Ararajuba 5(2):169-174
dezembro de 1997

Vertical stratification and diet of psittacids in a Tropical lowland forest of Brazil

Isaac Simão[1], Flavio Antonio Maës dos Santos[2] and Marco Aurelio Pizo[1]

[1] *Departamento de Zoologia/ Pós-Graduação em Ecologia, Instituto de Biologia, UNICAMP, C. P 6109, Cidade Universitária, 13081-970, Campinas, SP, Brazil*

[2] *Departamento de Botânica, Instituto de Biologia, UNICAMP, C. P. 6109, Cidade Universitária, 13081-970, Campinas, SP, Brazil*

Recebido em 13 de maio de 1997; aceito em 30 de junho de 1997

RESUMO. **Estratificação vertical e dieta dos psitacídeos em uma floresta tropical de baixada no Brasil.** Levantamentos sobre a dieta de psitacídeos na natureza são importantes porque ajudam a compreender a seleção de alimento por parte destas aves, e também representam informações importantes para o sucesso de programas de reintrodução na natureza de espécies ameaçadas de extinção. O presente estudo apresenta dados sobre a dieta de oito das 13 espécies de psitacídeos que ocorrem na Reserva Florestal de Linhares (Espírito Santo, sudeste do Brasil), e investiga a ocupação vertical da floresta por estas aves. Com base na altura em que os psitacídeos foram vistos pousados, dois grupos distintos foram identificados: (1) *Pyrrhura leucotis* e *P. cruentata*, que ocupam os estratos inferiores da floresta, pousando preferencialmente em poleiros inferiores a 15 m de altura, e (2) *Amazona rhodocorytha* e *A. farinosa* que, pelo contrário, escolhem os estratos superiores para pousar (acima de 15 m de altura). Frutos (polpa e sementes) de 22 espécies de plantas (14 famílias) foram consumidos pelos psitacídeos. As famílias de plantas mais bem representadas na dieta das aves foram Cecropiaceae e Moraceae (4 espécies cada), tendo sido *Cecropia hololeuca* a espécie mais utilizada (23 registros). Os dados sobre dieta confirmaram alguns aspectos gerais sobre as preferencias alimentares de psitacídeos neotropicais na natureza: (1) flores e folhas não são comumente consumidas por estas aves, sendo que polpa de frutos e especialmente sementes, pelo contrário, constituem boa parte de sua alimentação; (2) as infrutescências de *Cecropia*, gênero composto por plantas pioneiras bastante comuns em vegetações secundárias, são muito consumidas por algumas espécies de psitacídeos.
PALAVRAS-CHAVE: dieta, Espírito Santo, estratificação vertical, Psittacidae.

ABSTRACT. Surveys of the diet of psittacids in nature are important because they provide a basis for studies of food selection by these birds, and also because they provide information important for the success of reintroduction programs often carried out with threatened species. This study presents information about the diet of 8 psittacid species occurring at Reserva Florestal de Linhares (Espírito Santo, southeastern Brazil), and about the vertical stratification of these birds within the forest. We identified two distinct groups of parrots that differed in their vertical stratification patterns: (1) inferior strata species (perching mainly below 15 m) - *Pyrrhura leucotis* and *P. cruentata*, and (2) superior strata species (frequently perching between 15 m and 30 m) - *Amazona rhodocorytha* and *A. farinosa*. *Brotogeris tirica* was observed in a broad range of height classes, but does not seem to prefer any particular stratum. We recorded the fruits (seeds and pulp) of 22 plant species (14 families) in the diet of psittacids. The most utilized plant families were Cecropiaceae and Moraceae (4 species each), *Cecropia hololeuca* being the plant species consumed most frequently (23 of 79 feeding bouts recorded). The diet survey corroborated some general aspects related to food preferences of neotropical psittacids in nature: (1) flower- and leaf-eating are rare events. Psittacids rely heavily upon fruit pulp and specially seeds for food. (2) The infructescences of *Cecropia* spp, pioneer species common in second-growth vegetation, are also heavily utilized by some psittacids as food.
KEY WORDS: diet, Psittacidae, Tropical forest, vertical stratification.

