FRUIT CONSUMPTION BY FOUR WOODPECKER SPECIES (PICIDAE: AVES) IN SEMIDECIDUOUS SEASONAL FOREST REMNANTS OF SOUTH BRAZIL

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MIKICH[1], S.B. Fruit consumption by four woodpecker species (PICIDAE: AVES) in Semideciduous Seasonal Forest remnants of South Brazil. *Arq. ciên. vet. zool. UNIPAR*, 5(2) : p.177-186, 2002.

ABSTRACT. The present study, conducted between 1990 and 1997 in two Semideciduous Seasonal Forest fragments in the State of Paraná, south Brazil, examined the fruit consumption by four species of Picidae (*Melanerpes flavifrons, Veniliornis spilogaster, Colaptes melanochloros* and *Celeus flavescens*). The diet of these woodpeckers was evaluated by two complementary methods: visual records and faecal analysis. Forty-one visual records and 23 faecal samples were obtained; from the faecal samples more than half contained seeds in variable amounts (1 to 100) of up to three fruit species. Thirteen plant species were consumed and their characteristics are presented and discussed. On the contrary of what was expected, fruit consumption was higher during the period of less availability of this resource in the study areas, i.e., from October to March. Since this is the period when most birds breed and also the peak of insects availability, fruit consumption is discussed in terms of nutrients and energetic balance, especially for nestlings. Data on the capture of these species are presented in detail with the objective to stimulate other studies that may contribute to the better understanding of the biology of neotropical picids.

KEY WORDS: woodpeckers, Picidae, frugivory, seed dispersal, Semideciduous Seasonal Forest, Parana, Brazil

CONSUMO DE FRUTOS POR QUATRO ESPÉCIES DE PICA-PAUS (PICIDAE: AVES) EM REMANESCENTES DA FLORESTA ESTACIONAL SEMIDECIDUAL DO SUL DO BRASIL

MIKICH, S.B. Consumo de frutos por quatro espécies de pica-paus (PICIDAE: AVES) em remanescentes da Floresta Estacional Semidecidual do sul do Brasil. *Arq. ciên. vet. zool. UNIPAR*, 5(2) : p.177-186, 2002.

RESUMO. O presente estudo, realizado entre 1990 e 1997 em dois fragmentos da Floresta Estacional Semidecidual do Estado do Paraná, Brasil, examina o consumo de frutos por quatro representantes da família Picidae (*Melanerpes flavifrons, Veniliornis spilogaster, Colaptes melanochloros* e *Celeus flavescens*). A dieta dessas espécies foi avaliada através de duas técnicas complementares: registros visuais de consumo de frutos e análise de amostras fecais. Foram obtidos 41 registros visuais e 23 amostras de fezes, das quais mais da metade continha sementes de uma ou mais espécies em quantidades variáveis (1 a 100). No total, foram identificadas 13 espécies de frutos, cujas características são apresentadas e discutidas. Ao contrário do esperado, o maior consumo de frutos ocorreu durante o período de menor disponibilidade deste recurso na região, i.e. no período de outubro a março. Como é neste período que estas aves se reproduzem e também é nele que ocorre o pico de disponibilidade de insetos, o consumo de frutos é discutido em termos de equilíbrio de nutrientes e energia, principalmente para os ninhegos. Dados sobre a captura dessas espécies em redes de neblina são apresentados em detalhe, com o objetivo de estimular estudos que possam contribuir para o melhor entendimento da biologia de picídeos neotropicais.

PALAVRAS-CHAVE: pica-paus, Picidae, frugivoria, dispersão de sementes, Floresta Estacional Semidecidual, Paraná, Brasil

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CONSUMO DE FRUTAS POR CUATRO ESPECIES DE PÍCIDOS (PICIDAE: AVES) EN REMANECIENTES DEL BOSQUE ESTACIONAL SEMIDECIDUAL DEL SUR DE BRASIL

MIKICH, S.B. Consumo de frutas por cuatro espécies de pícidos (PICIDAE: AVES) en remanecientes del Bosque Estacional Semidecidual del sur de Brasil. *Arq. ciên. vet. zool. UNIPAR*, 5(2) : p.177-186, 2002.

