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Observations on Some Fruit-eating Birds in Mexico

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Fruit trees in the tropics provide the ecologist with an opportunity to examine a situation in which animal species share a common resource. Unfortunately, not much use has been made of this opportunity and literature on the subject is scarce. Accounts of avian utilization of fruit include those of Land (1963), Willis (1966), Diamond and Terborgh (1967), Leck and Hilty (1968), Terborgh and Diamond (1970), Leck (1971), and Howe (1977). The present study adds to the rather limited data base on the exploitation of particular fruit tree species by avian frugivores.

Observations were made from late May till early August 1975 near the Mayan ruins of Chicanná and Becán, near the town of Xpujil in the state of Campeche, Mexico. The vegetation here is a "semi-evergreen seasonal forest" (Beard 1955). From an unobstructed viewing station I observed birds coming to or leaving the fruit tree under study. The number of individual visits of a bird species was used as an assessment of fruit usage. Although this does not account for varying amounts of fruit consumed during a visit, previous investigators have found this to be a feasible and efficient method (Diamond and Terborgh 1967; Leck 1969, 1971, 1972).

Data were obtained on birds feeding on the fruit of five species of trees: *Neea psychotrioides* Donn. Sm. (Nyctaginaceae), *Ficus padifolia* H. B. K. (Moraceae), *Ehretia tinifolia* L. (Boraginaceae), *Metopium browneii* (Jacq.) Urban (Anacardiaceae) and *Talisia olivaeformis* (Kunth.) Radlk. (Sapindaceae). Characteristics of these fruits are given in Table 1. For each tree species, each hour of the day between approximately 0530 and 1800 was equally observed. For example, data often were collected from 0530 to 1800 on one day and from 1200 to 1800 on the next, making one 12-h "observation day." The variation in hours of observation per tree species was due to my relative success in locating suitable trees and to

TABLE 1. Fruit characteristics, number of trees observed, and hours of observation per tree species. Size refers to diameter except for *Metopium,* in which it refers to length and width.

	Fruit size (mm)			Color of fruit when ripe	Number of trees observed	Hours of observation
	N	x̄	SE			
Neea	71	5.4	0.05	green	2	37.5
Ficus	86	7.7	0.06	green	2	50.0
Ehretia	122	8.0	0.08	red	3	112.5
Metopium	57	10.5 × 5.3	0.09 × 0.07	red	2	50.0
Talisia	107	16.1	0.19	green	4	70.0

TABLE 2. Percentage of visits by birds to each species of fruit tree. Percentages are based on the average number of visits per day of observation, thus correcting for the difference in length of time various tree species were observed. Other bird species observed feeding, but with small sample size (less than 25 visits), are not listed here.

	Neea	*Ficus*	*Ehretia*	*Metopium*	*Talisia*	Total visits
Cracidae						
Ortalis vetula	0	0	44.7	55.3	0	31
Psittacidae						
Aratinga astec	0	0	72.5	24.9	2.6	632
Amazona albifrons	0	0	3.2	77.2	19.6	31
Trogonidae						
Trogon citreolus	8.3	32.4	51.9	7.1	0.3	392
Ramphastidae						
Pteroglossus torquatus	23.5	28.4	40.5	6.9	0.6	148
Ramphastos sulfuratus	15.7	9.8	54.6	19.9	0	404
Picidae						
Centurus aurifrons	0.6	10.0	70.8	9.9	8.7	1,343
Centurus pygmaeus	0	1.5	30.0	55.8	12.7	98
Cotingidae						
Cotinga amabilis	0	100.0	0	0	0	27
Tityra semifasciata	19.8	7.4	30.6	42.2	0	66
Tyrannidae						
Tyrannus melancholicus	0	45.9	17.1	37.0	0	82
Pitangus sulphuratus	0	58.6	41.4	0	0	259
Myiozetetes similis	0	74.0	10.4	15.6	0	116
Megarynchus pitangua	24.6	59.0	1.6	14.7	0	26
Corvidae						
Psilorhinus morio	0	23.1	58.9	6.0	12.0	179
Cyano corax yncas	0	0	53.4	15.5	31.1	47
Cissilopha yucatanica	0	0	57.9	14.8	27.3	441
Turdidae						
Turdus grayi	0	40.8	59.2	0	0	179
Icteridae						
Icterus gularis	3.0	3.4	80.2	2.2	11.2	183
Icterus prosthemelas	0	0	30.2	0	69.8	33
Icterus auratus	0	0	2.0	0	98.0	34
Icterus chrysater	0	0	4.6	5.2	90.2	29
Icterus mesomelas	0	0	89.8	0	10.2	28
Dives dives	0	11.1	81.4	0	7.5	185
Thraupidae						
Euphonia affinis	42.8	57.3	0	0	0	39
Euphonia hirundinacea	0	99.4	0.3	0.3	0	322
Fringillidae						
Saltator atriceps	0	30.7	64.9	3.7	0.6	195

