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### Feeding Habits of the Citreoline Trogon in a Tropical Deciduous Forest During the Dry Season

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The Trogonidae are important frugivores in the tropics, especially in the American tropical forests (Snow 1981). However, with the exception of quetzals (Skutch 1944, Wheelwright 1983) and some data on the diet of the Orange-bellied Trogon (*Trogon aurantiiventris*; Wheelwright et al. 1984), their feeding ecology is poorly known. In the tropical deciduous forest of the Mexican west coast, the Citreoline Trogon (*Trogon citreolus citreolus*) is one of the most abundant resident members of the frugivore guild. To our knowledge there are no reports on its foraging behavior or on the fruit species that it eats. We report here on the fruits eaten by the Citreoline Trogon and on its foraging behavior, during the dry season from 6 to 26 April 1984.

The observations were made in the tropical deciduous and subdeciduous forest in hilly areas and in the riparian vegetation of dry arroyo beds located near the Estación de Biología Tropical de Chamela (Jalisco, México, 19°30'N, 105°03'W, 0-250 m elevation). For a description of the location and vegetation see Solís (1980). Intensive observations were made at a fruiting fig tree (*Ficus pertusa*) on 13 and 16 April. On these dates, data were collected on the frequency of arrivals at the tree, foraging rates, and time spent

on each fruit. Timing was done to the nearest 0.2 s with two stopwatches. Ripe fruits of all species eaten by the trogons were measured and weighed, with the exception of *Comocladia engleriana* (Anacardiaceae), the resinous exudates of which cause severe irritation of the skin. Trogons regurgitated *Recchia mexicana* seeds after removing the pulp; we estimated the weight of the consumed pulp and skin of the fruit by subtracting the weight of the seed from the weight of the whole fruit.

Four fruit species were used by the Citreoline Trogon during the observation period (Table 1). Two were drupes produced by small trees (*Recchia mexicana* and *Comocladia engleriana*), one was the berry of a vine (*Trichostigma octandrum*), and one was the syconium of a fig tree (*Ficus pertusa*); the latter two plants were from riparian habitats. The fruiting seasons of these plants (except *F. pertusa*) are restricted to the end of the dry season (February-May; Table 1). Fruiting fig trees were scarce in the study area; in an intensive survey only one *F. pertusa* with ripe fruits was found. *Trichostigma octandrum* berries were locally abundant in large areas of the arroyo beds. Fruiting trees of *R. mexicana* and *C. engleriana* were common but widely dispersed, and each tree had few ripe fruits (100-400 in *R. mexicana*, 30-600 in *C. engleriana*) relative to the thousands of fruits of *T. octandrum* and *F. pertusa*. The weights and characteristics of the fruits of each species are summarized in Table 1.

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TABLE 1. Fruit eaten by the Citreoline Trogon during the dry season at Chamela, Jalisco, Mexico. Values are means  $\pm$  SD.

Species	Size (mm)		Weight (g)	n	Fruiting season*
	Length	Width			
<i>Ficus pertusa</i> (Moraceae)	14.5 $\pm$ 1.1	12.3 $\pm$ 2.0	0.94 $\pm$ 0.19	30	All year
<i>Trichostigma octandrum</i> (Phytolacaceae)	8.1 $\pm$ 1.1	8.1 $\pm$ 1.1	0.18 $\pm$ 0.05	25	March-May
<i>Comocladia engleriana</i> (Anacardiaceae)	10.0 $\pm$ 1.2	14.2 $\pm$ 1.3		7	February-April
<i>Recchia mexicana</i> (Simaroubaceae)	12.4 $\pm$ 0.3	11.7 $\pm$ 0.4	0.83 $\pm$ 0.1 (0.23 $\pm$ 0.03) <sup>b</sup>	30	March-May

\* Data from the Herbario Nacional (MEXU) at the Instituto de Biología.

<sup>b</sup> Weight of fruit without seed.

The trogons picked fruit from all species in a similar way. Birds searched for and chose fruits while perched on branches in or near the fruiting tree. The behavior of perching trogons indicated that perching time was used, at least in part, to search for fruit, as the birds turned their heads while peering toward fruit clusters.

In the fig tree the time spent per fruit was estimated from a regression of the time spent feeding (Y) and the number of fruits eaten during this period (X):  $Y = -82 + 91.8X$  ( $r = 0.88, n = 27$ ). The slope of the regression is the time invested per fruit (Table 2). This value refers to the time spent flying to get the fruit, to handle and swallow it, and to search for a new fruit; it does not include the time required for digestion. Figs were crushed in the bill before they were swallowed (Table 2). Mean chewing times, mean distance of flight for a fig, and mean duration of each flight were estimated directly (Table 2). The average time spent sitting between flying bouts, estimated from the slope value and the flying and handling times, was 79.2 s.

Fruits of the other three species were swallowed whole. The larger seeds of *R. mexicana* and *C. engleriana* were regurgitated; it was common to see the trogons gaping in the regurgitation process.

Trogons fed throughout the day (0630-1830). Visits to *R. mexicana* and *C. engleriana* were rare and usually were performed by solitary individuals; in contrast,

the fig tree and clumps of *T. octandrum* berries were visited intensively. The distribution of the number of arrivals to the fig tree per 5 min (Table 2) was significantly clumped (variance/mean = 4.24,  $t = 20.87, P < 0.01$ ; Smith 1980), suggesting that the trogons were foraging in loose flocks. A similar behavior has been reported for quetzals feeding in heavily fruiting trees (Wheelwright 1983).