RESUMEN. Este estudio se realizó entre 1990 y 1997, en dos fragmentos del Bosque Estacional Semidecidual en el Estado de Paraná, Brasil, y examinó el consumo de frutas por cuatro especies de carpinteros (*Melanerpes flavifrons, Veniliornis spilogaster, Colaptes melanochloros* y *Celeus flavescens*). La dieta de estas especies fue evaluada a través de dos métodos complementarios: registros visuales y análisis de muestras fecales. Se obtuvieron 41 registros visuales y 23 muestras fecales, de que más de la mitad contenían semillas de un o más especies, en cantidades variables (1 a 100). En todo, fueron identificadas trece especies de frutas, cuyas características se presentan y discuten. Al contrario de lo esperado, el consumo de frutas fue más grande durante el periodo de menos disponibilidad de este recurso en las áreas estudiadas, es decir, entre octubre y marzo. Desde que éste es el periodo en que la mayoría de estas aves se reproducen, y también la cumbre de disponibilidad de insectos, se discute el consumo de frutas cuanto a balanceo nutritivo y enérgico, sobre todo para las aves jóvenes que se mantienen en el nido. Datos sobre la captura de estas especies son presentados en detalle, con el objetivo de estimular otros estudios que pueden contribuir para el mejor entendimiento de la biología de los Picidae neotropicales.

PALABRAS-CLAVE: carpinteros, Picidae, frugivoría, dispersión de semillas, Bosque Estacional Semidecidual, Paraná, Brasil

Introduction

The family Picidae is almost worldwidely distributed, being absent only in Madagascar, Australia, and in extreme latitudes (SHORT, 1980; ALABARCE, 1981). Woodpeckers have several morphological, anatomic and behavioral adaptations that allow them to climb trees and seek for insect larvae inside tree trunks. In spite of this, several species have diversified diets that include fleshy fruits, besides insects and other arthropods that are hunted in several habitats and substracts, honey, eggs and nestlings of other birds, sap, buds and nuts, which can even be stored (SHORT, 1980; 1985; ALABARCE, 1981; STACEY, 1981; SICK, 1985). Woodpeckers can be important seed dispersers of some fruit species (PIZO, 1997; this study), since the consumption of this food item is not eventual or accidental as some authors (ALABARCE, 1981; BELTZER *et al.*, 1995) believed. In Brazil few studies (SICK, 1985; MARCONDES-MACHADO & ARGEL DE OLIVEIRA, 1988; ARGEL DE OLIVEIRA, 1992) made clear allusion to the frugivorous diet of the representants of this bird family. In addition, several papers that presented a list of consumers of particular fruit species included woodpeckers in it (VOSS & SANDER, 1980, 1981; SILVA, 1988; PIZO, 1997). Nevertheless, there are no papers dealing with this particular aspect of picid biology in Brazil or elsewhere. So, the objective of this study is to fill this gap, analysing the frugivorous diet of four picids (*Melanerpes flavifrons, Veniliornis spilogaster, Colaptes melanochloros* and *Celeus flavescens*) that live in Semideciduous Seasonal Forest remnants in southern Brazil. Besides, the paper presents data on the capture of these species and discusses the importance of using complementary methods in dietary studies.

Material and Methods

Study Areas

This study was carried out in the Parque Estadual de Vila Rica do Espírito Santo (PEVR) and in the Fazenda Guagivira (FGUA), both forest fragments no more than 2 km apart and

located in the municipality of Fênix, State of Parana, south Brazil. The first study area (PEVR) is 354 ha and the second (FGUA) is only 12 ha. Both are situated at the left margin of Ivai river, that is more than 100 m wide at this region, and surrounded by cultivated land. The study areas are covered by secondary (some parts with more than 350 years) Semideciduous Seasonal Forest. The altitude ranges from 290 to 370 m and the climate is **Cfa** (Koeppen). Although there is no dry season, rainfall reaches its peak during the summer (approximately 500 mm between December and February) and its lower values during the winter (approximately 250 mm between June and August) (ITCF, 1987). A detailed description of the vegetation of the study areas can be found in MIKICH & SILVA (2001).

