J. Field Ornithol., 71(3):467–471

SINGING BEHAVIOR OF THE HERMIT THRUSH

JAMES W. RIVERS[1]
Department of Forestry and Wildlife Management
University of Massachusetts, Amherst, Massachusetts 01003 USA

DONALD E. KROODSMA
Department of Biology
University of Massachusetts, Amherst, Massachusetts 01003 USA

Abstract.—Despite the Hermit Thrush's wide distribution and exceptional singing ability, its vocal behavior is poorly known. In recorded samples from Arizona and New England, we show that males have repertoires of 6 to 12 discrete song types. Those types can be presented in highly regular sequences, but the order varies among males, perhaps depending on context or motivation. Arizona and New England songs differed in several frequency and temporal features, such as the duration and frequency of the introductory whistle and the remainder of the song, suggesting regional differences in Hermit Thrush songs. How these geographic differences in song are influenced by song development and dispersal should be a focus of future research.

CONDUCTA DEL CANTO DE *CATHARUS GUTTATUS*

Sinopsis.—Apesar de la amplia distribución del zorzal *Catharus guttatus* y de su excepcional canto, su conducta de vocalización es poco conocida. En grabaciones hechas desde Arizona hasta Nueva Inglaterra, hemos encontrado que los machos tienen un repertorio de 6–12 tipos discretos de canciones. Estos cantos pueden ser presentados en secuencias altamente regular, pero el orden varía entre machos, tal vez dependiendo del contexto o motivación del canto. Los cantos de aves de Arizona y de Nueva Inglaterra difieren en varias frecuencias y aspectos temporales, tales como duración y frecuencia del pitido introductorio y el restante de la canción. Todo esto sugiere diferencias regionales en la canción del ave. Como estas diferencias geográficas son influenciadas por el desarrollo de la canción y la dispersión, deben ser el foco de futuros trabajos.

The Hermit Thrush (*Catharus guttatus*) is a common songbird in northern hardwood forests and in most boreal and mountainous coniferous forests throughout North America. Despite this wide distribution and this thrush's exceptional singing qualities (e.g., see Hartshorne 1973), little is known about its singing behavior (Jones and Donovan 1996). We therefore set out to describe the fundamentals of its singing behavior, as derived from tape-recorded samples from two geographically distant locations, Arizona and New England.

STUDY SITE AND METHODS

In north central Arizona, from May–July of 1996, we recorded males of the Audubon's Hermit Thrush (*C. g. auduboni*) in the Coconino and Apache-Sitgreaves National Forests of Arizona (see Martin and Roper 1988). Then, in southern New England, from July–August of 1996, we recorded the Eastern Hermit Thrush (*C. g. faxoni*) in the Green Moun-

[1] *Current address: Kansas Cooperative Fish and Wildlife Research Unit, Division of Biology, 205 Leasure Hall, Kansas State University, Manhattan, Kansas 66506 USA.*

tain National Forest in southern Vermont and in the Pioneer Valley of western Massachusetts. Preliminary analyses suggested that a male cycles through his entire song repertoire in about 20 consecutive songs, so we attempted to record a continuous sequence of at least 30 songs from each individual; more typically, our samples were double that, and sometimes consisted of 300–350 songs. From our recordings of 49 individuals, we selected 12 from Arizona and seven from New England, based on recording quality and duration. We further restricted our analysis by using only recording made from 5 h before to 45 min after sunset (we found no obvious difference between morning and evening recordings).

To record, we used a Marantz PMD222 cassette recorder and Maxell tape (MS-60, CrO_2). For microphones, we used either a Sennheiser MKH-106 microphone in a 60-cm aluminum parabola or, less frequently, a Sennheiser ME66 short shotgun microphone with a Nature SME BA-3 amplifier. Recorded songs were analyzed on a Kay Elemetrics DSP 5500 spectrum analyzer (filter bandwidths analogous to 117 Hz and 150 Hz for measuring frequency and time, respectively).

To determine if Arizona and New England songs were different from each other, we chose four semi-random songs from each of four New England birds and from each of 12 Arizona birds, for a total of 64 songs. Several temporal and frequency measures were made on each song. Then, each sonagram was cryptically labeled, and a third person compared each sonagram to all other sonagrams, seeking the most similar song in the entire array.

