GEOGRAPHIC VARIATION IN WING LENGTH OF THE ROSE-BREASTED GROSBEAK

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Numerous studies have suggested that a correlation exists between long, pointed wings and migratory behavior. Averill (1920) compared the wing length of 41 species of warblers and eight geographic groups of Common Yellowthroat (*Geothlypis trichas*) to show that in any group those with longer wings make the longest migrations. Congeneric pairs of species, of which the migratory species possesses longer, more pointed wings than the sedentary species are documented by Kipp (1958) and Kuroda (1964). Species with long-winged migrant populations and short-winged resident populations have been identified by Behle (1973), Chapman (1940), Hogstad (1983), Lo Valvo *et al.* (1988), Mead (1983), and Scebba and Lovei (1986). Species in which certain populations have longer wings and apparently migrate farther are known from Norway (Rostad 1986) and elsewhere in Europe (Lovei 1983). Intraspecific wing-length variation, and a relationship between wing length and migration distance, has not been previously documented in the Rose-breasted Grosbeak (*Pheucticus ludovicianus*), which also may fit this pattern.

METHODS

Measurements of wing chord, tail, and tarsus (Baldwin *et al.* 1931) were taken from study skins with dial calipers and recorded to the nearest 0.1 mm. The 394 specimens included in the study were all adult males collected during the breeding season and showing no excessive feather wear. Twelve geographic groups ("populations") of specimens were defined, based on the availability of study skins currently in museums. Generally, the samples included specimens taken between 25 May and the end of July. To avoid including migrants in southern populations (*i.e.*, Nebraska and North Carolina samples), only June and July specimens were included. In some northern populations 15 May was used as the early date and these samples may include some migrants. There was no evidence that late May migrants introduced bias into the samples. Comparisons of late May (15-31 May) samples with June/July samples from the same area showed no significant difference in mean wing lengths (*e.g.*, for Connecticut, $F=1.13$, $df=33$, $P=0.349$).

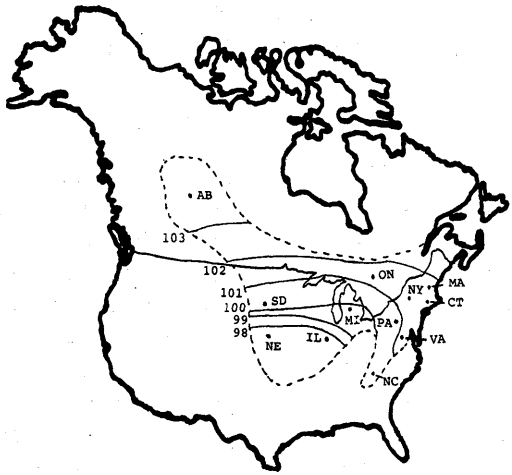

Figure 1. Isophenes for wing length in the Rose-breasted Grosbeak (data in table 1).

Data were analyzed on an IBM personal computer using Number Cruncher Statistical System (Hintze 1987). ANOVA F-ratios were used to suggest the degree of variation between populations. Student's t-tests were used to compare the means of two populations. Variances were equal in all comparisons.

RESULTS

The mean wing length for the twelve populations of Rose-breasted Grosbeak shows statistically significant geographic variation ($F=15.00$, $df=393$, $P<.001$, Table 1). The wing length data arranged into means for these twelve geographic areas show a clinal pattern increasing in size northwestward and northeastward from the central United States (Fig. 1). The contour lines of Figure 1 were fitted by eye using the mean wing length values of the twelve samples; so the figure provides a tentative graphic portrayal of the data. While the contour lines do not correspond to significant differences between separated populations, in general populations separated by two contour lines have average wing lengths that are significantly different. Statistical comparisons between average wing lengths of the twelve populations are in Table 2.

Figure 2. Representative banding and recovery records for Rose-breasted Grosbeak from Table 3.

Banding and recovery data (Table 3) indicate that birds which breed in the northeastern United States migrate a longer distance than those which breed in the central United States. Figure 2 illustrates the migratory pattern by mapping representative records from Table 3. All 25 records are not shown because many are similar and, although they might emphasize the pattern, they add clutter without adding information.