Study Species

In the neotropical region there are 95 woodpecker species that belong to 11 genera, several of them endemic or with only one representant out of this region (SHORT, 1985). In Brazil there are 46 species of woodpeckers (SICK, 1985), 17 of them in the state of Parana (SCHERER NETO & STRAUBE, 1995). Although in the study region one can find up to 10 species (some are rare), data of fruit consumption were recorded for four of them: Yellow-fronted Woodpecker, *Melanerpes flavifrons,* White-spotted Woodpecker, *Veniliornis spilogaster,* Green-barred Flicker, *Colaptes melanochloros* and Blond-crested Woodpecker, *Celeus flavescens*. *Melanerpes flavifrons* is a colorful and social species that is 19.5 cm long and weighs approximately 60 g. It occurs in Brazil, Paraguay and Argentina (Misiones). *Veniliornis spilogaster* is olive-green with definite barring above and below. It is the smallest studied species, 17.5 cm long and 40 g. It ranges from Rio de Janeiro and Minas Gerais through São Paulo (Brazil) to eastern Paraguay, Misiones and eastern Corrientes (Argentina), where it occupies various types of woodland and forest in lowlands. *Colaptes melanochloros* is 26 cm long and weighs up to 150 g. It is barred dorsally and spotted ventrally. Habitats occupied are quite diverse, as savannas, riverine woods and moist lowland and hill forests. It occurs from Marajo Island in north Brazil to Paraguay, Argentina and Uruguay. *Celeus flavescens* has a long yellow crest and the body is yellow and black. It is 27 cm long and weighs approximately 165 g. This species lives in lowland and galery forests of Brazil, Paraguay and Argentina (SHORT, 1980; SICK, 1985).

Procedures

To study the woodpeckers' diet two complementary techniques were used: visual records of feeding birds and faecal analysis.

The visual records where obtained opportunistically while walking through the trails located inside the study areas, along 82 field trips conducted between January 1990 and September 1997. One record corresponds to one or more individuals of a bird species consuming one species of fruit at a given time.

To obtain the faecal samples, the woodpeckers were captured with mist nets (mesh sizes: 36, 61, 100 and 121 mm; four bags) and left inside cotton bags for approximately 30 minutes before being released. Mist-nets were set 0.6 m above the ground (final height = 3 m) along existing trails in the forest and secondary habitats. The nets were in place from dawn to sunset, totaling 8,998 net hours, from which only 36 net hours were carried out at FGUA.

Faecal samples were filtered under running water and left to dry in open Petry dishes before being analysed. Each seed species found was counted and identified with the help of a reference collection mounted along the study. Fragments of arthropods were recorded and their identification will be presented elsewhere (MIKICH & MIYAZAKI, *in prep*).

The phenology of all zoochoric species (more than 200) found in the study areas was recorded monthly for all the study period (MIKICH & SILVA, 2001), so that fruit consumption could be related to fruit availability. Data presented here represent the mean of the phenological events recorded between 1990 and 1997.

Results & Discussion

Woodpeckers' Capture

From 1,242 birds captured between June

1993 and September 1997 only 30 (2.4%) were picids, which demonstrates that the capture of the members of this family with mist-nets is not expressive in this study region. In the Parque Botânico Morro do Baú (state of Santa Catarina, southern Brazil), MARTERER (1996) recorded (through visual or vocal contacts) *M.flavifrons* and *V. spilogaster* at 100% of the samples, but no individuals of the first species were captured with mist-nets. The value for the relative frequency of capture for the second species was 0.2503 while for other bird species such value varied from 0.1252 to 16.0200. Such data indicate that the capture of Picidae was not expressive in that study area too.

