SHORT COMMUNICATIONS

A Temperate Species-rich Assemblage of Migrant Frugivorous Birds

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In the tropics, where frugivorous birds are often a significant component of the avifauna (Orians 1969, Karr 1976), fruiting trees are frequently the focus of species-rich bird assemblages (e.g. Beebe 1916, Willis 1966, Leck 1969, Kantak 1979). Typically 10 to 20 or more species are seen feeding in one or a few trees in a limited area. In northern temperate regions, fleshy fruits are also an important food resource for many birds during some periods of the year (Martin et al. 1951). Species-rich assemblages are rarely reported for the north temperate zone, however (Robbins et al. 1975), although it is clear that many frugivorous species can co-occur in a small area (Thompson and Willson 1979). We report a temperate frugivore assemblage during autumn migration with species richness similar to that described for the tropics.

We studied birds feeding on the fruit of northern arrowwood (*Viburnum recognitum* Fern., Caprifoliaceae) during the autumn of 1974 at a site near Ithaca, Tompkins County, New York (42°N). The study site is roughly rectangular (210 m × 50 m, ~ 1 ha) and comprised of a dense, nearly pure stand of arrowwood. The site is sharply bordered on the north by a road, on the east by a herbaceous field, and on the southeast by an old field. The southwestern and western portions of the site are continuous with and grade into an area of arrowwood mixed with many young trees. Arrowwood is a multi-stemmed shrub reaching a height of 2–3 m on the study area. In the Ithaca area, arrowwood flowers in June (Wiegand and Eames 1925), and fruits ripen between late August and early September (Sherburne 1972). Ripe fruit are spheroid bluish-black drupes (5.5–6.0 mm diameter) borne in compound cymes. Crop size varies greatly among individual plants; it ranges from 0 to ~8,000 drupes at the time of ripening. At the start of our study (7 September), plants on the site averaged probably 400–500 drupes.

We censused avian populations by capturing birds in mist nets and marking them with U.S. Fish and Wildlife leg bands. On 32 mornings between 13 September and 12 November, a mean of 11 12-m-long nets were set in lanes cut within the study area. Nets were opened for an average of 3.25 h per morning. Although mist nets do not catch all species equally well (Heimerdinger and Leberman 1966), their use afforded the only feasible way of sampling birds in the dense vegetation. Arrowwood frugivores were identified by direct observation of feeding or by examination in the hand. Birds that feed on arrowwood fruit are often characteristically stained on and around the bill and vent. Staining frequency varied among species (8–100%/species), and such data could be used as estimates of species' preference for arrowwood fruit. We do not present or discuss staining frequency, however, because two factors complicate the data: (1) for several species, sample sizes are too small (e.g. <10; see Table 1) to make meaningful inferences about the frequency of arrowwood frugivory in their populations, and (2) staining is a function of residence time in the arrowwood patch; we caught many birds early in the morning after nights of heavy migrant influx. These birds had little opportunity to eat fruits.

We netted 643 birds of 47 species during the study. Of these, 344 individuals (54% of the total) belonged to 15 species identified as arrowwood frugivores (Table 1). The daily catch of arrowwood frugivores ranged from 0 to 53 (mean = 10.8) individuals, with 0–8 species represented (mean = 3.5 species/day). The majority of frugivorous individuals were caught in the first 3 weeks of October (peak = 53 on 11 October). White-throated Sparrows were the most common frugivore (Table 1). They were netted on 20 of 32 mornings, and more than 20 were captured on 3 days (maximum = 25 on 11 October).

Many arrowwood drupes fell to the ground on windy or rainy days. Most frugivorous species ate these fallen fruits as well as fruits still attached to the plants. The two *Vireo* species are probable exceptions; we have no evidence that they foraged terrestrially. None of the 15 species is exclusively frugivorous during the autumn; all are insectivorous and/or granivorous to varying degrees (Martin et al. 1951).

September and October are months of considerable southward migration in the Ithaca area. Most birds that fed on arrowwood fruit were probably migrating, because very few individuals of any species were

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TABLE 1. Bird species identified as arrowwood frugivores and number of individuals mist-netted.[a] Eleven genera and six families are represented among these 15 species.

Species	Total caught
White-throated Sparrow (*Zonotrichia albicollis*)	138
Song Sparrow (*Melospiza melodia*)	42
Hermit Thrush (*Catharus guttatus*)	39
Gray Catbird (*Dumetella carolinensis*)	36
Swainson's Thrush (*Catharus ustulatus*)	17
Rusty Blackbird (*Euphagus carolinus*)	13
Swamp Sparrow (*Melospiza georgiana*)	13
American Robin (*Turdus migratorius*)	12
Red-eyed Vireo (*Vireo olivaceus*)	9
Philadelphia Vireo (*Vireo philadelphicus*)	8
Wood Thrush (*Hylocichla mustelina*)	5
Rufous-sided Towhee (*Pipilo erythrophthalmus*)	5
Fox Sparrow (*Passerella iliaca*)	3
White-crowned Sparrow (*Zonotrichia leucophrys*)	3
Common Flicker (*Colaptes auratus*)	1
Total	344