DISCUSSION

Rose-breasted Grosbeak breeds in North America east of the Rocky Mountains roughly from central Canada to central United States (Fig. 1, area within dashed line), winters from central Mexico to northern South America, and migrates through the West Indies, northeastern Mexico, and the southern United States east of the Rockies (A.O.U. 1983). Figure 1 illustrates the clinal pattern discovered for the wing length of Rose-breasted Grosbeak. Bergmann's rule, which predicts larger size with increasing latitude in warm-blooded vertebrates, does not explain this phenomenon because tail ($F=1.67$, $df=349$, $P=0.14$), and tarsus ($F=1.55$, $df=348$, $P=0.17$) lengths do not show clines corresponding to the wing length. Furthermore, the wing-length cline has a west-to-east aspect as well as a south-to-north aspect.

Table 1. Wing length (mm) of several populations of adult male breeding Rose-breasted Grosbeak

Population	Sample Size	Range	Mean ± SE	SD
Alberta+	23	98.8-112.0	103.3±0.6	2.78
Mass.,New Hampshire, and Maine*	15	97.6-105.4	101.9±0.7	2.92
Connecticut*	35	96.0-107.3	101.6±0.5	2.72
New York*	53	94.0-107.0	101.5±0.4	2.78
Ontario*	10	96.4-105.8	101.4±0.8	2.68
Virginia, Delaware, Maryland*	14	99.3-103.4	101.2±0.4	2.55
Pennsylvania and New Jersey*	54	94.5-107.6	100.8±0.4	2.65
North Carolina#	6	99.3-103.4	100.5±0.7	1.66
South Dakota+	31	94.7-107.1	100.1±0.5	2.98
Michigan+	41	93.6-105.8	99.4±0.4	2.90
Nebraska#	106	90.5-105.6	97.6±0.3	2.72
Illinois+	5	94.0-100.1	97.1±1.2	2.58
All	394	90.5-112.0	100.1	

June and July specimens
+ 25 May - July specimens
* 15 May - July specimens

Rose-breasted Grosbeak which breed in New York State have an average wing length that is intermediate between other populations. Those which breed in Alberta have a greater average wing length and those breeding in the central United States have a smaller average wing length. Banding data provide an incomplete picture of where breeding populations winter. They do suggest, however, that while New York breeders generally migrate to southern Central America and northern South America, grosbeaks that breed in the central United States, which have shorter wings, only migrate as far as Mexico and central Central America. There are no banding and recovery records from breeding populations that have longer wings than those which breed in New York State.

The question arises whether or not the farthest distance from the winter range can be equated to the longest distance of migration. Between the years 1923 and 1988 the Bird Banding Laboratory has collected records of 1,333 banded and recovered Rose-breasted

Grosbeaks, 25 of which link the possible breeding and wintering location of specific individuals (Table 3). The pattern that emerges from these records (Fig. 2) indicates that Rose-breasted Grosbeaks that breed in New York and New England have longer wings and migrate a greater distance than those that breed in the central United States.

The straight-line, point-to-point, distance covered by populations in the vicinity of New York traveling to South America is about 2400 miles compared to about 2000 miles for birds traveling from the vicinity of Michigan and Minnesota to Central America. This implies that the New York birds, which have an average wing length about 2 mm greater than midwestern U.S. birds (Table 1), are flying about 20% farther.

Table 2. Comparison of mean wing length of adult male Rosebreasted Grosbeak from several populations. Entries are P-value of t-tests, with statistically significant values in boldface.

	MA	CT	NY	ON	VA	PA
AB	.144	**.025**	**.012**	.080	.006	**<.001**
MA		.713	.612	.662	.405	.146
CT			.869	.842	.521	.158
NY				.921	.596	.169
ON					.830	.491
VA						.442

	NC	SD	MI	NE	IL
AB	.028	**<.001**	**<.001**	**<.001**	**<.001**
MA	.288	**.047**	**.005**	**<.001**	**.004**
CT	.354	.251	**.001**	**<.001**	**.001**
NY	.402	**.027**	**<.001**	**<.001**	**.001**
ON	.480	.208	**.050**	**<.001**	**.011**
VA	.389	.096	**.005**	**<.001**	**<.001**
PA	.820	.251	**.018**	**<.001**	**.005**
NC		.712	.359	**.013**	**.027**
SD			.353	**<.001**	**.046**
MI				**<.001**	**.097**
NE					.667

Based upon the observation that longer-winged grosbeaks seem to migrate further south, a reverse clinal pattern should exist in the winter range with short-winged populations wintering in Mexico and long-winged populations wintering in northern South America.

