

Seasonal change in the diet of the Pacific Parakeet *Aratinga strenua* in Nicaragua

Diets of bird species may change as abundance and availability of food sources vary in both space and time (Calver & Wooller 1981, Grant & Grant 1981, Price 1987, Wiens 1989). However, very few studies have surveyed feeding continuously throughout the year. Smith *et al.* (1978), Schluter (1982a,b) and Grant and Grant (1980) have documented dietary changes of birds between the wet and the dry seasons in the neotropics. The diets of parrots have been found to vary seasonally in Australia (Cannon 1981, Long 1984, 1985) and Brazil (Galetti 1993). Parrots generally feed on seeds and fruits (Forshaw 1989) but also eat insects (Cannon 1981, Forshaw 1989, Sazima 1989), especially in the breeding season (Long 1984, Smith & Moore 1991), and flowers (Oren & Novaes 1986), especially in the dry season (Galetti 1993).

Psittacines are both seed predators (Janzen 1981, Jordano 1983, Galetti & Rodrigues 1992, Galetti 1993) and seed dispersers (Fleming *et al.* 1985). Furthermore, they exploit cultivated crops (Long 1985, Smith & Moore 1991, Bucher 1992).

I studied the feeding habits of the Pacific Parakeet *Aratinga strenua*, which had not been studied in detail previously. Forshaw (1989) suggested that they feed on seeds, fruits, nuts, berries and probably vegetable matter produced by trees and bushes. The Pacific Parakeet is found on the Pacific Slope of Middle America from Oaxaca and Chiapas in Mexico (Forshaw 1989) to southwestern Nicaragua. This study presents basic information on the feeding ecology of the Pacific Parakeet in Nicaragua and compares the composition of its diet between different seasons of the year.

METHODS

This study was conducted in the District of Masaya (12°N, 86°W) in Nicaragua from April 1993 to March 1994. The area is tropical

dry forest (Volcán Masaya National Park) surrounded by agricultural land. The climate of the region is characterized by two distinct seasons: a wet season from May to October and a dry season from November to April, when the majority of the trees lose their leaves. The annual rainfall averages 1500 mm.

Data were collected throughout the day during 1 year. Whenever a group of Pacific Parakeets was found feeding, I recorded the name of the plant species, the part of the plant the parakeets were consuming, the time, date and place where parakeets were observed and, when possible, the group size. An observation of a group of parakeets on a plant species was recorded as a feeding bout (Altmann 1974, Cannon 1981, Galetti 1993, O'Donnell & Dilks 1993). The results are based on the frequency of feeding bouts. Using this method, it is possible to determine the food sources consumed by the parakeets. Likewise, the period when each feeding source was available was determined. The diversities of the seasonal diets (D) were determined by using Simpson's index (e.g. Begon *et al.* 1990), $D_i = 1 : \sum p_h^2$, where p_h is the proportion of the h th food item for species i and D_i is the diet breadth of species i .

RESULTS

The Pacific Parakeets were observed to feed from 06.00 h to 18.00 h throughout the day in single-species flocks. The parakeets used 15 different plant species or groups of species from 12 families (Table 1). Seasonal variation in the feeding sources was evident, and only a few foods were important in any season. In the dry season, West Indian Birch *Bursera simaruba* and figs *Ficus* spp. were the most important food sources. In the rainy season and, consequently, in the breeding season (July–September), Candle Berry *Byrsonima crassifolia* fruits were the most consumed food items. The diversity of foods consumed did not vary much in different seasons: the Simpson's index was 5.4 in the dry season and 4.8 in the rainy season. Cultivated plants formed 12.8% (grain 10.8%) of the diet in the dry season and 24.1% (grain 19.4%) in the rainy season.

DISCUSSION

Diet composition of Pacific Parakeets varied between the wet and the dry seasons as do, for example, the diets of *Geospiza* finches of the Galápagos Islands (Smith *et al.* 1978, Grant & Grant 1980, Schluter 1982a, Wiens 1989). Pacific Parakeets fed mainly on fruits and seeds (Forshaw 1989) and to a lesser extent on flowers, which formed a part of the diet in the dry season (Galetti 1993). Only a few plants provided the main bulk of the food (Cannon 1981, O'Donnell & Dilks 1993). Candle Berry was apparently the most important food during the wet season and, consequently, during the breeding season. West Indian Birch and figs were consumed in considerable quantities in both seasons. Considering the whole year, West Indian Birch was the most used food and fig species ranked at third place after Candle Berry. Like other species feeding on figs, Pacific Parakeets also fed on other fruits available at the same time (Jordano 1983).

Although *Muntingia calabura* produces fruit year round, the parakeets were observed feeding on them only in the dry season (Flem-

Table 1. Seasonal variation in the percentages of observations of Pacific Parakeet groups feeding on a plant species

Plant species ^a	Dry season <i>n</i> = 249 (%)	Rainy season <i>n</i> = 170 (%)	Total <i>n</i> = 419 (%)	Availability ^b	
				Dry season	Rainy season
Anacardiaceae					
Mango <i>Mangifera indica</i> (p)	0.4	1.2	0.7	+	+
Hog Plum <i>Spondias mombin</i> (p)	0.0	11.8	4.8	-	+
Burseraceae					
West Indian Birch <i>Bursera simaruba</i> (p)	28.9	11.8	22.0	++	++
Combretaceae					
Indian Almond <i>Terminalia catappa</i> (p)	0.8	0.0	0.5	++	++
Ehretiaceae					
<i>Cordia dentata</i> (p, s)	15.3	5.3	11.2	+	+
Elaeocarpaceae					
<i>Muntingia calabura</i> (p, s)	1.2	0.0	0.7	++	++
Gramineae					
Rice <i>Oryza sativa</i> (s)	0.4	0.0	0.2	++	++
Sorghum <i>Sorghum vulgare</i> (s)	9.6	5.3	7.9	+	+
Maize <i>Zea mays</i> (s)	0.8	14.1	6.2	+	+
Leguminosae					
<i>Gliricidia septum</i> (f)	6.8	0.0	4.1	+	-
Malpighiaceae					
Candle Berry <i>Byrsonima crassifolia</i> (p)	0.0	38.8	15.8	-	+
Moraceae					
Figs <i>Ficus</i> spp. (p, s)	21.7	2.9	14.1	++	++
Rutaceae					
Citrus fruits <i>Citrus</i> spp. (p, s)	0.8	0.0	0.5	++	++
Sapindaceae					
Genip <i>Melicococcus bijugatus</i> (p)	0.0	3.5	1.4	-	+
Ulmaceae					
<i>Celtis iguanaea</i> (p)	13.2	5.3	10.0	+	+

^a Part eaten: p = pulp, s = seed, f = flower.

^b ++ = available through the season, + = available, - = not available.

ing *et al.* 1985) when few alternate sources were available. The diversities of the seasonal diets were quite similar although the Simpson's index was slightly higher in the dry season. Cultivated plants, mainly grains, formed an important part of the diet, especially in the rainy season.

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