

PATTERNS OF SPRING AND FALL MIGRATION IN NORTHWEST FLORIDA

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The southeastern United States just north of the Gulf of Mexico is important for the study of bird migration. The Gulf is a formidable obstacle for long-distance migrants; for other species, the north-Gulf region is the southern extent of winter ranges. Although the potential there for migration study is great, all available observational methods have limitations and biases (Richardson 1978); no one method can most efficiently record all (Robbins 1967). "Combinations of . . . techniques are desirable since their differing strengths and limitations are often complementary" (Richardson 1978).

In this paper we compare results from 2 long-term migration studies in northwest Florida: a television-tower casualty study (25 yr of data) and a field-count study (23 yr of data). The 2 methods are quite different, and may produce different results from day to day (Howell 1955, Stevenson 1958, 1960). Nevertheless, compared results of concurrent tower and field studies generally agree with regard to certain groups of species (papers in Avery et al. 1980), and we think this will be especially true if the data span several years rather than 1 or 2 days. Thus we compare data from our 2 studies in order to examine some peculiar patterns of occurrence in northwest Florida for certain groups of birds.

Stoddard (1962) noted that, among the bird casualties here considered, many species breeding far north of Florida were rare in spring compared with their fall status, but migrants breeding nearby were frequent casualties both in spring and fall. Crawford noted that the northern breeders comprised 2 groups: trans-Gulf migrants and winter residents. These observations are the basis for the arrangement of the species in Tables 1, 2, and 3.

METHODS

Data are from Leon County, Florida, about 20-40 km north of the Gulf Coast. Tower-kill data are from the long-term study of bird casualties at the 308 m WCTV tower at Tall Timbers Research Station. Daily searches for dead birds under this tower have been made since October 1955 (Crawford 1981). Stevenson has counted birds monthly in Leon County since 1946 (Stevenson 1956). For each month and year similar percentages of the total effort were made in certain areas (e.g., Lake Jackson, ca. 22.2% of total hours per month and per year; roadside by car, ca. 5.4%; time in darkness, ca. 3.0%). Field coverage was so planned as to include comparable time periods in the habitats available, and allowances were made for habitat changes over the years. To avoid skewedness, each third of each month was represented by 30-35% of the total hours for the month. All birds seen and heard were counted; rainy weather was avoided.

TABLE 1. Individuals of transient species that breed north of Leon County.

Species	WCTV tower		Field data	
	Spring	Fall	Spring	Fall
Black-billed Cuckoo <i>Coccyzus erythrophthalmus</i>	6	41	0	0
Swainson's Thrush <i>Catharus ustulatus</i>	50	484	1	27
Gray-cheeked Thrush <i>Catharus minimus</i>	156	146	1	14
Veery <i>Catharus fuscescens</i>	96	1018	3	25
Worm-eating Warbler <i>Helmitheros vermivorus</i>	24	151	4	4
Golden-winged Warbler <i>Vermivora chrysoptera</i>	0	69	0	10
Blue-winged Warbler <i>Vermivora pinus</i>	3	49	1	7
Tennessee Warbler <i>Vermivora peregrina</i>	4	544	0	35
Yellow Warbler <i>Dendroica petechia</i>	15	102	6	66
Magnolia Warbler <i>Dendroica magnolia</i>	1	519	2	57
Black-throated Green Warbler <i>Dendroica virens</i>	1	64	0	23
Cerulean Warbler <i>Dendroica cerulea</i>	0	130	2	15
Blackburnian Warbler <i>Dendroica fusca</i>	0	374	0	20
Chestnut-sided Warbler <i>Dendroica pensylvanica</i>	0	483	0	56
Bay-breasted Warbler <i>Dendroica castanea</i>	0	466	0	8
Ovenbird ^a <i>Seiurus aurocapillus</i>	23	802	1	11
Northern Waterthrush ^a <i>Seiurus noveboracensis</i>	30	437	2	41
American Redstart <i>Setophaga ruticilla</i>	63	716	3	123
Scarlet Tanager <i>Piranga olivacea</i>	28	125	5	4
Total	500 (7%)	6720 (93%)	31 (5%)	546 (95%)

