

## FLOCKING BEHAVIOR OF MIGRATORY WARBLERS IN WINTER IN THE VIRGIN ISLANDS<sup>1</sup>

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**Abstract.** We assessed the flocking behavior of birds on St. John and St. Thomas, U.S. Virgin Islands, with systematic surveys along trails in moist forests. Winter residents (species breeding in North America and that winter in the Virgin Islands), all of which were warblers, comprised 91% of the individuals found in 28 flocks but only 49% of solitary individuals. The average flock size was 4.0 individuals of 3.1 species, and did not differ between St. John and St. Thomas even though the average forest tract on St. John (1,000 ha) was much larger than on St. Thomas (62 ha). Northern Parula (*Parula americana*) and Black-and-white Warbler (*Mniotilta varia*), the most common species in flocks, occurred in 76% and 79% of the flocks, respectively. Northern Parula flocked significantly more frequently on St. Thomas than on St. John, but no other species showed a difference in flocking behavior between the two islands. Each flock typically included one individual of each species.

**Key words:** *Parulinae; winter residents; Virgin Islands; mixed foraging flocks; habitat fragmentation.*

### INTRODUCTION

There are few descriptions of mixed foraging flocks of winter-resident and permanent-resident species of songbirds in the West Indies (Eaton 1953, Lack and Lack 1972, Willis 1973, Post 1978, Staicer, in press). As part of a study of the ecology of wintering birds (species that only occur during the winter and migration) in the U.S. Virgin Islands, we investigated their flocking behavior on St. John (50 km<sup>2</sup>), which has extensive tracts of forest and is 62% forested, and on St. Thomas (71 km<sup>2</sup>), which is largely developed (only 12% forested) and has many small forested tracts that are isolated from one another (Askins et al., in press). Only 3 km apart, the two islands are topographically and floristically similar. Considering the differences in forest configuration on the two islands, the goals of our study were (1) to describe the composition and dynamics of mixed foraging flocks and (2) to determine if the occurrence or composition of mixed foraging flocks is associated with different patterns of habitat fragmentation.

### METHODS

Steep slopes, cut by narrow ravines, characterize St. John and St. Thomas. Dry forests and scrub

dominate lower slopes while moist forest occurs along high ridges, in ravines and in coastal basins (Woodbury and Weaver 1987). Virtually all forests have become re-established since the 1800s. Moist forests have two to three strata and a canopy height of 10–30 m. More than 70% of the trees are evergreen. In contrast, dry forests are dominated by deciduous, thorny, small-leaved trees that are typically 5–10 m high (Woodbury and Weaver 1987).

We recorded the social status (single or in a flock) of permanent-resident and winter-resident insectivorous, granivorous and nectarivorous passerines from 12 November–4 December 1987 on St. John and from 5–15 December 1987 on St. Thomas. Surveys were completed in moist forest or ecotone between moist forest and dry woodland because most species of winter residents were largely restricted to these habitats (Robertson 1962, Askins et al., in press). Surveys on St. John were conducted in three extensive tracts of forest (average tract size = 1,000 ha; range 82–2,238 ha) while those on St. Thomas were completed in three forest fragments (average tract size = 62 ha; range 3–151 ha). We spent 31.2 hr censusing 14.9 km of trails on St. John and 3.2 hr censusing 3.0 km of trails on St. Thomas. Surveys were completed between 07:39 and 16:45 Atlantic Standard Time.

We searched for both permanent and winter

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residents by walking slowly along trails as described by Hutto (1987). Each trail was surveyed only once to avoid double-counting birds during and between observation periods. Birds found 25 m or more from any other passerine birds were classified as single individuals. Pairs of permanent-resident birds were considered non-flocking individuals. Birds within 25 m of each other constituted a flock (Post 1978), which is equivalent to an aggregation (Lack and Lack 1972). Birds within 25 m of each other were considered to be part of a flock because we found that birds that close together frequently traveled together. Because it takes an average of approximately 1 min to locate each member of a flock (Gibb 1960, Hutto 1987), solitary birds were observed for at least 2 min to determine their social status. Flocks were followed until lost from view or for a period of at least 30 min. We recorded the composition of the flock, agonistic interactions between birds, and the distance the flock moved (the linear distance between the first and last points of observations of flock members) during the observation period. We classified unidentified warblers as winter residents since only 2.0% of 151 observations of identified warblers were of Yellow Warblers (scientific names are given in Table 1), the only species of warbler in the Virgin Islands that is a permanent resident (Pashley 1988).