[a] The following species were mist-netted on the study area but exhibited no evidence of arrowwood fruit consumption (number caught follows scientific name): *Picoides villosus*, 1; *P. pubescens*, 2; *Sayornis phoebe*, 1; *Empidonax* spp. (*traillii, alnorum* and/or *minimus*), 3; *Cyanocitta cristata*, 2; *Parus atricapillus*, 47; *P. bicolor*, 1; *Troglodytes troglodytes*, 7; *Toxostoma rufum*, 2; *Catharus minimus*, 1; *Regulus satrapa*, 11; *R. calendula*, 98; *Vermivora peregrina*, 6; *V. ruficapilla*, 8; *Dendroica magnolia*, 4; *D. caerulescens*, 2; *D. coronata*, 5; *D. virens*, 3; *D. pensylvanica*, 3; *Seiurus aurocapillus*, 6; *Oporornis agilis*, 1; *Geothlypis trichas*, 21; *Wilsonia pusilla*, 2; *Setophaga ruticilla*, 1; *Agelaius phoeniceus*, 1; *Cardinalis cardinalis*, 1; *Pheucticus ludovicianus*, 1; *Carduelis tristis*, 18; *Junco hyemalis*, 7; *Spizella arborea*, 20; *S. pusilla*, 6; *Melospiza lincolnii*, 7.

recaptured and no frugivorous species were seen after mid-November. Five species (Swainson's Thrush, Philadelphia Vireo, Rusty Blackbird, White-crowned Sparrow, and Fox Sparrow) do not nest in the Ithaca area, and two species do so only in very low numbers (Hermit Thrush and White-throated Sparrow). These seven essentially nonlocal species comprised 64% of all individuals of species determined to be arrowwood frugivores (Table 1).

We caught 32 species (299 individuals; see Table 1) that showed no evidence of arrowwood frugivory. The majority of nonfrugivorous individuals belong to three families: Parulidae—12 species, Fringillidae—7 species, and Regulidae—2 species. It is possible that some of these species ate arrowwood fruit but too infrequently to be detected in our samples; we do not believe, however, that any important arrowwood frugivores that occurred on the study site were missed or misclassified as nonfrugivores.

Ricklefs (1977) has shown that the factors determining which birds feed on the fruit of a given plant species can be complex and nonintuitive. Our observations suggested that arrowwood frugivores may be distinguished, at least partly, from nonfrugivores by bill length. We compared the distribution of culmen lengths among nonfrugivores with that among frugivores (Mann-Whitney U test, two-tailed). Data were the means of male and female culmen lengths given by Ridgway (1901–1918); in this analysis (as in two presented below) the comparison is at the species level, and the number of individuals/species is not a variable. Male and female Red-winged Blackbirds were treated separately because they differ considerably (>18%) in culmen length. In all other species the sexes differ by less than 10%. The *Empidonax* mean used was the average of values given for Least, Alder, and Willow flycatchers. The analysis indicates that frugivores and nonfrugivores differ significantly ($P = 0.023$) in culmen length, with the latter group averaging shorter (13.0 mm) than the former (15.2 mm). Frugivore culmen length ranges from 10.0 mm (Philadelphia Vireo) to 34.2 mm (Common Flicker); among nonfrugivores it ranges from 7.6 mm (Golden-crowned Kinglet) to 28.2 mm (Hairy Woodpecker). This difference probably reflects the ability of birds to swallow arrowwood fruit or their ability to bite or peck into the arrowwood's firm thin pericarp. Because many nonfrugivores possess culmens very similar in length to those of frugivores, failure to eat arrowwood fruit may reflect other morphological features (e.g. overall size), digestive physiology, or availability of alternate foods.

There are few descriptions of temperate assemblages with which to compare our arrowwood data. Robbins et al. (1975) describe birds eating red mulberry (*Morus rubra*) during June and July at three sites in Michigan (a total of 20 bird species, with the number/site ranging from 9 to 12). Baird (1980) lists the birds seen eating 10 species of autumn-ripening forest and forest-edge fruits in New Jersey; avian assemblages at these plants were comprised of from 3 species [at greenbrier (*Smilax rotundifolia*) and Japanese Honeysuckle (*Lonicera japonica*)] to 12 species [at flowering dogwood (*Cornus florida*)]. The Michigan and New Jersey frugivore assemblages all had at least one species in common with the arrow-