From the 30 woodpeckers captured, all in the PEVR, 22 were *Celeus flavescens* and eight *Colaptes melanochloros*. *Celeus flavescens* was captured in mist-nets of 61 mm (18 individuals), 100 mm (three individuals) and 121 mm (one individual) mesh sizes, while *C. melanochloros* was captured exclusively with 61 mm mesh size. So, 26 (87%) birds were captured with 61 mm mesh size, which represented 6,780 net hours or 75.4% of the total (8,998 net hours), suggesting that this mesh had an efficiency higher than expected. KARR (1990) verified that mesh size 36 mm are efficient to capture birds less than 100 g of body weight. Since both species captured in the PEVR have approximately 150 g each, a larger mesh size (61 mm in this case) must be indicated. SHORT (1985) regarded *Celeus* similar to *Colaptes* not only morphologically, but also behaviorally, so a capture device that is adequate for one genus must also work well for the other.

From the 30 woodpeckers captured, three fell in the first bag (0.6 to 1.2 m above the ground), nine in the second (1.2 to 1.8 m), 12 in the third (1.8 to 2.4 m) and six in the fourth (2.4 to 3.0 m), indicating that most travel above 1 m from the ground. Usually these canopy or sub-canopy birds must travel higher, but since most captures were conducted at a site where the vegetation was 5 m tall, the birds probably travel at lower heights there.

Fruit Consumption

Forty-one visual records of fruit consumption were obtained for the four species of woodpeckers: 32 for *C. flavescens*, five for *C. melanochloros*, three for *M. flavifrons* and one for *V. spilogaster*. Such values seem to reflect the abundance of these species in the study areas (pers. obs.) and not any preference for this food item, since according to SHORT (1980) *Melanerpes* is more frugivorous than any other genus of the family Picidae. Such information however must be viewed with caution since according to the same author, the biology of several genus, as *Veniliornis* and, mainly, *Celeus*, is almost unknown.

From the 22 *C. flavescens* and eight *C. melanochloros* captured 23 faecal samples were obtained, 19 for the first species and four for the second. From the 19 samples obtained for *C. flavescens*, 10 (53%) contained seeds and fragments of arthropods, seven (37%) contained exclusively arthropods, one (5%) contained exclusively seeds and one (5%) contained none of these food items. For *C. melanochloros* only one sample (25%) contained both itens, while the other three (75%) were composed exclusively by insects. Since the number of samples obtained for the second species was extremely low it is not possible to say that it consumes less fruit than *C. flavescens*. Eighteen (55%) out of 33 stomach contents of picids examined by MOOJEN *et al.* (1941), contained seeds and fruit pulp besides insects and seven (21%) contained exclusively seeds. SCHUBART *et al.* (1965) presented the stomach contents of 80 woodpeckers distributed in seven genera and 25 species or subspecies. Sixty-three (79%) of them contained only arthropods, 14 (17%) contained seeds plus arthropods and only three (4%) stomachs contained only seeds. Seeds were found in the stomachs of *Melanerpes*, *Colaptes*, *Celeus* and *Campephilus* and *Celeus* was the genus with the highest number of seed records.

From 11 faecal samples of *C. flavescens* which contained seeds, eight (73%) were represented by a single species of seed, two (18%) by a pair of species and one (9%) by three species. Within the single faecal sample of *C. melanochloros* which contained seeds, only one species was present.

The number of seeds found in each sample ranged from one to approximately 100. Usually relatively large seeds, like those of *Nectandra megapotamica,* were represented by few units

(1 to 12) and small seeds, like those of *Cecropia pachystachya,* by many units (up to 100). In the case of *C. pachystachya* this could be explained by the fact that a single fruit (or infrutescence) has thousands closely packed seeds (see Table 1). Nevertheless, up to 85 seeds of *Trema micrantha*, that has only one seed per fruit, were found in a single faecal sample of *C. flavescens.* In fact, visual records of this species and of *C. melanochloros* feeding on fruits of *T. micrantha* revealed that more than a hundred fruits can be ingested in a single feeding session. Besides, the consumption of this item is extremely fast – in another visual record approximately 50 fruit were ingested in 2 minutes. Two stomach contents, one of *Melanerpes candidus* and one of *Celeus lugubris*, presented by SCHUBART *et al.* (1965) contained, respectively, 90 and 50 seeds of *C. pachystachya.* The highest number of seeds found in a single stomach by these authors was 90 and the lowest, one.