Neotropical psittacids, with the exception of large species such as macaws whose diets are composed mainly by palm fruits (Roth 1984, Brandt and Machado 1990, Yamashita and Valle 1993), eat fruits of a variety of species (in some cases also flowers, leaves and animal matter; Roth 1984, Sazima 1989, Scherer Neto 1989, Galetti 1993, Desenne 1995, Martuscelli 1995, Pizo *et al.* 1995) and, given current knowledge, can be regarded as food generalists. There is some evidence, however, that psittacids do select certain foods from the pool of plants available in their habitats: some sympatric species, for example, often explore different fruit species or alternatively the same fruit species but in different proportions (Roth 1984, Desenne 1995, Galetti 1997). The several criteria used by frugivorous birds such as psittacids to select their foods in nature interact in complex and poorly known ways (Martin 1985). For psittacids, the criteria probably include fruit availability (Pizo *et al.* 1995), fruit hardness (Galetti 1997), and

presence of secondary compounds (Munn 1988) given that many unripe fruits are eaten (Desenne 1995).

Diet surveys provide the background for research on food selection by psittacids. Fortunately, the amount of information concerning the diet of neotropical psittacids in nature is growing rapidly (e.g. Desenne 1995, Martuscelli 1995, Pizo *et al.* 1995). That information is valuable not only for theoretical purposes but also for practical ones. Individuals interested in breeding threatened psittacid species in captivity often face problems of nourishing their birds adequately. In addition, reintroduction programs for the recovery of declining psittacid populations must tailor the diet in captivity to match the food items the newly-reintroduced birds will encounter in nature (papers in Pasquier 1982, Da-Ré 1996).

In this paper we present the results of surveys of the diets of 13 psittacid species occurring at an Atlantic forest site in southeastern Brazil. We also provide information on the vertical stratification of these species in the forest, which is likely, at least in part, to determine the fruit species selected for food.

STUDY SITE AND THE PSITTACID SPECIES

The study was carried out at the Reserva Florestal de Linhares (RFL, 19°18'S, 39°45'W), in the north of Espírito Santo state, southeastern Brazil. RFL is a private reserve of about 218 Km^2 covered by semideciduous ombrofilous forest. This reserve, together with the contiguous and similar-size Sooretama Biological Reserve represents one of the largest remaining blocks of tropical forest in lowland eastern Brazil. Although the forest at RFL is part of the Atlantic forest domain, it nevertheless differs in some aspects of physiognomy and plant species composition from the most typical form of this vegetation. The forest occurring at RFL may have been linked to the Amazonian forest in the past. For this reason, the present fauna and flora of RFL include both Atlantic forest and Amazonian forest elements (Peixoto and Gentry 1990).

Four types of vegetation can be distinguished at RFL: (1) 'terra firme' forest (68 % of the area) - dense forest with trees up to 40 m tall; (2) 'mussununga' forest (8 %) - dense forest with small shrubs and trees (up to 15 m tall) growing on a sandy soil; (3) 'várzea' forest (4 %) - seasonally forest with scattered trees and palms and a grassy ground cover; and (4) 'campos nativos' (6 %) - open fields with many shrubs, small trees, and Gramineae species (Peixoto 1982, Peixoto and Gentry 1990).

The ten most common plant families at RFL are: Leguminosae, Myrtaceae, Sapotaceae, Bignoniaceae, Lauraceae, Euphorbiaceae, Annonaceae, Hippocrateaceae, Apocynaceae and Rubiaceae (Peixoto and Gentry 1990). Jesus (1987) cited 478 trees and 103 herbaceous and shrub species that occur at RFL.

The reserve is almost perfectly flat with elevations varying from 28 to 65 m. The climate is warm and humid with a mean annual rainfall of 1403 mm, and a mean annual temperature of 23.6°C. Between April and August there is a marked dry season.

