the song length decreased proportionately. Song length in the measured sequences did show a trend to decrease as the singing pattern complexity increased (average song length in identical transitions = 0.70 s, alternating songs = 0.67 s, triplets = 0.65 s) but this trend was not quite significant ( $F = 2.97$ ,  $.05 < P < .110$ ). The decrease in song length, however, was by a factor of about 0.9 whereas intersong interval increased by a factor of about 3.0. Thus, percent performance time did increase with increasing singing pattern complexity, as Hartshorne (1973) predicts. It is interesting that the regression line intersects the X-axis before a quadruplet pattern (ABCD...), a singing pattern with a recurrence number of 3, is reached. No quadruplet singing patterns were found in 3,780 songs.

The anti-monotony hypothesis has recently been challenged by Dobson and Lemon (1975) who presented data that refuted Hartshorne's relation between continuity and versatility of songs between species. They used repertoire size as a measure of versatility, which we do not believe is appropriate. Birds that sing with eventual variety (Hartshorne 1973), such as Cardinals (*Cardinalis cardinalis*) (Lemon 1965), Rufous-sided Towhees (*Pipilo erythrophthalmus*) (Kroodsma 1971), and Carolina Wrens (*Thryothorus ludovicianus*) (Borror 1956), do not use their entire repertoires in a given singing bout and, therefore, have effectively smaller repertoires at any given time. If a fraction of the repertoire is used during a lengthy time period then total repertoire size may overestimate versatility. Studies of Rock Wrens (*Salpinctes obsoletus*) by Kroodsma (1975), Long-billed Marsh Wrens by Verner (1975) and Wood Pewees

(*Contopus virens*) by Craig (1943) have shown that intersong interval is longer between identical transitions than between different songs. These results, as well as the data presented here, do indeed suggest that a positive correlation between versatility and continuity, as measured by intersong interval, does exist.

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### Crows use Automobiles as Nutcrackers

DAVID B. GROBECKER AND THEODORE W. PIETSCH

*College of Fisheries, University of Washington, Seattle, Washington 98195 USA*

On 19 November 1977 at 0930 we observed a Common Crow (*Corvus brachyrhynchos*) hovering over a busy street in a residential area of Long Beach, California. From a height of ca. 10 m, the bird dropped from its beak a palm fruit (*Washingtonia* sp.) that broke into two pieces on the heavily traveled street. Immediately after release, the crow flew to a nearby lamppost where it perched and seemingly watched the palm fruit as cars passed. After approximately 2 min, one car ran over a piece of the fruit. Within seconds the bird flew to the shattered food and flew off with a fragment. After 20 min the feeding sequence was repeated with the exception that upon impact with the pavement the palm fruit failed to break, and it took considerably longer, approximately 7 min, for a moving car to run over the fruit.

Surprisingly complex behavioral adaptations of crows are well documented. Crows are characterized by their resourcefulness, adaptability to diverse habitats, and extraordinary learning capabilities (Frings and Frings 1959, Peterson 1963, Powell 1972). Powell (1972) showed that the operant behavior of the Common Crow is comparable to that of pigeons, rats, and monkeys, and Porter (1910) demonstrated that this species can learn a door-opening response by simply watching another, trained crow. The Hooded Crow (*C. cornix*) is known to pull up fishermen's lines set through holes cut in the ice to steal bait or fish (Homberg 1957, Scott 1974). Crows are known to follow milkmen on their route; when bottles are left alone, the bird pries off the caps with its beak and sips the milk (Scott 1974). The possibility that crows deliberately drop walnuts, to be cracked, in the direct path of automobiles has been previously suggested, based on a single observation (Maple 1974). Our observations, however, now support that suggestion. This is indeed an ingenious adjustment to the intrusion of man's technology.

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