Thirteen fruit species were recorded (five exclusively by visual contact, five only through faecal analysis and three through both methods) for the diet of the four picid species (Table 1). Fruits consumed belong to 10 different families of plants, and they also differ: 1. in life form, although most (92%) were trees, which could be related to the strata frequented by these birds as discussed above; 2. in the habitat in which they occur, indicating that habitat diversity is important for the maintanence of these bird species; 3. in their abundance, even though the majority (85%) of them were common or abundant in the study areas; 4. in the type of fruit, since both fleshy indehiscent and dry dehiscent fruits were consumed, but in the last case the seeds were covered by an edible and attractive (bright red) aril; 5. in fruit color, that was variable, including even green fruits that are less conspicuous among the foliage; 6. in fruit size, which varied from 3.3 to 150 mm x 3.3 to 60 mm; 7. in seed size, which varied from 2 to 12 mm x 1 to 12 mm; 8. in the number of seeds per fruit (or infrutescence), which is related to seed size, and 9. in the form of consumption, that is directly related to fruit size, since relatively large fruit (in relation to the bird's gape) were always consumed in pieces.

Table 1 - List and characteristics of fruit species consumed by four woodpecker species in Fênix, Paraná, Brazil

WOODPECKER				FRUIT SPECIES	FAMILY	CHARACTERISTICS							FC
Cf	Cm	Mf	Vs			LF	HB	AB	TF	CD	SD	NS	
X	X			*Dendropanax cuneatum*	Araliaceae	TR	FO	2	FI	BK	5.0x4.0 3.0x1.9	5	W
X				*Euterpe edulis*	Arecaceae	TR	FO	4	FI	BK	13x14 12x12	1	W
X	X	X	X	*Cecropia pachystachya*	Cecropiaceae	TR	FE SG	3	FI	GR	122x10 2.1x1.0	~5000	P
X				*Cecropia glaziouii*	Cecropiaceae	TR	FE SG	3	FI	GR	150x9.0 n.a.	~3000	P
X				*Alchornea triplinervia*	Euphorbiaceae	TR	FO SG	3	DD	RD	6.7x5.9 5.3x4.7	2	W
X				*Nectandra megapotamica*	Lauraceae	TR	FO SG	4	FI	BK	12x8.0 10x6.0	1	W
X				*Miconia pusilliflora*	Melastomataceae	BS	FO	2	FI	BL	4.5x4.5 2.7x1.6	1 - 4	W
X				*Trichilia catigua*	Meliaceae	TR	FO	3	DD	RD	15.5x9.0 8.8x6.7	1 - 3	W
X				*Ficus insipida*	Moraceae	TR	FO	3	FI	GR	24x23 2.0x1.4	100 – 300	P
X		X		*Morus nigra*	Moraceae	TR	CL SG	4	FI	VN	18x12 2.2x1.5	~30	W
X				*Eugenia florida*	Myrtaceae	TR	FO SG	4	FI	BK	6.0x7.0 4.0x5.0	1	W
X				*Psidium guajava*	Myrtaceae	TR	CL SG	4	FI	YE	80x60 4.1x3.3	~60	P
X	X	X		*Trema micrantha*	Ulmaceae	TR	FE SG	4	FI	OR	3.3x3.3 2.0x1.8	1	W

Legend: WOODPECKER: Cf= *C. flavescens*; Cm= *C. melanochloros*; Mf= *M. flavifrons*; Vs= *V. spilogaster*; LF= life form (TR= tree; BS= bush); HB= habitat (FE= forest edge; CL= cultivated areas; SG= second growth; FO= forest; AB= abundance (1= rare ; 2= intermediate; 3= common; 4= abundant); TF= tipe of fruit (FI= fleshy indehiscent; DD= dry dehiscent); CD= color of the diaspore (YE= yellow; BL= blue; OR= orange; BK= black; GR= green; RD= red; VN= vine); SD= size (length x width; mm) of the diaspore (first line) and of the seed (second line), n.a.= information not available; NS= number of seed/fruit or infrutescence; C= fruit consumed whole (W) or in pieces (P)

The seeds removed from feces were visually intact, sugesting that these woodpeckers can act as true seed dispersers. PIZO (1997) regarded *M. flavifrons* as one of the main seed dispersers of *Cabralea canjerana* (Meliaceae) in the Parque Estadual Intervales (state of São Paulo, southeastern Brazil), due to the high number of diaspores removed by this species.

