The organization of behaviour remains one of the prime concerns of ethologists with the songs of birds representing one area of particular interest. The songs are well suited to sequential analysis because they usually consist of discrete acoustic patterns rather analogous to phonemes in human speech. Instrumental analysis has now reached such sophistication that these can readily be studied visually in long sequences.

To date, certain models have been used to predict the sequential relationships of events in song in probabilistic terms. Of these, one has exploited the urn model of Cane (1961) showing that events are serially repeated such that the number of repetitions of each kind of event is relative to its probability. Repetitions of the same song type in series by Cardinals (Cardinalis cardinalis) (Lemon & Chatfield, 1971) fit this model to some extent, although the number of repetitions exceeds that expected by chance alone. Another probabilistic model employed is the Markov series wherein events of different kinds are predictable solely on the basis of immediately preceding events. Again in Cardinals, switches from one song type to another follow a first order Markov rule in being predictable solely on the basis of the immediately preceding event. Markov models have also been applied to song in other species such as Rose-breasted Grosbeaks (Pheucticus ludovicianus) (Lemon & Chatfield, 1973) and Western Meadowlarks (Sturnella magna) (Falls & Krebs, 1975).

A linear control model has been developed by Todt and his colleagues. Using European Blackbirds (Turdus merula) which tend to repeat immediately a song played to them if they have it in their repertoire, Todt (1975) has gathered evidence of three interacting factors: the input component from another bird or playback of a recording; the periodic component or probability of recurrence of a particular song; and the throttling component.

1) Supported by NRC grants to R. E. Lemon.
which reduces the probability of the song being immediately repeated for some
time after it has been sung.

These models recognize the discreteness of particular events of song and
might be called atomistic. Nelson (1973) has suggested that such an approach
is less satisfactory than one which recognizes more general patterns of
organization, the so-called holistic approach of Bohm (1968).

In support of his contention he presented results from the songs of
Swainson’s thrushes (Hylocichla ustulata) and from these claims a “rhomboidal patterning” which is shared with human music and features of plant
and animal morphology. This model asserts that within songs of this thrush
successive sound patterns tend to fit a pentatonic scale with approximately
equal logarithmic frequency intervals. The rhomboidal patterning results
from interaction of the regular pentatonic intervals with the fact that dif-
terent song types begin from different key notes.

In this paper we examine for ourselves the songs of the Swainson’s Thrush.
In so doing we do not find consistent rhomboidal patterning or pentatonic
scales. Instead our thrushes exhibited so much individuality that we question
whether such a holistic model contributes much to an understanding of song
organization.

MATERIALS AND METHODS

We recorded songs of Swainson’s thrushes from 10 individuals of which six gave
sufficient samples for analysis of sequences of song events. All thrushes were resident
in the Province of Quebec when recorded in July 1975 (Table I). Recordings were
made by a Uher 4200 tape recorder at 19 and 9.5 cm per second using a Dan Gibson
parabolic reflector and microphone.

<table>
<thead>
<tr>
<th>No.</th>
<th>Date recorded</th>
<th>Location</th>
<th>Songs recorded</th>
<th>Songs per bout</th>
<th>Song types</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18/7/75</td>
<td>Matane, Québec</td>
<td>346</td>
<td>100, 78, 65, 54, 5</td>
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<td>2</td>
<td>18/7/75</td>
<td>Matane</td>
<td>57</td>
<td>42, 15</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>18/7/75</td>
<td>Matane</td>
<td>55</td>
<td>32, 12, 8, 5</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>6/7/75</td>
<td>Lac Carré</td>
<td>40</td>
<td>22, 9, 5, 2, 2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>20/7/75</td>
<td>Percé</td>
<td>222</td>
<td>73, 34, 31, 39, 5</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>20/7/75</td>
<td>Percé</td>
<td>41</td>
<td>24, 16, 15</td>
<td>3</td>
</tr>
</tbody>
</table>

We analyzed the songs on a Ubiquitous Spectrum Analyzer (Federal Scientific, model
UA-500) equipped with an Analyzer Averager (model UA-500-1), a three dimensional
Automatic Display Generator (66-2A) and an Intensity Modulator (option 67). Displays
were made on a Tektronix Oscilloscope (5103N) and recorded by a Grass Kymograph
Camera (model C4N). Such instrumentation yields a continuous frequency analysis on