wood assemblage. No species was present in all assemblages, but the White-throated Sparrow was found at all but red mulberry. The Michigan and New Jersey assemblages each included at least one species that occurred in our arrowwood patch but that did not eat arrowwood fruit. We compared the distribution of culmen lengths (from Ridgway 1901–1918) in five fall frugivore assemblages [arrowwood, and from Baird (1980): flowering dogwood, poison ivy (*Rhus radicans*), spicebush (*Lindera benzoin*), and Asiatic bittersweet (*Celastrus orbiculatus*)]; three of Baird's assemblages were omitted from the analysis, two because of relatively small sample sizes and a third because data were combined from four unnamed grape (*Vitis*) species. We found no significant difference in mean culmen length (Kruskal-Wallis one-way analysis of variance, $H = 0.74$, $P > 0.90$). Mean culmen length ranged from 15.0 mm for species visiting spicebush to 17.8 mm for those at poison ivy. A significant difference did exist in mean culmen length between the *Morus* assemblage and the five autumn assemblages discussed above (Mann-Whitney U test, two-tailed, $z = 2.135$, $P < 0.04$); mean culmen length was longer in the *Morus* assemblage (20.1 mm) than in the fall assemblages (16.4 mm). These results probably reflect in part the influence of fruit size in attracting birds of particular culmen lengths. Red mulberries, at 20–30 mm longest axis, are considerably larger than the five autumn-ripening fruits (5–10 mm longest axis) considered above (fruit measurements by the authors and from Gleason 1963).

Most reports of tropical assemblages list from 10 to 30 species of birds, although some are much higher (e.g. 51, Beebe 1916). Thus, the 15 species observed at arrowwood is within the range of species richness found at tropical fruiting trees. The arrowwood assemblage contrasts in several ways, however, with those of the tropics. First, our observations were made in an area containing hundreds of shrubs. Tropical studies have usually detailed the birds of one or only a few trees (but see Leck and Hilty 1968). Second, the arrowwood assemblage was comprised of migrating birds and dominated by nonlocally nesting species. Several tropical assemblages have been described in which migrants are numerically important (Leck and Hilty 1968; Leck 1972a,b; Howe and De Steven 1979); an assemblage composed entirely of migrants seems otherwise unknown [Baird's (1980) temperate assemblages include migrants, wintering species, and year-round residents]. Third, the number of individuals in the arrowwood congregation appears to be much higher than in tropical assemblages (but see Leck and Hilty 1968). More extensive use of avian marking techniques in the tropics, however, may reveal this difference to be small or a property of the plant-bird community under study.

Finally, our analyses have shown that culmen length in several temperate frugivore assemblages is related to the occurrence of a bird species in a given assemblage. In contrast, in a similar multivariate analysis of several tropical assemblages, Ricklefs (1977) found bill dimensions to be unimportant. Other morphological characters, such as the ratio of wing length to body length, were significant discriminators between frugivores visiting different tree species or between frugivores and nonfrugivores visiting the same tree. These results suggest that, relative to the tropics, coevolution between avian frugivores and plants in the temperate zone has been fairly simple and unsubtle.

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Sex-related Differences in Territorial Aggression by Ring-billed Gulls

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Although both male and female *Larus* gulls generally share the duties associated with rearing offspring, the precise nature of their roles in defense of territory and brood has been examined in detail for only a few species. In Laughing Gulls (*L. atricilla*), Burger and Beer (1975) found that although both sexes defended the territory, they did so in different ways. Males, for example, were more likely to give long-calls and to chase intruders. Territorial defense in Herring Gulls (*L. argentatus*) and Black-headed Gulls (*L. ridibundus*) has been attributed, for the most part, to the male (Tinbergen 1956).

From 16 May to 4 July 1976, I observed 17 marked pairs of Ring-billed Gulls (*L. delawarensis*) to determine if sex-related differences in territorial aggression existed. The 17 nests were distributed in three separate groups at non-edge, arbitrarily chosen study locations within the Calcite Colony in northern Michigan (Presque Isle County, 45°N, 83°W). Adult birds were marked with paint during early to mid-incubation and were observed for a total of 87.7 h (mean time/bird = 12.8 h) from a car that served as a blind.

Aggressive encounters between marked birds and intruders were recorded using Moynihan's (1962) terminology, with one exception. Gape-jabbing was defined as a forward thrusting head movement accompanied by an open bill (W. E. Southern in prep.; "gaping" of Moynihan). When birds became involved in long sequences of aggressive interactions, I considered only the initial act for final analysis, though supplemental notes were kept on such behavioral sequences.

In order to determine the sex of the birds studied, I initially captured and measured each bird (Shugart 1977, Ryder 1978). The capture technique, however, disturbed the birds too much to justify its continuation. New study areas and birds were chosen, and thereafter careful notes were kept of size differences within pairs and of copulation behavior. Marking was accomplished by placing paint-soaked materials at the nest rims during incubation, a technique not requiring capture. Toward the end of the breeding season, it was necessary to collect several birds for another study, and 14 (1 member each from 14 pairs) were collected and sexed. On the basis of observed intrapair size differences, I had predicted correctly the sex of all 14 birds. I have included data for the remaining three pairs in this analysis, relying on the same visual determination of sex that proved 100% accurate for all others.

Overall, male Ring-billed Gulls spent slightly more time on territory than did females (Fig. 1; 238.7