As already mentioned, several intact seeds, including those of cultivated species like papaya (*Carica papaya,* Caricaceae), were also found in the digestive system of several species of *Colaptes*, *Melanerpes*, *Celeus* and *Campephilus* examined by MOOJEN *et al.* (1941) and SCHUBART *et al.* (1965).

Fruit consumption was not restricted to the peak of availability of each species (Table 2), but such information must be viewed with caution since phenological events reported here represent the mean of several years of study. For the same reason some records of fruit consumption appear in months were there are no fruits according to the Table 2. In this case, such records belong to a particular year when fruit availability was antecipated or late or to fruits found by the birds when those were so rare that could not be detected from the ground. In the case of *Nectandra megapotamica* and/or *Ocotea puberula* the trees, fruits and seeds were so alike that it was not possible to tell them apart, but their frutification seem to be coincident or sequential. Their fruits are consumed imature by several species of birds and mammals (pers. obs.) explaining the presence of seeds of these species in the feces of woodpeckers in October. The consumption of imature fruit by birds were recorded by FOSTER (1977) and SOUZA *et al.* (1992) and it is usually associated with fruit scarcity.

Table 2 - Fruit availability (shaded areas) and consumption (number of records) by four species of Picidae in two Semideciduous Seasonal Forest remnants of south Brazil

FRUIT SPECIES	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dendropanax cuneatum	2										2		
Euterpe edulis	1			1									
Cecropia pachystachya	8			3	2						2		1
Cecropia glaziouii	2								1		1		
Alchornea triplinervia	3	1											2
*Nectandra megapotamica**	4										2	1	1
Miconia pusilliflora	1											1	
Trichilia cf. *catigua*	1										1		
Ficus insipida	1	1											
Morus nigra	8								1	2	2	1	2
Psidium guajava	1			1									
Eugenia florida	2											2	
Trema micrantha	23	8	3	6	3	1	1						1
TOTAL	57	10	3	11	5	1	1	0	2	2	10	5	7

Legend: light grey= medium and low availability of fruit; dark grey= high availability of fruit (fruit peak); *Nectandra megapotamica**= can include data of *Ocotea puberula*.

Trema micrantha was the species with more records of consumption (n= 23), followed by *Cecropia pachystachya* (n= 8) and *Morus nigra* (n= 8). Fruits of *Cecropia* spp. are commonly cited for the diet of birds, including that of neotropical Picidae (EISENMANN, 1961; OLSON & BLUM, 1968; LECK, 1972; SKUTCH, 1980; MARCONDES-MACHADO & ARGEL DE OLIVEIRA, 1988; FLEMING & WILLIAMS, 1990). For the other two species of fruit there seem to be no prior records of consumption by Picidae even in the several papers (VOSS & SANDER, 1980; WHEELWRIGHT *et al.*, 1984; ARGEL DE OLIVEIRA, CASTIGLIONI & SOUZA, 1996; GALETTI & PIZO, 1996) that provide lists of consumers of *T. micrantha.*

Figure 1 reveals that most records of fruit consumption were obtained between October and March, the period when most birds breed in the region. Data on nesting activities of the study species presented by SHORT (1980) indicated

that they breed between August/September and January/February in south Brazil. According to SKUTCH (1950) most forest birds that live at least 5° off Equator have the peak of their breeding activities in the spring and summer, which usually coincides with the rainy season. In fact, December to February is the peak of rainfall in the study region (see Figure 2).