RESULTS

Each male used a discrete number of song types in his singing. Each song began with the characteristic introductory whistle, followed by a distinctive, complex series of fluty warbles (Fig. 1). Successive songs were always different, and five of the 19 males presented their entire song repertoire before repeating any of their song types (i.e., the first 10 recorded songs revealed the entire repertoire of 10 song types). Each song type recurred in long sequences of singing, so that we could be confident that we had recorded the entire repertoire of commonly used songs by each male. For 16 of the 19 males, no new song types were encountered after the first 20 songs, even though we analyzed an average of 44 songs/male (range 30–59). In Arizona, the repertoire size ranged from 6 to 12 song types (median = 8.5, $n = 12$), in New England from 9 to 10 (median = 10, $n = 7$).

Males tended to present their song repertoires in fairly predictable sequences. Three Arizona males, in fact, always presented their song types in the same rigid sequence (over samples of 60, 53, and 48 songs for repertoires of 7, 7, and 9 song types, respectively). In their recorded samples, we could thus predict the next song type in a sequence with 100% accuracy. Other males, however, were less predictable. Overall, among our 12 Arizona birds, the predictability ranged from 54% to 100% (median, 77.5%; chance would be about 12.5% for a median repertoire of 8.5 song

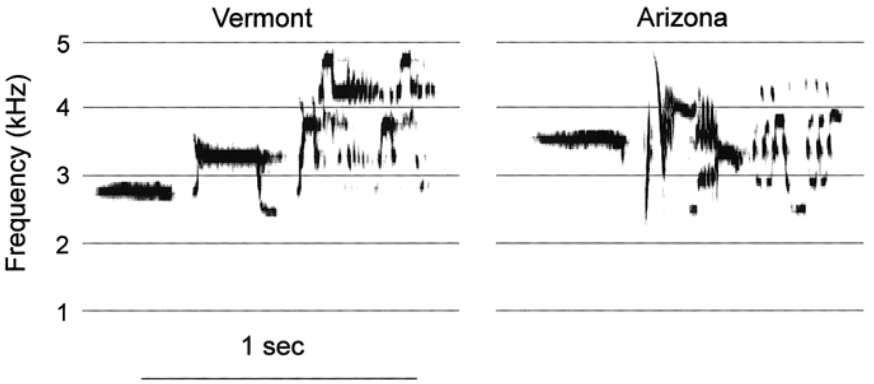

FIGURE 1. Representative songs of Hermit Thrushes. New England (Vermont) males typically have a lower introductory whistle than do Arizona males. Furthermore, in New England, the energy in the rest of the song is typically well above the introductory whistle, but in Arizona no striking rise in frequency occurs.

types). Predictability for our seven New England birds was lower, ranging from 50% to 90% (median, 50%; chance would be about 10%).

In a number of features, songs from Arizona and New England differed (Table 1). The introductory whistle in Arizona, for example, was higher pitched and of greater duration than in New England. For the remainder of the song, the frequency with the greatest concentration of energy tended to be higher in New England than in Arizona. Consequently, representative songs from Arizona and New England often sounded very different, because the increase in frequency from the whistle to the rest of the song in New England was much greater than in Arizona (e.g., Fig. 1). Other features of the songs differed, too, such as the duration of the non-whistled portion of the song, which was greater in New England than in Arizona.

TABLE 1. Songs of Arizona and New England birds differ in temporal and frequency features (median, range). Analyses are based on two-tailed Wilcoxon Rank Sum Test, $n_1 = 12$ Arizona males, $n_2 = 7$ New England males. For each male, the median value from four semi-randomly chosen songs was used in this analysis. N.S., $P > 0.05$; **, $P < 0.01$; ***, $P < 0.001$.