## RESULTS

Yellow Warbler, Bananaquit, Black-faced Grassquit and 14 species of wintering warblers were noted during the 34.4 hr of timed survey work; all except one species (Hooded Warbler) were found in at least one of the 28 flocks we observed (Table 1). Northern Parula and Black-and-white Warbler were the most common winter residents, representing 29% and 21% of wintering warblers seen on the surveys, respectively, and only four other species were commonly seen. While conducting point counts of birds during the same two month study period (Askins et al., in press), density of Northern Parulas and Black-and-white Warblers in moist forests on St. John was estimated to be 4/ha and 1–2/ha, respectively, and on St. Thomas, the estimated densities were 1–2/ha and <1/ha, respectively.

More of the individuals in flocks were winter residents than permanent residents on both St. John ( $\chi^2 = 31.2$ ,  $P < 0.005$ ) and on St. Thomas ( $\chi^2 = 13.7$ ,  $P < 0.005$ ). Every flock seen had

winter residents, but permanent residents only occurred in 17% of the flocks. Of the 116 individuals detected in flocks on both islands, 91% were winter residents. Winter residents comprised 49% of the 97 individuals recorded as being alone.

The mean number of individuals per flock and mean number of species per flock were not significantly different between St. John and St. Thomas (Wilcoxon two-sample test,  $t = 0.27$ ,  $P > 0.05$  and  $t = 0.69$ ,  $P > 0.05$ , respectively). When data from the two islands were pooled, the mean number of individuals per flock was 4.0 and there was an average of 3.1 species per flock.

Of those flocks observed for at least 20 min, six remained in a tree or group of trees while nine moving flocks traveled through the vegetation column at an average rate of 1.9 m/min (range: 0.4 m/min–4.8 m/min; standard error = 0.4). All flocks were seen between 08:02 and 16:40.

Of the 28 flocks we located on both islands, 76% included Northern Parulas and 79% included Black-and-white Warblers. A significantly larger proportion of Northern Parulas participated in flocks on St. Thomas compared to St. John ( $\chi^2 = 4.7$ ,  $P < 0.05$ ; Table 1), but the proportion of Black-and-white Warblers in flocks was not significantly different between the islands ( $\chi^2 = 0.1$ ,  $P > 0.05$ ).

Northern Waterthrushes and Ovenbirds occurred singly, accounting for 21 of the 48 observations of solitary winter residents. Only one individual of each species occurred with a flock. Both of these species are reported to be territorial elsewhere in their winter ranges (Schwartz 1964, Rappole and Warner 1980).

Seventeen of the 28 flocks (60%) had one individual of each species. Of 11 flocks having two or more conspecifics, only three flocks contained individuals of the same sex. Two flocks had the maximum number of three Northern Parulas (each with one male and two females) and one flock had the maximum number of three Black-and-white Warblers (two males and one female).

We noted 1.0 agonistic interaction/hr (based on 8.9 hours when flocks were under observation) among winter residents identified to species; six of nine observations were interspecific chases between members of a flock and three were chases involving conspecifics (Northern Parula, Cape May Warbler and American Redstart). In these chases, males supplanted females

TABLE 1. Number of individuals of each species recorded during the transect surveys in the Virgin Islands during 1987. Each individual was classified as being alone (&gt;25 m from any other passerine bird other than a presumed mate) or in a flock (&lt;25 m from any other passerine bird).

Species	St. John		St. Thomas	
	Alone	In flock	Alone	In flock
Blue-winged Warbler ( <i>Vermivora pinus</i> )	0	1	0	0
Northern Parula ( <i>Parula americana</i> )	11	23	0	10
Yellow Warbler ( <i>Dendroica petechia</i> )	1	1	0	1
Chestnut-sided Warbler ( <i>Dendroica pensylvanica</i> )	0	1	0	0
Magnolia Warbler ( <i>Dendroica magnolia</i> )	1	1	0	0
Cape May Warbler ( <i>Dendroica tigrina</i> )	0	1	0	5
Black-throated Blue Warbler ( <i>Dendroica caerulescens</i> )	0	0	1	2
Black-throated Green Warbler ( <i>Dendroica virens</i> )	0	0	0	3
Prairie Warbler ( <i>Dendroica discolor</i> )	0	5	0	1
Black-and-white Warbler ( <i>Mniotilta varia</i> )	4	21	1	7
American Redstart ( <i>Setophaga ruticilla</i> )	4	11	0	3
Worm-eating Warbler ( <i>Helminthos vermivorus</i> )	2	3	0	1
Ovenbird ( <i>Seiurus aurocapillus</i> )	7	1	3	0
Northern Waterthrush ( <i>Seiurus noveboracensis</i> )	10	1	1	0
Hooded Warbler ( <i>Wilsonia citrina</i> )	2	0	0	0
warbler (unidentified)	0	4	1	0
Bananaquit ( <i>Coereba flaveola</i> )	38	5	8	3
Black-faced Grassquit ( <i>Tiaris bicolor</i> )	0	0	2	1

in six cases but no females displaced males. This is a conservative estimate of agonistic behavior because we observed three chases in which neither participant could be identified.