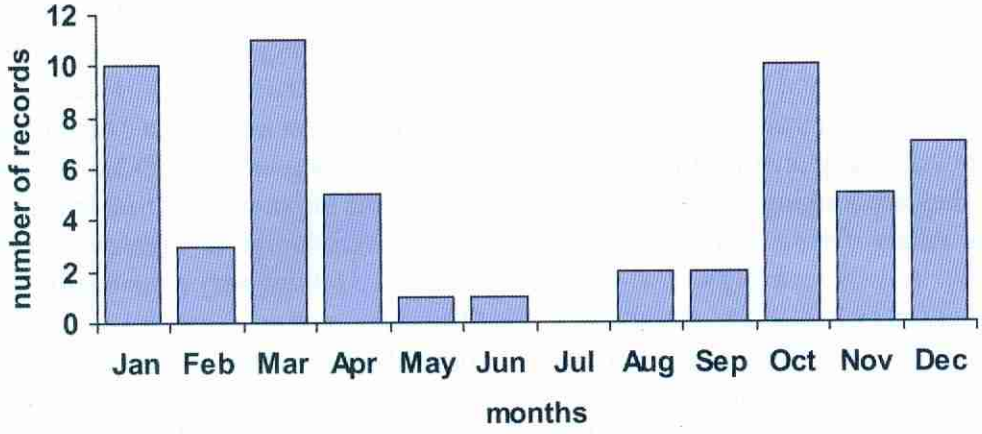

Figure 1 - Monthly variation in the number of records of fruit consumption by four species of Picidae in south Brazil between January 1990 and September 1997

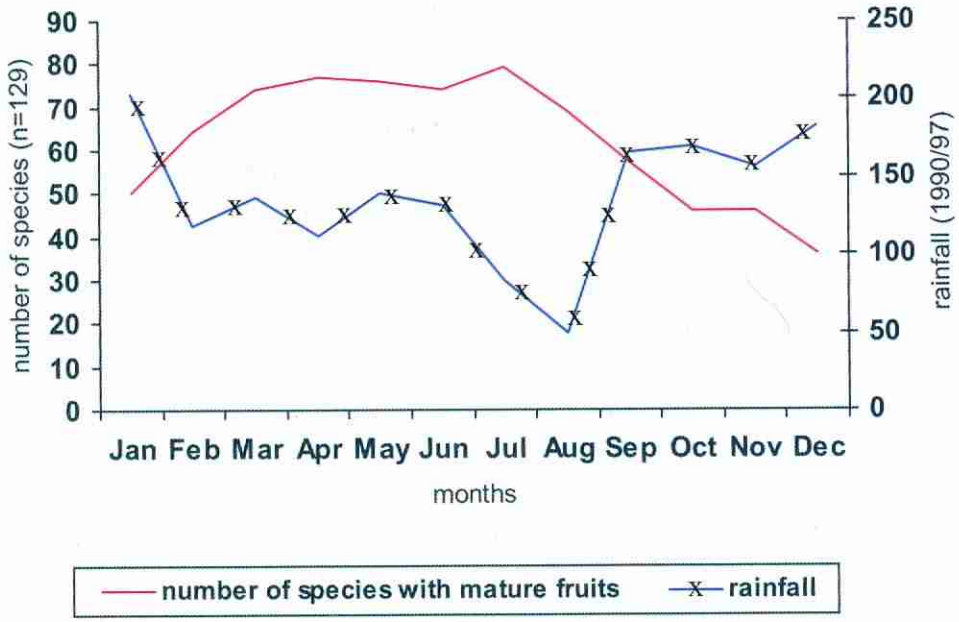

Figure 2 - Availability of mature fruit in relation to rainfall in the PEVR, Fênix, PR, Brazil
ewWhere: medium highs of rainfall were calculated for the period 1990/97 (Source: SUDERHSA)

Food availability seems to be the most important factor determining the breeding period of birds, since several species with specialized diets (e.g., nectarivores and some granivores) do not breed when most birds do, but when their main food resource is available (SKUTCH, 1950).