As in other trogons, insects probably comprise a substantial proportion of the diet, especially for nestlings and in times of fruit scarcity (Bent 1940, Skutch 1944, and data from gut contents of specimens of the bird collection at the Instituto de Biología), but we saw only two individuals feeding on insects during

TABLE 3. Birds observed feeding from the fruits of the plants used by the Citreoline Trogon. FP = *Ficus pertusa*, TO = *Trichostigma octandrum*, CE = *Comocladia engleriana*, RM = *Recchia mexicana*. X indicates presence at the plant.

Species	FP	TO	CE	RM
Wagler's Chachalaca ( <i>Ortalis poliocephala</i> )	X <sup>a</sup>		X <sup>a</sup>	X
Orange-fronted Parakeet ( <i>Aratinga canicularis</i> )	X			
Lilac-crowned Parrot ( <i>Amazona finschi</i> )	X			
Citreoline Trogon ( <i>Trogon citreolus</i> )	X	X	X	X
Golden-cheeked Woodpecker ( <i>Melanerpes chrysogenys</i> )	X			
Social Flycatcher ( <i>Myiozetetes similis</i> )		X		
Great Kiskadee ( <i>Pitangus sulphuratus</i> )	X	X		
Yellow Grosbeak ( <i>Pheucticus chrysopheplus</i> )	X	X		
Grayish Saltator ( <i>Saltator coerulescens</i> )	X	X		X
Yellow-winged Caci que ( <i>Cacicus melanicterus</i> )	X	X		X
Streak-backed Oriole ( <i>Icterus pustulatus</i> )	X	X		X

<sup>a</sup> S. Bullock pers. comm.

TABLE 2. Citreoline Trogon feeding at *Ficus pertusa*. Values are means  $\pm$  SD unless otherwise indicated.

Time invested/fig (s)	91.0 $\pm$ 15.6 <sup>a</sup>
Duration of flight/fig (s)	1.6 $\pm$ 0.6 <sup>b</sup>
Time spent chewing 1 fig (s)	10.8 $\pm$ 4.2
Time spent sitting between flying bouts (s)	79.2
Distance of flight/fig (m)	2.5 $\pm$ 1.5 <sup>c</sup>
Number of birds arriving/5 min	3.9 $\pm$ 4.1 <sup>d</sup>

<sup>a</sup>  $\bar{x} \pm$  SE.

<sup>b</sup>  $n = 40$ , range = 0.6-3.8 s.

<sup>c</sup>  $n = 42$ , range = 0.5-8.0 m.

<sup>d</sup>  $n = 84$  5-min intervals.

the 20 days of observation. These birds hovered below the undersides of leaves and snatched the insects.

Trogon were never seen perched near the ground (perching range 3–15 m) and never perched close to another trogon (minimum distance between individuals, 50 cm). Intraspecific aggressions were seen only twice and involved male-female interactions [trogon apparently breed later in the year (June–July; data from specimens of the bird collection at the Instituto de Biología)]. No interspecific aggressions involving a Citreoline Trogon were recorded.

The fruits used by the Citreoline Trogon in the study area were used by other bird species (Table 3). The Grayish Saltator (*Saltator coerulescens*) commonly used all species of fruits. The Yellow-winged Cacique (*Cacicus melanicterus*) was common at *F. pertusa* and *T. octandrum* and occasional at *R. mexicana*, but was absent at *C. engleriana*. In *R. mexicana* the caciques were wasteful feeders, stripping the fleshy part of the fruits without swallowing the seed and dropping many half-eaten fruits to the ground below the parent tree. Wagler's Chachalaca (*Ortalis poliocephala*) consumes figs and fruits of *C. engleriana* and *R. mexicana* (S. Bullock pers. comm.), but we did not observe the species feeding from *F. pertusa* or from *C. engleriana*; chachalaca activity in *R. mexicana* was confined to the early morning and dusk.

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### Morphology and Physiology of Female-female Pair Members

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Female-female pairing has been documented in Western Gulls (*Larus occidentalis*), California Gulls (*L. californicus*), Ring-billed Gulls (*L. delawarensis*; Hunt and Hunt 1977, Conover et al. 1979, Ryder and Somppi 1979), Herring Gulls (*L. argentatus*; Fitch 1979), and Caspian Terns (*Sterna caspia*; Conover 1983). It generally is believed that this type of pairing is a response to a shortage of adult males in the breeding population (see Hunt and Hunt 1977; Ryder 1978a; Conover et al. 1979; Hunt 1980; Hunt et al. 1980; Wingfield et al. 1980a; Kovacs and Ryder 1981, 1983; Fox and Boersma 1983; Lagrenade and Mousseau 1983; Conover 1984a, b). Conover and Hunt (1984) showed that the incidence of female-female pairing increased in California and Ring-billed gull colonies after the removal of breeding-age males.

The occurrence of such an imbalance in undisturbed colonies is thought to be related to differential male mortality. Male gulls may be subject to higher mortality rates than females because of stress related to the acquisition and defense of territories (Coulson and Wooller 1976, Hunt 1980, Hunt et al. 1980). It also has been suggested that toxic chemical contaminants may contribute to reduced male survivorship relative to females through physiological differences between the sexes in lipid and lipophilic toxic chemical dynamics (Wurster et al. 1965, Gish and Chura 1970, Shugart 1980, Conover 1984b). Fry and Toone (1981) injected DDT at concentrations comparable to those found in wild seabird eggs and reported a developmental feminization of testicular tissues of gull embryos to the extent that these individuals would be unable to breed as adults.

Mating systems often are discussed in terms of sexual selection, acting such that females choose among a group of available, often competing, males (Darwin

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