The only avian predators we noted in the moist forests of the Virgin Islands were one Peregrine Falcon (*Falco peregrinus*) and one Sharp-shinned Hawk (*Accipiter striatus*). The Sharp-shinned Hawk was the first record of an accipiter in the Virgin Islands (Norton 1988). We did not observe a Merlin (*Falco columbarius*), an uncommon winter resident in the Virgin Islands (Wauer 1988, Raffaele 1989), but Merlins have been seen chasing Pearly-eyed Thrashers (*Margarops fuscatus*) on St. John (Robert Norton, pers. comm.). The introduced mongoose (*Herpestes auropunctatus*), though common on the forest floor, probably takes few, if any, birds in the canopy or sub-canopy where most flock members foraged (Seaman 1952, Pimentel 1955, Seaman and Randall 1962).

## DISCUSSION

In winter, interspecific flocks of the same size and similar species composition occur in small forest fragments on St. Thomas, where the density and diversity of winter residents are low, and in large tracts of forest on St. John, where migrants are more abundant. Flocks are found primarily in the canopy, are relatively small (see

Powell 1985 for comparative data in the neotropics), and usually include only one individual of each species. These flocks consist almost entirely of migratory warblers, unlike most flocks on mainland Mexico, Central America, and South America, where migrants typically join mixed-species flocks of residents (Johnson 1980, Powell 1980, Powell 1985, Hutto 1987, but see Chipley 1976). On other West Indian islands, associations or flocks of winter residents do not appear to be cohesive (Lack and Lack 1972, Post 1978), except on Cuba (Eaton 1953), and may include resident species (Eaton 1953, Lack and Lack 1972). Relatively few warblers participate in flocks on Puerto Rico (Willis 1973), at least in cohesive flocks (Post 1978, Faaborg, pers. comm., Staicer, in press). At Cabo Rojo, Puerto Rico, Staicer (in press) reported that although 60% of Northern Parulas, Prairie Warblers, and Cape May Warblers observed were in associations (i.e., within 10 m of another individual), these were not necessarily cohesive flocks. These descriptions of flocks must be interpreted cautiously since researchers have neither defined flocks consistently nor used the same methods to study flocks.

Flocks in the Virgin Islands moved at approximately the same rate as mixed foraging flocks composed of permanent residents and migrants in open forests of Costa Rica, (1.6 m/min and 1.3 m/min, respectively), which is less than half

the rate of movement of flocks of resident understory species in the neotropics (Powell 1980). Mixed foraging flocks are seen during most of the daylight period in Central and South America (Powell 1985) and in the Virgin Islands. Agonistic encounters between winter residents in flocks or aggregations were uncommon, as in Colombia (Chipley 1976), Costa Rica (Tramer and Kemp 1980), and Puerto Rico (Staicer, in press).

Social behavior and dispersion of the two most common winter residents in forests in the Virgin Islands, Northern Parula and Black-and-white Warbler, is quite variable during the non-breeding season. At Cabo Rojo, Puerto Rico, Northern Parulas exhibit winter site fidelity, have restricted home ranges, and frequently associate with other Parulinae, including conspecifics (Staicer, in press). However, at Guanica, Puerto Rico, winter site fidelity was rarely observed in an area where density of migrants was low and return rates were determined by mist netting (Faaborg and Arendt 1984). Eaton (1953) found that Northern Parulas occur in mixed-species flocks on Cuba. They were more likely to join flocks on St. Thomas than on St. John, but this result is difficult to interpret with our small sample size. Black-and-white Warblers display winter site fidelity in the West Indies (Faaborg and Arendt 1984, Robbins et al. 1987). They are frequently found alone on Puerto Rico, as in the Virgin Islands, yet mixed-species flocks often have single individuals of this species (Staicer, pers. comm.).

Although the factors that determine why a bird joins a flock are based on complex ecological and behavioral interactions, our results suggest that flocks did not differ significantly in size or species composition between small, fragmented forest patches on St. Thomas and relatively large and continuous forest tracts on St. John. This indicates that differences in habitat fragmentation did not obviously influence flocking behavior of wintering warblers.

