

GENERAL NOTES

Population Sizes and Philopatry of Winter Resident Warblers in Puerto Rico.—Keast and Morton (1980) provided insights into the complex interactions between migrant birds and permanent residents with which they live in the Neotropics much of the year. While previous authors had made generalities about the ecological traits of winter resident warblers in tropical habitats, the message from this symposium is that even within the Parulinae, a variety of wintering "strategies" seems to exist.

In monitoring bird populations in a Puerto Rican dry forest over a 12-year period, we have accumulated information on winter resident warblers. Weights and some information on homing were presented in Faaborg and Winters (1979, 1980). The apparent interactions between winter resident warblers and resident insectivores, particularly with regards to density fluctuations, have been discussed (Faaborg and Terborgh 1980, Faaborg 1982). Here we focus on species-specific traits of the winter residents, with particular emphasis on degree of philopatry shown by each species, territorial behavior, sex ratios, and fluctuation in population sizes.

Our measurements were made in the Guanica Forest of southwest Puerto Rico. This area supports sclerophyll vegetation typical of seasonally dry locations in the West Indies (see Terborgh and Faaborg (1973) for a description and photographs). Rainfall averages nearly 100 cm yearly, but drying winds, poor soils, and a 3–4 month dry season lead to a drought-adapted vegetation.

Warbler populations were sampled using mist nets in the manner described by Terborgh and Faaborg (1973). In the thick scrub of this forest, the generally silent winter resident warblers are difficult to see, so mist nets are the only suitable sampling tool for our purposes. Two lines of 16 nets (12 m long, 2.6 m wide, with 36 mm mesh) each were operated the first few years (Faaborg and Winters 1979). Here we report on data gathered from only one line for the period 1973 through 1984, excluding 1977 and 1979. This line of nets placed end to end was operated for 3 consecutive days from dawn to dusk in each of these years but 1976, when only 2 days were completed. These 48 net-day or approximately 576 net-h sampling periods occurred on 10–12 February 1973, 3–5 February 1974, 20–22 January 1975, 4–5 January 1976 (32 net-days), 6–8 January 1978, 2–4 January 1980, 25–27 January 1981, 6–8 February 1982, 7–9 January 1983, and 13–15 January 1984. By the third day of netting, the number of new captures was very low, suggesting that a high proportion of a sedentary population had been captured. All birds were banded, weighed with Pesola scales, measured, and released. The net of each capture was recorded to aid measurement of movements both within and among samples. In 1980 we color-banded all warblers, but so few sightings were made that this was discontinued.

The total number of winter resident warblers captured each year varied from 8 to 31; ten species have been captured, with the yearly number of species ranging from 3 to 7 (Table 1). The frequency of recaptures (captures of a bird banded in a previous year's sample) varied greatly among species, as did the longest time span between captures (Table 2). Our measure of territorial behavior is a very conservative one that looks at the net numbers in which individuals of a species were caught within a 3-day sample. When net numbers overlapped or 3 or more individuals were caught in the same net, we felt that no territorial behavior existed. Only the Ovenbird showed territorial behavior under this definition (Table 2).

While the data suggest much variation among individuals and species, we feel these warblers can be split into 2 groups:

(1) A set of regular winter residents that seems to be fully integrated into the Guanica Forest bird community. These show fairly stable populations from year to year and relatively high recapture rates. Included are the Black-and-white Warbler, American Redstart, and Ovenbird, although the latter species has become less common in recent years. We did not sex Ovenbirds, but both Black-and-white Warblers and American Redstarts had populations composed largely of females (85% and 74%, respectively). The Black-and-white Warbler lacked the territorial behavior recorded on its wintering grounds in southern Mexico (Rappole and Warner 1980).

TABLE 1. Number of winter resident warblers captured each year.

Species	1973	1974	1975	1976	1978	1980	1981	1982	1983	1984
Northern Parula (<i>Parula americana</i>)		6	4	7	4	1		1	4	2
Cape May Warbler (<i>Dendroica tigrina</i>)			9	3					3	1
Prairie Warbler (<i>Dendroica discolor</i>)		7	3	2	2	2				1
Black-and-white Warbler (<i>Mniotilta varia</i>)	5	6	2	4	4	8	2	4	5	5
American Redstart (<i>Setophaga ruticilla</i>)	6	8	3	6	5	4	5	8	9	5
Prothonotary Warbler (<i>Protonotaria citrea</i>)				1	2	1				
Ovenbird (<i>Seiurus aurocapillus</i>)	3	4	1	1	4	3	1	2		
Northern Waterthrush (<i>Seiurus noveboracensis</i>)										1
Hooded Warbler (<i>Wilsonia citrina</i>)			1					2		1
Wilson's Warbler (<i>Wilsonia pusilla</i>)					1					
Total captures	14	31	23	24	22	19	8	17	21	16