	Arizona		New England
Introductory whistle			
Duration	0.29 s (0.20–0.33)	**	0.24 s (0.17–0.26)
Frequency	3.40 kHz (2.89–3.94)	***	2.75 kHz (2.32–3.01)
Post-introductory whistle			
Frequency of greatest energy	3.26 kHz (2.63–4.19)	N.S.	3.64 kHz (3.49–4.11)
Change in frequency from introductory whistle	+0.14 kHz (−0.25–0.60)	***	+1.17 kHz (0.79–1.70)
Duration	0.77s (0.52–0.98)	**	0.90 s (0.84–0.97)

Our naïve sorter of sonagrams, not knowing any of the above facts, also recognized a consistent difference between the Arizona and New England songs. When searching for the most similar sonagram pairs in our sample, he paired Arizona songs 46 of 48 possible times (chance would have been only 47/63*48 = 35.8 out of 48) and New England songs 14 of a possible 16 times (chance, 15/63*16 = 3.8 out of 16). None of these pairings, however, contained identical sonagrams, suggesting that the birds had not learned the details of their songs from each other.

DISCUSSION

The repertoire size of 6 to 12 songs for the Hermit Thrush is not atypical of other North American thrushes. A male Veery (*Catharus fuscescens*), for example, has one to three song types in its repertoire (Weary et al. 1987). The Wood Thrush (*Hylocichla mustelinus*) organizes its singing a little differently, thus making a direct comparison with the Hermit Thrush more difficult. Each Wood Thrush song consists of three parts, a few low pitched notes (A), the loud, flute-like *eeohlay* (B), and then higher-pitched trills (C). Males have 2–8 B phrases and 6–12 C phrases, comparable to the repertoire of the Hermit Thrush, but the B and C phrases are sung in different combinations, perhaps yielding up to 25 different songs (Beck 1971, Whitney 1985).

In the Wood Thrush, as perhaps with the Hermit Thrush, the sequence in which songs are delivered varies with circumstance. A Wood Thrush that is not interacting with other thrushes tends to sing his B song phrases in a highly predictable order, but the preferred order is disrupted when other males are within earshot (Whitney 1985). In our recorded samples of Hermit Thrushes, more frequent use of song playback in New England later in the season may have decreased the predictability of song sequences there.

Songs of our New England and Arizona sites differed in many features, but possible range-wide differences in song, and the basis for it, need additional study. We believe our limited samples are typical of songs from the Southwest and from New England, but additional sites from those regions would be needed to verify regional differences. We are also intrigued by how local and regional differences in song may be influenced by song development and dispersal; neighboring male Hermit Thrushes in Arizona do not share song types, even though the general patterns are similar, suggesting either that males invent their songs (as Wood Thrushes invent their C song phrases; Lanyon 1979) or that males learn their songs and then disperse to a new location, thus scrambling different song types among locations. If the birds invent their songs without reference to what other males are singing, then regional differences in song would reflect regional differences in genetic background. Distinguishing these possibilities will be a focus of future research.

ACKNOWLEDGMENTS

We thank those who helped us bring this project together: J. Briskie, R. DeGraaf, J. Farrington, C. Griffin, T. Martin, and W. Rivers. M. Smith and R. Rehmeier provided valuable

comments on the manuscript. Special thanks are due to T. Smith for assistance and logistical support in the field. Financial support was provided by T. Fuller, the University of Massachusetts Student Chapter of the Wildlife Society, the Rocky Mountain Elk Foundation, and the National Science Foundation (IBN-9408520).

LITERATURE CITED

BECK, R. M. 1971. Sequence patterning of Wood Thrush song. Am. Zool. 11:16.

HARTSHORNE, C. 1973. Born to sing. An interpretation and world survey of bird song. Indiana University Press, Bloomington, Indiana.

JONES, P., AND T. M. DONOVAN. 1996. Hermit Thrush (*Catharus guttatus*). No. 261, *in* A. Poole, and F. Gill, eds. The birds of North America. Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D. C. 28 pp.

LANYON, W. E. 1979. Development of song in the Wood Thrush (*Hylocichla mustelina*) with notes on a technique for hand-rearing passerines from the egg. Am. Mus. Novit. 2666: 1–27.

MARTIN, T. E., AND J. J. ROPER. 1988. Nest predation and nest-site selection of a western population of the Hermit Thrush. Condor 90:51–57.

WEARY, D. M., R. E. LEMON, AND E. M. DATE. 1987. Neighbor-stranger discrimination by song in the Veery, a species with song repertoires. Can. J. Zool. 65:1206–1209.

WHITNEY, C. L. 1985. Serial order in wood thrush song. Anim. Behav. 33:1250–1265.

Received 12 Mar. 1999; accepted 12 Jul. 1999.