SHORT COMMUNICATIONS

The Condor 93:1001–1003

SONG SIMILARITY IN AN ISOLATED POPULATION OF FOX SPARROWS (*PASSERELLA ILIACA*)[1]

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Key words: Fox Sparrow; Passerella iliaca; *song similarity; founder effect; isolated.*

The structure of song in island populations of birds has been the subject of a number of studies (see review in Miller 1982). Two different hypotheses predict how song might evolve in such populations. First, island populations may have more complex songs because they are subject to weaker selective pressures for species-specific signals than are mainland populations (Miller 1982). We refer to this as the song complexity hypothesis. Second, founder effects may constrain song structure (Nottebohm 1969, Thielcke 1973, Mundinger 1975, Mirsky 1976, Baptista and Johnson 1982, Lynch and Baker 1986); a population bottleneck could lead to reduced song variation because young birds are exposed to fewer kinds of songs and song elements (Baker and Jenkins 1987). We refer to this as the founder effect hypothesis. These two hypotheses are not necessarily incompatible, as a population could possess complex songs that are highly stereotyped within each bird and vary little among birds, or could possess simple songs that vary greatly from male to male. Furthermore, in a small population, periodic bottlenecks after low population levels, such as might occur after a season of high mortality, could function to re-establish song similarity.

As a contribution to our understanding of song characteristics in island populations, we present data on the song structure of an insular population of Fox Sparrows (*Passerella iliaca*) in Nova Scotia, Canada. Fox Sparrows reach the southeastern limit of their breeding range in Nova Scotia, and breeding birds are largely restricted to scattered small offshore islands along the coast, where relatively few other passerine species breed. These populations are therefore isolated by the location of islands and the paucity of adjacent mainland populations. Fox Sparrows are largely migratory, but probably exhibit high fidelity to the island (see discussion).

In the spring of 1990, we tape recorded the songs of all males in the largest known population of Fox Sparrows in Nova Scotia. In this paper we compare the number of song types and total number of syllables possessed by this population with these parameters from other populations for which published data exist.

Our study site was the Evelyn and Morrill Richardson Field Station in Biology on Bon Portage Island, Shelburne County, Nova Scotia (43°46'N, 65°45'E). The island is about 3 km long, 400–600 m wide and lies 3 km from shore. No breeding concentrations of Fox Sparrows of comparable size are known in the province, the nearest sizable populations being found in Newfoundland, about 600 km distant. A sample of at least 20 songs was obtained from each male between 11 and 22 May 1990 using an Akai PJ-35 recorder with a Realistic 33-992C directional microphone mounted on a 60 cm parabolic reflector. Individual males were not color-marked, but were widely spaced on their territories, so it was unlikely we sampled the same birds twice. The strong similarity of recordings from the same locations on different days support this assumption. We analyzed recordings on a Macintosh computer using the MacSpeech Lab II pro-

TABLE 1. Characteristics of variation in Fox Sparrow songs.

Location[1]	Source[2]	No. of males	Song types per male	Syll.[4] in pop.	No. syll. per song[5]	Syll. types per song[5]	Syll. diversity
1	A	11	1	15	7.4	7.2	0.96
2[3]	B	9.5	3.3	48.5	8.2	8.2	1
3[3]	B	28.5	3.1	49	8.2	8.2	1
4[3]	B	23.5	3.4	49	8.2	8.2	1
5	C	19	1	37	11.4	9.4	0.82
6	C	16	1	42	12.6	10.6	0.83

[1] Locations: 1 = Bon Portage Is., Nova Scotia, 2 = Cub R. Canyon, Utah/Idaho, 3 = Logan R. Canyon, Utah/Idaho, 4 = Blacksmith Fork Canyon, Utah/Idaho, 5 = Baccaleau Is., Newfoundland, 6 = Gull Is., Newfoundland.
[2] Sources: A = this study, B = Martin (1977), C = Blacquiere (1979).
[3] Mean of data from two years.
[4] Syll. = Syllables.
[5] Mean values are given for the three Utah/Idaho populations (Miller 1982).