Lincoln (1952) implies that the migration distance of the birds breeding in the New England area is even greater by asserting that all Rose-breasted Grosbeak cross the Gulf of Mexico through a window between Vera Cruz and the Yucatan Peninsula. Thus, for example, birds wintering in Venezuela and headed for New York would travel in a curved course northwest through Central America, north across the Gulf of Mexico and then northeast to their breeding range. A record of a bird banded in New York (22 Aug 75, Lat. 41.4°N Long. 74.2°W) and recovered in Honduras in May (11 May 81, Lat. 15.0°N Long. 87.0°W), probably during migration, supports Lincoln's view. However, the fact that Rose-breasted Grosbeak is commonly found throughout the West Indies during migration (Bond 1980) argues that some, including the eastern populations, may migrate along fairly direct north-south routes.

The banding data leave some questions still unanswered. For example, the winter range of the Alberta breeding population is not known. These long-winged individuals presumably migrate farther than any other group of Rose-breasted Grosbeaks. The winter range of the North Carolina population is also not known. The small sample of six from North Carolina suggests a rather long-winged population nests in a southern state. If this sample is representative, it poses an interesting problem because, even if North Carolina grosbeaks migrate to northern South America, they would not necessarily have to migrate farther than do Michigan birds which migrate to El Salvador (about 2000 miles).

That the clinal pattern observed in Rose-breasted Grosbeak wing lengths is due solely to migration distance is not certain. James (1970) found similar clines in twelve other North American bird species, many of which are not migratory. James documents a high degree of concordance between mean wing length and climatic gradients which would also account for the longer-winged population in the Appalachian Mountains of North Carolina. Further, sedentary Dark-eyed Junco (*Junco hyemalis carolinensis*), also of the Appalachian region, have longer wings than their migratory counterparts (*J. h. hyemalis*) (Mulvihill and Chandler 1991).

Table 3. Rose-breasted Grosbeak banding and recovery data

BANDED			RECOVERED		
Location	**Lat-Long**	**Date**	**Location**	**Lat-Long**	**Date**
Mass.	422-0711	30 Jul 47	Panama		23 Jan 48*
New York	424-0735	24 Jul 75	Panama	074-0814	22 Oct 75
New York	424-0770	29 Aug 75	Venezuela	102-0714	Jan 76*
Pennsylvania	400-0791	22 May 71	Columbia	062-0761	7 Feb 72*
W. Virginia	393-0795	14 May 73	Honduras	154-0860	9 Mar 75
Illinois	422-0891	7 Aug 82	El Salvador	131-9880	23 Nov 82*
Indiana	395-0860	20 Sep 70	El Salvador	142-0892	27 Oct 71
Iowa	410-0922	6 May 81	El Salvador	133-0880	27 Feb 82*
Michigan	430-0822	8 May 68	El Salvador	131-0883	29 Jan 71
Michigan	422-0853	18 Sep 74	Guatemala	141-0894	9 Nov 75
Michigan	422-0853	27 Sep 82	Honduras	141-0874	30 Nov 82
Michigan	444-0843	13 May 84	El Salvador	135-0892	31 Dec 86*
Minnesota	441-0915	24 Jul 60	Guatemala	143-0910	Oct 64
Minnesota	450-0930	5 Aug 63	Guatemala	143-0895	4 Feb 65*
Minnesota	450-0925	23 Jul 65	Guatemala	144-0893	Dec 66
Minnesota	450-0925	8 Jul 70	Honduras	152-0875	5 Feb 73*
Minnesota	450-0925	26 Jun 81	Guatemala	141-0905	22 Oct 82
Minnesota	441-0931	19 May 86	El Salvador	313-0883	21 Dec 86
Missouri	403-0952	16 May 84	Guatemala	142-0895	2 Nov 87
Wisconsin	444-0881	20 May 72	Honduras	134-0874	30 Nov 72
N. Dakota	484-1020	21 Aug 69	Mexico		Jan 71*
Ontario	423-0801	18 May 66	Columbia	084-0755	11 Nov 70*
Ontario	423-0801	7 Sep 78	El Salvador		Jan 80
Ontario	435-0812	21 Aug 81	Honduras	143-0885	1 Feb 82*
Ontario	435-0782	5 Sep 81	Honduras	134-0874	17 Jan 86

* These records are illustrated in figure 2 to provide a general picture of the migratory pattern between breeding and winter ranges of Rose-breasted Grosbeak.

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