how long they stayed in fruit. All the trees were located in edge situations of forest and clearings. The greatest physical separation between any two individual trees was less than 2 km, and there were no discernible barriers or major habitat changes between tree localities.

None of the bird species equally distributed its visits to the five kinds of fruit trees, and most made over 80% of their feeding visits to only two of the trees (Table 2). Overall utilization of the fruit trees by avian frugivores was distinctively uneven, with the tree bearing intermediate-sized fruit attracting the greatest number of bird species (Fig. 1). Terborgh and Diamond (1970) concluded from their observations of 10 individual trees of six species that small fruits attracted the greatest number of frugivores and large fruits the least. In their study fruits less than 5 mm were designated "small" and those over 10 mm "large," a range in fruit size similar to that of the present study. However, my observations indicate that based on the single criterion of size, smaller fruits do not necessarily attract more species of avian frugivores (Fig. 1).

Although all the study trees were relatively close to one another and all were apparently available to any of the birds, the bird species showed a definite preference for one or two of the fruits. In addition to the obvious possibility that bill length or gape width of a bird might influence its choice of fruit, other features of the bird pertaining to feeding should be considered. For example, I often observed corvids
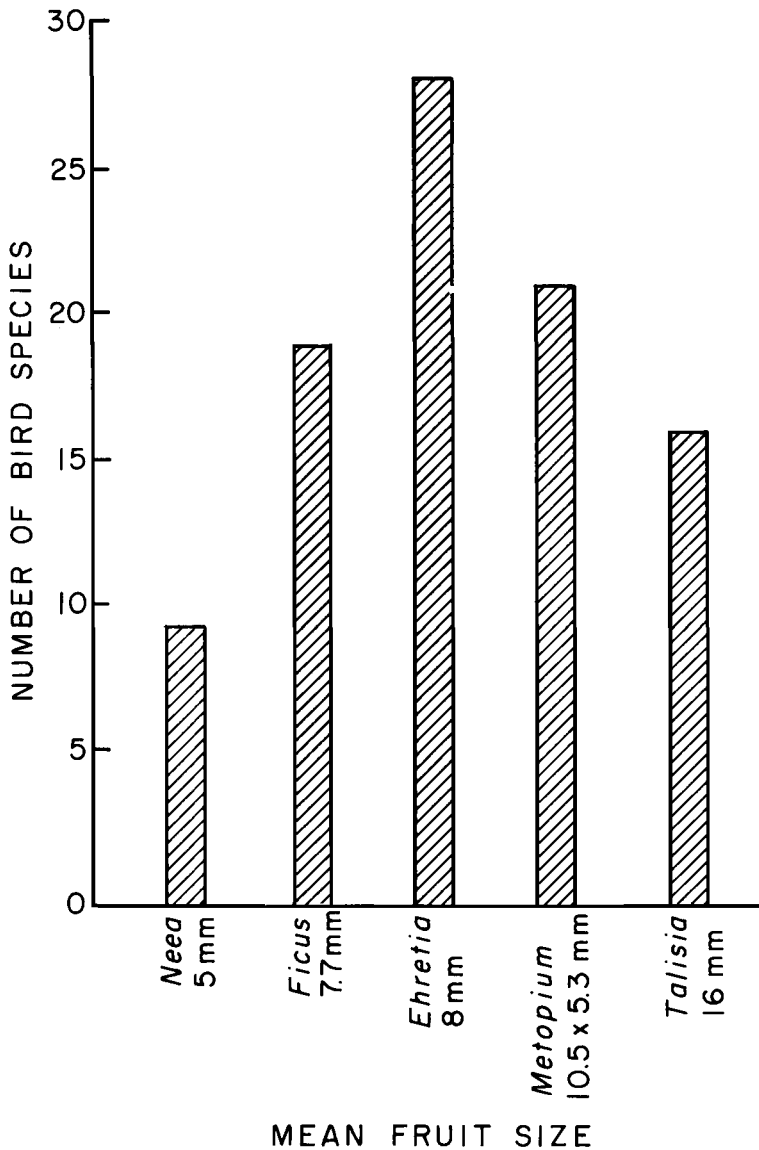
Fig. 1.   Number of bird species using fruit in 3 days of observation of each fruit tree. Use of data from only 3 observation days allows comparison of frugivore diversity per tree species over a comparable time period. These totals include some species not listed in Table 2 since their total number of feeding visits was less than 25.