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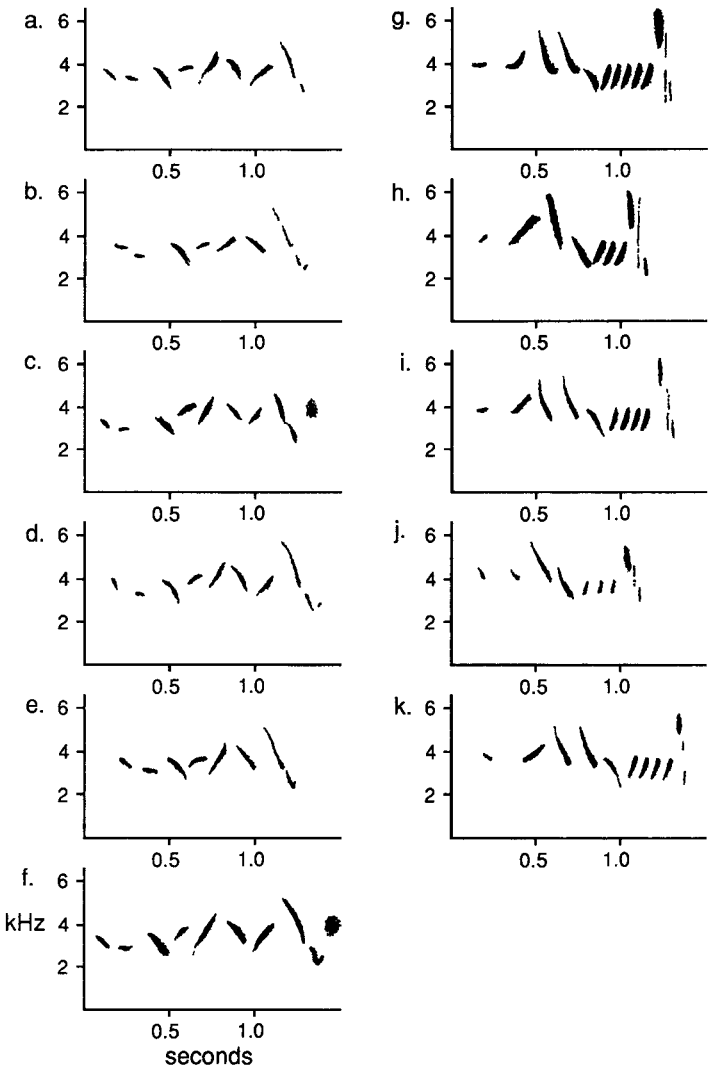

FIGURE 1. Representative song from each of the 11 males recorded in 1990. Each bird possessed only one song type with a high degree of similarity among males.

gram (version 1.5). Spectrographs were produced using a 300 Hz analyzing filter. Songs were visually divided into syllable types. We defined a syllable as a sound or series of sounds preceded and followed by a silent interval of at least 10 msec.

In comparing our results with others from non-isolated populations, we considered only published data from populations with discrete boundaries and of known population size. Three such populations were described by Martin (1977, 1979) from canyons in Utah and Idaho, and two by Blacquiere (1979) from islands off Newfoundland. Of all these populations only Bon Portage is at the range limit and has no nearby populations to facilitate gene flow.

We observed 11 males singing on the island in 1990. Each male sang only one song type, as in Newfoundland (Table 1; Fig. 1; Blacquiere 1979). A representative spectrograph of the song of each of these males is shown in Figure 1. The songs fall clearly into two song types, with six males singing one, and five the other. Songs within each song type were very similar among males and within each male, with two exceptions. First, males c and f (Fig. 1) rarely deleted the terminal syllable. Second, the number of repetitions of the penultimate syllable occasionally varied in birds g–k (Fig. 1).

Although the sample sizes in Table 1 are quite small, some differences are apparent. Variation among males

was much less in the Bon Portage population than in the populations studied by Blacquiere and Martin, as predicted from the founder effect hypothesis. A total of 15 syllables was identified from Bon Portage Fox Sparrows, compared to 37 to 49 for the other populations (Table 1). Song complexity, however, was not higher in the Nova Scotia birds. Of four measures of song complexity (see Miller 1982), repertoires were not larger, songs had fewer syllables and fewer syllable types per song, and the syllable diversity (number of different syllables in a song divided by the total number of syllables in that song), although greater on Bon Portage than in Newfoundland, was still slightly smaller than in Utah/Idaho (Table 1). Certainly, other factors such as the effectiveness of a song type in attracting females and repelling rival males, genetic constraints, breeding density and the auditory environment could also influence song structure, but these factors cannot be addressed in a descriptive study on a small population.

The studies cited at the outset of this paper all deal with resident populations. In contrast, the Bon Portage population is mostly or entirely migratory. Despite this, we believe that the population has remained effectively isolated, for several reasons. First, the song types we documented were also present on the island in 1989, based on a small sample recorded then (Naugler, unpublished). Furthermore, Fox Sparrow song repertoires do not change once they are acquired (Peyton 1971, Martin 1977, Blacquiere 1979), so the birds we recorded in 1990 were probably residents or the progeny of residents—immigrants would likely bring different song types. New song types or syllables could only be added to this population by errors in learning existing types (Lemon 1975) or by immigration. The fixity of song types in mature males would preclude the learning of new vocal signals on migration. Finally, a limited number of Fox Sparrows were banded in previous years and subsequently recaptured on the island. To our knowledge, this study is the first to suggest bottleneck effects as the cause of song stereotypy in a migratory population.

We would like to thank Dr. Elizabeth Blackmer for the use of her sound analysis software, Dr. Laurene Ratcliffe, Dr. James Briskie, Scott Shackleton, and two reviewers for helpful comments, and Richie and Bonnie Watkins for assistance in the field.

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