Source	Sum of squares	Degrees of freedom	\bar{x} squares	F-value	Significance
Species	9.680	18	0.538	4.936	$P < 0.01$
Season	25.668	1	25.668	74.400	$P < 0.01$
Technique	12.690	1	12.690	78.333	$P < 0.01$
Spp. \times season	6.218	18	0.345	3.165	$P < 0.01$
Spp. \times tech.	2.923	18	0.162	1.486	$P > 0.05$
Season \times tech.	1.634	1	1.634	14.990	$P < 0.01$
Error	1.969	18	0.109		
Total	60.782	75			

^a A rare winter resident in Leon County.

For this study, consideration of both data sets is limited to the migration seasons: spring (February–May) and fall (August–November) from October 1955 through September 1980 for the tower and from October 1955 through September 1978 for the field data (2414 h afield, of which 24.5% was contributed by persons other than Stevenson). We include species well-represented in both data sets that are winter residents (but not local breeders) in Leon County, and trans-Gulf migrants that are transients, local breeders, or both. Many species use a trans-Gulf and a circum-Gulf route (Stevenson 1957); we exclude species strongly associated with a Florida-peninsula or western Atlantic route. Except for cuckoos and the Yellow-bellied Sapsucker, all species herein are passerines. The data were tested by a 2-way factorial ANOVA mixed model with a $\log_{10}(x + 1)$ transformation (Sokal and Rohlf 1969).

RESULTS

The data in Table 1 show that trans-Gulf migrants that breed north of Leon County were generally numerous in the fall at the tower and in the field, but were generally rare by both methods in the spring. Locally-breeding trans-Gulf migrants (Table 2) were generally numerous in both seasons by both techniques. Non-breeding winter residents (Table 3), generally common by both techniques in the fall, were rare in spring at the tower, but were frequently recorded in the spring in the field. Thus the 2 techniques record similar patterns for the species groups in Tables 1 and 2, but not for those in Table 3. Results of analyses of variance are consistent with our presentation of these results.

DISCUSSION

For species that breed far north of Leon County, the data differ in numbers among species and between seasons, but in Tables 1 and 2 the proportions are similar with regard to season. For some variations there are obvious explanations. The large number of Gray-cheeked Thrushes in spring at WCTV (Table 1) is because 104 of them were killed on one night, 1–2 May 1964—a freak occurrence (Stoddard and Norris 1967). The greater proportion of breeding migrants for Stevenson's spring data than for the tower's (Table 2) is probably because, in addition to birds sighted, more birds are audibly conspicuous in spring than in fall. Because our results from the 2 techniques in Tables 1 and 2 are so similar, and because most other tower-field data sets are likewise similar (Graber and Graber 1980, Avery et al. 1978, 1980), we attribute the differences between the data sets in Table 3 to the birds' behavior rather than to an artifact of technique.

Some of the paucity of trans-Gulf migrants in Table 1 may be due to the Gulf coast hiatus (Lowery 1945). Lowery found that in Louisiana trans-Gulf migrants continued to fly inland if they reached the coast in fair weather and with a tail wind. Encountering head winds and inclement weather accompanying a cold front, however, caused the birds to stop on the nearest land. Thus their absence is only apparent; they fly

TABLE 2. Individuals of migrant species that breed in Leon County.