During the onset of the rainy season insects become abundant and more active. Such phenomenon was observed in Central America by SKUTCH (1950) and JANZEN (1973). Inventories of insects conducted at the PEVR in 1986/87 using Malaise (DUTRA, 1993) and light (MIYAZAKI, 1995) traps revealed that the end of spring and the onset of summer was the peak of insect availability in the study area. Captures of Coleoptera and Hymenoptera, the main orders of Insecta consumed by Picidae (SHORT, 1980; SICK, 1985; ALABARCE, 1981; BELTZER *et al.*, 1995), reach their maxima in November/ December and their minima in June/July. So, there is a positive correlation between rainfall (and air temperature) and insect abundance in the study area. Since the family Picidae is primarily insectivorous, its representatives can take advantage of this food abundance to raise their young.

One could imagine that the high level of

fruit consumption verified between October and April would coincide with the peak of fruit availability in the study area, since according to SHORT (1985) woodpeckers can be opportunists when there is abundant food. Nevertheless, Figure 2 shows exactly the opposite, i.e., fruit availability is inversely related to rainfall. So, the study species are not eating fruit because they are abundant. A possible explanation for this fact would be that they are looking for a nutritional balance for the young since a diet very rich in protein would not be enough for their development (FOSTER, 1978). MORTON (1973) and FOSTER (1978) examined the importance of insects (and consequently, protein) in the diet of young frugivorous birds, but appearently there are no papers dealing with the opposite case, i.e., the importance of fruit in the diet of insectivorous birds. Nevertheless, information presented in MORTON (1973) and FOSTER (1978) can be useful to analyse this case. According to FOSTER (1978), even though the syntesis of tissue rely mostly on protein (aminoacids), production and maintenance activities depend on calories, that can be obtained from the oxidation of proteins, lipids and carbohydrates. Lipids and carbohydrates, however, are more effective than proteins to produce calories. Since fruits are rich in carbohydrates and/or protein they would be an excellent source of calories for a growing bird. It is also possible that fruits are used as specific nutrients sources (e.g., some vitamins) that are not usually found in insects. Besides, fruits are easy to locate and catch on the contrary of insects, meaning that less energy and time is spent feeding on the first. It would be important to know whether adult woodpeckers use fruit for their own maintenance and doing so have more time to hunt insects for their young or both adults and young are feeding on fruit. Unfortunately there are no studies on the breeding biology of *C. flavescens, C. melanochloros* and *V. spilogaster*, a problem already discussed by SHORT (1980) and confirmed by a recent review of the literature. YAMASHITA & LO (1995)described the cooperative nesting of *Melanerpes flavifrons* and observed the storage of insects and fleshy fruits, which would be supposedly later used to feed the nestlings. In fact, in several other picid species reported by SHORT (1980), the young were fed the same items consumed by the adult birds. In *M. formicivorus*, a species that consumes large amounts of fruits and seeds (mainly nuts), SHORT (1980) found that initially the young are fed exclusively with insects, but when bigger they also get nuts that were stored, as well as fruit which would be used to complement their diet. But even this author, who wrote a monograph on Picidae, does not discuss further the importance of fruit in the diet of these birds, even though he regarded several species (mainly *Melanerpes*) as partially frugivorous. The consumption of insect alone during the first days of life probably results in fast growing since during this period protein can be used exclusively for this purpose. The reason is that during this period the young are ectotermic and their temperature is maintained by the adults (brooding), so there is no energy expenditure to keep it and consequently no need of extra calories. When they become endotermic the diet has to be more varied in order to guarantee nutrients for growing and energy for maintenance (MORTON, 1973).

Conclusions

Data presented here demonstrate that fruit consumption by Picidae is not sporadic or accidental, as suggested by some previous studies. Fruits consumed by woodpeckers belong to diferent plant life forms and habitats, have various colors, sizes, number of seeds, and the amount ingested (evaluated by the proportion of faecal samples containing seeds, the diversity of seed species, and the amount of seeds in each sample) is highly expressive. The temporal distribution of fruit consumption records exhibits a peak near the end of the year which coincides with the peak of rainfall and the peak of insect availability, as well as with the breeding period of the study birds. The peak of fruit consumption, however, was recorded exactly when this resource is less abundant in the study area. In the absence of detailed studies on the biology of these species of woodpeckers, it is proposed that this phenomenon is related to the maintenance of the energetic and nutritional balance, especially of nestlings.

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