(2) A set of opportunistic species whose populations vary greatly from year to year and who show little site fidelity. As a group, these showed their greatest abundance during the period 1974–1980 when resident bird populations were low due to repeated drought conditions during the resident birds' breeding season (May–July). Two species (Northern Parula and Prairie Warbler) became regular winter residents during this period, the Cape May Warbler was the most common warbler one year and occurred in 4 samples, while the others (Prothonotary Warbler, Northern Waterthrush, Hooded Warbler, and Wilson's Warbler) occurred in low numbers. These species showed declining capture rates within the 3-day samples, suggesting a somewhat sedentary population, but we do not know if there is a slow turnover of individuals through the winter. None of these was observed to be territorial, and Cape May Warblers were occasionally seen in small flocks. The low occurrence of recaptures within this group suggests that any attachment to a site by an individual is within a season and not between seasons.

This span of winter resident characteristics from stable populations with high site fidelity to variable populations with no site fidelity has also been observed among mainland wintering warblers (Keast and Morton 1980). More information is needed to understand the occurrence of varying sex ratios in the Guanica Forest, the area and habitats needed by the apparently more mobile species within or between years, the effects of resident densities on winter residents, area-sensitivity in winter residents that show high levels of philopatry, etc. While we have much to learn, it is obvious that even within this small set of warblers using a homogeneous habitat in winter, several ecological and behavioral strategies are used.

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TABLE 2. Characteristics of recaptures, sex ratios, and territorial behavior for the winter resident warblers in this study.

Species	% recaptures	\bar{x} time of recapture ^a	Longest recapture	Sex ratio (M/F)	Territorial behavior? ^b
Northern Parula	3	7-0	7-0	7/10	No
Cape May Warbler	0	—	—	6/5	No
Prairie Warbler	0	—	—	3/4	No
Black-and-white Warbler	22	1-11	4-0	5/28	No
American Redstart	15	1-11	7-0	11/32	No
Prothonotary Warbler	50	3-0	4-0	1/1	U ^c
Ovenbird	16	1-8	2-0	U	Yes
Northern Waterthrush	0	—	—	U	U
Hooded Warbler	0	—	—	1/2	U
Wilson's Warbler	0	—	—	0/1	U

^a Mean time of recapture and longest recapture are shown in years-months.

^b Territorial behavior as determined by recording the number of the net where captures occur. No territorial behavior is suggested when a species is caught in overlapping net numbers.

^c Either unable to sex or sample sizes too small to determine territorial behavior.

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LITERATURE CITED

- FAABORG, J. 1982. Avian population fluctuations during drought conditions in Puerto Rico. *Wilson Bull.* 94:20-30.
- , AND J. W. TERBORGH. 1980. Patterns of migration in the West Indies. Pp. 157-163 in *Migrant birds in the Neotropics: ecology, behavior, distribution, and conservation*. A. Keast and E. S. Morton, eds. Smithsonian Inst. Press, Washington, D.C.
- , AND J. E. WINTERS. 1979. Winter resident returns and longevity and weights of Puerto Rican birds. *Bird-Banding* 50:216-223.
- . 1980. More returns from the Guanica Forest, Puerto Rico. *J. Field Ornithol.* 51: 368.
- KEAST, A., AND E. S. MORTON (EDS.). 1980. *Migrant birds in the Neotropics: ecology, behavior, distribution, and conservation*. Smithsonian Inst. Press, Washington, D.C.
- RAPPOLE, J. H., AND D. W. WARNER. 1980. Ecological aspects of migrant bird behavior in Veracruz, Mexico. Pp. 353-393 in *Migrant birds in the Neotropics: ecology, behavior, distribution, and conservation*. A. Keast and E. S. Morton, eds., Smithsonian Inst. Press, Washington, D.C.
- TERBORGH, J., AND J. FAABORG. 1973. Turnover and ecological release in the avifauna of Mona Island, Puerto Rico. *Auk* 90:759-779.
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House Sparrows Kill Eastern Bluebirds.—Competition for nesting cavities between Eastern Bluebirds (*Sialia sialis*) and introduced species such as European Starlings (*Sturnus vulgaris*) and House Sparrows (*Passer domesticus*) is mentioned often as a cause of the well-documented decline in bluebird numbers in the eastern United States (e.g., Zeleny 1978). Presentations of stuffed House Sparrow skins elicit aggression from both male and female bluebirds; furthermore, the frequency and pattern of bluebird aggression to models of House Sparrows is consistent with the interpretation that bluebirds defend nesting cavities