Species	WCTV tower		Field data	
	Spring	Fall	Spring	Fall
Yellow-billed Cuckoo <i>Coccyzus americanus</i>	106	351	236	207
Great Crested Flycatcher <i>Myiarchus crinitus</i>	17	17	1104	101
Acadian Flycatcher <i>Empidonax virescens</i>	18	90	108	81
Eastern Wood-Pewee <i>Contopus virens</i>	10	38	171	292
Wood Thrush <i>Hylocichla mustelina</i>	35	308	82	71
Yellow-throated Vireo <i>Vireo flavifrons</i>	114	174	338	95
Red-eyed Vireo <i>Vireo olivaceus</i>	2558	4591	688	225
Prothonotary Warbler <i>Protonotaria citrea</i>	300	140	229	18
Swainson's Warbler <i>Lymnolthypis swainsonii</i>	96	80	4	0
Northern Parula <i>Parula americana</i>	603	852	1853	471
Prairie Warbler <i>Dendroica discolor</i>	353	512	139	39
Louisiana Waterthrush <i>Seiurus motacilla</i>	39	23	8	13
Kentucky Warbler <i>Oporornis formosus</i>	137	382	35	34
Yellow-breasted Chat <i>Icteria virens</i>	16	78	138	8
Hooded Warbler <i>Wilsonia citrina</i>	396	728	123	175
Orchard Oriole <i>Icterus spurius</i>	64	10	698	41
Summer Tanager <i>Piranga rubra</i>	145	146	776	372
Blue Grosbeak <i>Guiraca caerulea</i>	27	57	354	555
Indigo Bunting <i>Passerina cyanea</i>	130	731	1131	990
Total	5164 (36%)	9308 (64%)	8215 (68%)	3788 (32%)

Source	Sum of squares	Degrees of freedom	\bar{x} squares	F-value	Significance
Species	18.254	18	1.014	21.438	$P < 0.01$
Season	0.102	1	0.102	0.658	$P > 0.05$
Technique	0.001	1	0.001	0.002	$P > 0.05$
Spp. \times season	2.782	18	0.155	3.277	$P < 0.01$
Spp. \times tech.	10.716	18	0.595	12.579	$P < 0.01$
Season \times tech.	1.808	1	1.808	38.224	$P < 0.01$
Error	0.852	18	0.047		
Total	34.515	75			

TABLE 3. Individuals of non-breeding winter residents in Leon County.

Species	WCTV tower		Field data	
	Spring	Fall	Spring	Fall
Yellow-bellied Sapsucker				
<i>Sphyrapicus varius</i>	0	93	133	159
House Wren				
<i>Troglodytes aedon</i>	1	380	267	945
Winter Wren				
<i>Troglodytes troglodytes</i>	0	26	14	43
Marsh Wren				
<i>Cistothorus palustris</i>	18	113	10	20
Sedge Wren				
<i>Cistothorus platensis</i>	37	213	56	77
American Robin*				
<i>Turdus migratorius</i>	32	59	4707	1930
Hermit Thrush				
<i>Catharus guttatus</i>	0	179	188	101
Golden-crowned Kinglet				
<i>Regulus satrapa</i>	0	59	56	110
Ruby-crowned Kinglet				
<i>Regulus calendula</i>	0	983	1288	1019
Solitary Vireo				
<i>Vireo solitarius</i>	0	124	43	34
Black-and-white Warbler				
<i>Mniotilta varia</i>	45	577	52	151
Orange-crowned Warbler				
<i>Vermivora celata</i>	21	278	123	103
Yellow-rumped (Myrtle) Warbler				
<i>Dendroica coronata</i>	1004	1191	13,681	1625
Northern (Baltimore) Oriole				
<i>Icterus galbula</i>	1	30	45	12
Savannah Sparrow				
<i>Passerculus sandwichensis</i>	38	914	1628	608
Grasshopper Sparrow				
<i>Ammodramus savannarum</i>	13	361	5	2
Henslow's Sparrow				
<i>Ammodramus henslowii</i>	4	37	0	0
Vesper Sparrow				
<i>Poocetes gramineus</i>	14	135	627	249
Dark-eyed (Slate-colored) Junco				
<i>Junco hyemalis</i>	2	22	166	112
Chipping Sparrow				
<i>Spizella passerina</i>	16	519	1046	897
White-throated Sparrow				
<i>Zonotrichia albicollis</i>	33	454	6441	1644
Fox Sparrow				
<i>Passerella iliaca</i>	0	15	8	1
Swamp Sparrow				
<i>Melospiza georgiana</i>	30	526	608	494
Song Sparrow				
<i>Melospiza melodia</i>	2	265	632	493
Total	1311 (15%)	7553 (85%)	31,824 (75%)	10,829 (25%)

TABLE 3. Continued.