and icterids using their feet as well as bills to get at the inner flesh of the *Talisia* fruits. Perhaps it was lack of this manipulative ability that prevented many of the other birds from making much use of this fruit. Likewise, more attention should be focused on features of the tree other than fruit size, such as nutritional value and color. From my observations I am led to believe that the degree of accessibility of the fruit on the branches may be very important. Fruit on the tips of tiny branches was not accessible to large birds that fed from perches (e.g. the ramphastids and corvids), but was available to small birds (thraupids) or to birds that snatched fruit from the branches while on the wing (trogons, tyrannids). Thus spatial position in a fruit tree may be important even though the same kind of food is encountered

at each location in the tree. While one may not expect to find as many morphological or behavioral feeding specializations in frugivores as are found in insectivores (Snow 1971), this is not to say that various adaptations of the bird species that are primarily related to other functions (e.g. feeding on an alternative insect food source, reproductive display) may not also have secondary effects in determining the kinds of fruit that the bird can most efficiently include in its diet. Future studies are required that would include more detailed data on the feeding method of the birds and on characteristics of the fruit other than size.

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Diet-Correlated Variations in Social Behavior of Wintering Tennessee Warblers

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From 14 December 1976 to 6 March 1977 we made extensive observations of the foraging and social interactions of Tennessee Warblers (*Vermivora peregrina*) wintering at Monteverde, located at 1,400 m on the Cordillera de Tilarán in northwestern Costa Rica (10°18′N, 84°49′W). Most Tennessee Warblers foraged for insects in the foliage of trees of all sizes. Like other winter residents they sometimes participated in mixed-species flocks, but more often they foraged for insects in pairs or small conspecific groups.

At any given time a small minority of the warblers fed on nectar, mostly at the flowers of the machete tree (*Erythrina lanceolata* Standl.:Leguminosae), scattered individuals of which stood at pasture edges and homesites. This small tree was conspicuous because its leafless branches bore pendant clumps of bright scarlet flowers. That wintering Tennessee Warblers feed on nectar is apparently common knowledge among ornithologists in Central America (e.g., F. G. Stiles and E. Morton, pers. comm., see also Peterson and Chalif 1973, A Field Guide to the Birds of Mexico, Boston, Houghton-Mifflin, p. 203).

Unlike their counterparts foraging for insects, nectar-feeding warblers were intolerant of conspecifics. Each individual defended its *Erythrina* and other trees within a radius of about 15 m by chasing conspecifics away. Agonistic encounters occurred during 55% of our 31 observations of nectar-feeding warblers. In approximately half of these encounters conspecifics were driven off, while in the other half a warbler was supplanted by hummingbirds (*Amazilia tzacatl* or *Campylopterus hemileucurus*) or, in one case, by a Black-throated Green Warbler (*Dendroica virens*), although the latter bird did not flower-feed.

On 13–14 January and 7–8 March in San José we observed Tennessee Warblers nectar-feeding in Poró trees (*E. poeppigiana*), which have far greater crown volumes than *E. lanceolata*. Entire Porós were apparently too large for one warbler to defend successfully. Typically, four or five birds spaced themselves