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#### LITERATURE CITED

- ASKINS, R. A., D. N. EWERT, AND R. L. NORTON. In press. Abundance of wintering migrants in fragmented and continuous forests in the U.S. Virgin Islands. *In* J. M. Hagan and D. W. Johnston [eds.], Ecology and conservation of neotropical migrant landbirds. Smithsonian Institution Press, Washington, DC.
- CHIPLEY, R. M. 1976. The impact of wintering migrant wood warblers on resident insectivorous passerines in a subtropical Colombian oak woods. *Living Bird* 15:119-141.
- EATON, S. W. 1953. Wood warblers wintering in Cuba. *Wilson Bull.* 65:169-174.
- FAABORG, J., AND W. J. ARENDT. 1984. Population sizes and philopatry of winter resident warblers in Puerto Rico. *J. Field Ornithol.* 55:376-378.
- GIBB, J. A. 1960. Populations of tits and goldcrests and their food supply in pine plantations. *Ibis* 102:163-208.
- HUTTO, R. L. 1987. A description of mixed-species insectivorous bird flocks in western Mexico. *Condor* 89:282-292.
- JOHNSON, T. B. 1980. Resident and North American migrant bird interactions in the Santa Marta highlands, northern Colombia, p. 239-247. *In* A. Keast and E. S. Morton [eds.], Migrant birds in the neotropics: ecology, behavior, distribution and conservation. Smithsonian Institution Press, Washington, DC.
- LACK, D., AND P. LACK. 1972. Wintering warblers in Jamaica. *Living Bird* 11:129-153.
- NORTON, R. L. 1988. West Indies region. *Am. Birds* 42:142-144.
- PASHLEY, D. N. 1988. Warblers of the West Indies, I. The Virgin Islands. *Caribb. J. Sci.* 24:11-22.
- PIMENTEL, D. 1955. Biology of the Indian Mongoose in Puerto Rico. *J. Mammal.* 36:62-68.
- POST, W. 1978. Social and foraging behavior of warblers wintering in Puerto Rican coastal scrub. *Wilson Bull.* 90:197-214.
- POWELL, G.V.N. 1980. Migrant participation in Neotropical mixed species flocks, p. 477-483. *In* A. Keast and E. S. Morton [eds.], Migrant birds in the neotropics: ecology, behavior, distribution and conservation. Smithsonian Institution Press, Washington, DC.
- POWELL, G.V.N. 1985. Sociobiology and adaptive significance of interspecific foraging flocks in the neotropics, p. 713-732. *In* P. A. Buckley, M. S. Foster, E. S. Morton, R. S. Ridgley, and F. G. Buckley [eds.], Neotropical ornithology. *Ornithol.*

- Monogr. No. 36. American Ornithologists' Union, Washington, DC.
- RAFFAELE, H. A. 1989. A guide to the birds of Puerto Rico and the Virgin Islands. Princeton Univ. Press, Princeton, NJ.
- RAPPOLE, J. H., AND D. W. WARNER. 1980. Ecological aspects of migrant bird behavior in Veracruz, Mexico, p. 353-393. *In* A. Keast and E. S. Morton [eds.], *Migrant birds in the neotropics: ecology, behavior, distribution and conservation*. Smithsonian Institution Press, Washington, DC.
- ROBBINS, C. S., B. A. DOWELL, D. K. DAWSON, J. COLON, F. ESPINOZA, J. RODRIGUEZ, R. SUTTON, AND T. VARGAS. 1987. Comparison of Neotropical winter bird populations in isolated patches versus extensive forest. *Acta Oecol. Gen.* 8:285-292.
- ROBERTSON, W. B., JR. 1962. Observations on the birds of St. John, Virgin Islands. *Auk* 79:44-76.
- SCHWARTZ, P. 1964. The Northern Waterthrush in Venezuela. *Living Bird* 3:169-184.
- SEAMAN, G. A. 1952. The mongoose and Caribbean wildlife. *Trans. N. Amer. Wildl. Conf.* 17:188-197.
- SEAMAN, G. A., AND J. E. RANDALL. 1962. The mongoose as a predator in the Virgin Islands. *J. Mammal.* 43:544-546.
- STAICER, C. A. In press. Social behavior of the Northern Parula, Cape May Warbler and Prairie Warbler wintering in second-growth forest in southwestern Puerto Rico. *In* J. M. Hagan and D. W. Johnston [eds.], *Ecology and conservation of neotropical migrant landbirds*. Smithsonian Institution Press, Washington, DC.
- TRAMER, E. J., AND T. R. KEMP. 1980. Foraging ecology of migrant and resident warblers and vireos in the highlands of Costa Rica, p. 285-296. *In* A. Keast and E. S. Morton [eds.], *Migrant birds in the neotropics: ecology, behavior, distribution and conservation*. Smithsonian Institution Press, Washington, DC.
- WAUER, R. H. 1988. Virgin Islands birdlife. Getting to know birds and where they live. Univ. Virgin Islands Cooperative Extension Service, Extension Handbook 3.
- WILLIS, E. O. 1973. Local distribution of mixed flocks in Puerto Rico. *Wilson Bull.* 85:75-77.
- WOODBURY, R. O., AND P. L. WEAVER. 1987. The vegetation of St. John and Hassel Island, U.S. Virgin Islands. U.S. National Park Research/Resources Manage. Repr. SER-83, Southeast Regional Office, Atlanta.