Species	Sum of squares	WCTV tower		Field data	
		Spring	Fall	Spring	Fall
Source		Degrees of freedom	\bar{x} squares	F-value	Significance
Species	44.098	23	1.917	18.612	$P < 0.01$
Season	9.131	1	9.131	48.312	$P < 0.01$
Technique	8.659	1	8.659	13.509	$P < 0.01$
Spp. \times season	4.352	23	0.189	1.835	$P > 0.05$
Spp. \times tech.	14.755	23	0.641	6.223	$P < 0.01$
Season \times tech.	13.143	1	13.143	127.602	$P < 0.01$
Error	2.372	23	0.103		
Total	96.510	95			

* A rare breeder in Leon County.

overhead out of sight. We do not attribute the rarity of trans-Gulf migrants in Stevenson's Table 1 data entirely to a Gulf-coast hiatus, however, because those migrants are likewise virtually absent from the tower kills. Even if the birds flew over without being seen, some would likely hit the tower. For example, Bobolinks (*Dolichonyx oryzivorus*), rarely recorded by field observers in the interior southeastern U.S. during fall migration, are nevertheless frequent victims of autumn tower kills there (Crawford 1980). Conditions causing passerines to be susceptible to tower kills will probably affect them equally when they are aloft. Lowery and Newman (1951) suggested that the main trans-Gulf flights from the south are usually across the western half of the northern Gulf of Mexico.

TABLE 4. Individual swallows recorded in Leon County during the study period.

Species	WCTV tower		Field data	
	Spring	Fall	Spring	Fall
Tree Swallow <i>Tachycineta bicolor</i>	5	8	7756	2931
Bank Swallow <i>Riparia riparia</i>	0	0	11	348
Rough-winged Swallow <i>Stelgidopteryx ruficollis</i>	0	0	43	437
Barn Swallow <i>Hirundo rustica</i>	1	3	370	2142
Cliff Swallow <i>Hirundo pyrrhonota</i>	0	0	0	39
Purple Martin <i>Progne subis</i>	2 ^a	0	751	2142

* Martin casualties at WCTV probably were not migrants, but rather from a colony on the tower grounds (Crawford 1981).

Stevenson (1957) showed that most of the wholly-transient species had their peak spring abundances in the western part of the Gulf (Texas and Louisiana). Rappole et al. (1979) reached a similar conclusion. Consequently, in northwest Florida those species in Table 1 may be rare in spring at the tower and in the field simply because they are not ordinarily there in considerable numbers. Their infrequent spring influxes in Florida may be brought about by westerly winds (Stevenson 1954).

Only nocturnal migrants are killed in large numbers at towers. For example, Avery et al. (1978) noted that 2 diurnal migrants, American Goldfinch (*Carduelis tristis*) and Chestnut-collared Longspur (*Calcarius ornatus*), were abundant in the field about their tower but were virtually absent from the kills. At WCTV, diurnal migrants occur similarly. Swallows, for example, well-known diurnal migrants (Lincoln 1935:12), and abundant transients in Leon County, rarely strike the WCTV tower (Table 4). Because the winter residents listed in Table 3 are so commonly seen in the field in spring but are nearly lacking from the tower kills then, we suggest that they begin their northward journeys in the spring by day—not by night as in the fall.

SUMMARY

Twenty-five years of TV-tower kill data and 23 years of concurrent field data from northwest Florida are compared. The data agree with other studies indicating that northerly-breeding passerine trans-Gulf migrants have the bulk of their spring migration to the west of Florida. New evidence suggests that some non-breeding winter residents may leave northwest Florida by day-time flights rather than by nocturnal flights.

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