Psittacid species occurring at RFL are (names follow Forshaw 1978): Illiger's Macaw (*Ara maracana*), Red-shouldered Macaw (*A. nobilis*), Peach-fronted Conure (*Aratinga aurea*), Blue-throated Conure (*Pyrrhura cruentata*), White-eared Conure (*P. leucotis*), Blue-winged Parrotlet (*Forpus xanthopterygius*), Plain Parakeet (*Brotogeris tirica*), Golden-tailed Parrotlet (*Touit surda*), Blue-headed Parrot (*Pionus* menstruus), Scaly-headed Parrot (*P. maximiliani*), Red-crowned Amazon (*Amazona rhodocorytha*), Orange-winged Amazon (*A. amazonica*) and the Mealy Amazon (*A. farinosa*). *Aratinga aurea* occurs only in 'campos nativos' and 'várzea' forest. The remaining species occur both in 'terra firme' forest and 'mussununga' forest. These species can be grouped into three categories according to body weight: < 100 g (*Aratinga aurea*, *Pyrrhura cruentata*, *P. leucotis*, *Forpus xanthopterygius* and *Brotogeris tirica*), 200-300 g (*Ara nobilis*, *Pionus menstruus* and *P. maximiliani*), and > 400 g (*Ara maracana*, *Amazona rhodocorytha*, *A. amazonica* and *A. farinosa*). *Pyrrhura cruentata*, *T. surda* and *A. rhodocorytha* are considered threatened species (Collar *et al.* 1992).

METHODS

Between March 1992 and January 1993, we made 8 visits (8-15 days each month, from sunrise to approximately 18:00) to RFL. We looked for psittacids by walking around the area whenever weather permitted for a total of 374 hs of field observation. Walks were conducted along the extensive system of dirt roads that crossed the reserve. The used roads comprised approximately 14 Km, being 12 Km in the 'terra firme' forest, 1,5 Km in the 'mussununga' forest and 500 m in the 'várzea' forest; hence we obtained a sample which approximately represents the vegetational coverage of the whole area. Several of the roads have continuous canopy over them.

We recorded each observation of a flock or individual feeding on a resource as one feeding bout. If a psittacid (or a flock) moved to another food source and fed on it, a new bout was recorded (Galetti 1993, Pizo *et al.* 1995). Plants whose parts were eaten were identified at the RFL herbarium and with the staff of the Departamento de Botânica of the Universidade Estadual de Campinas (UNICAMP), Campinas, state of São Paulo, Brazil. All identified plant species have voucher specimens in the RFL herbarium.

To access the vertical stratification of psittacids, we visually estimated the perch height of the birds (even if they were not feeding) to the nearest 5 m class interval.

RESULTS

Vertical stratification. Perch heights of psittacids are summarized in table 1 for those species for which we gathered three or more records. *Ara maracana* was observed perched just once at three m height, and no data are available for *Ara nobilis*, *Forpus xanthopterygius* and *Touit surda*. Overall, our data indicate that the heaviest species occupy most commonly the highest strata (> 25 m) in the vegetation,

Table 1. Frequency (%) distribution of perch height for the psittacids from Reserva Florestal de Linhares. The most frequent perch height class for each species are highlighted.

Species	N	Height classes (m)						P[a,b]
		0-5	6-10	11-15	16-20	21-25	26-30	
Aratinga aurea[c]	6	33	**50**	17	-	-	-	NS
Pyrrhura cruentata	14	14	**50**	29	7	0	0	$P < 0.025$
Pyrrhura leucotis	57	7	**46**	26	9	3	9	$P < 0.001$
Brotogeris tirica	26	4	15	**27**	23	11	19	NS
Pionus menstruus	3	0	0	0	**67**	0	33	NS
Pionus maximiliani	8	0	12	12	0	25	**50**	NS
Amazona rhodocorytha	26	0	4	0	15	19	**61**	$P < 0.001$
Amazona amazonica	5	0	20	20	0	0	**60**	NS
Amazona farinosa	13	0	8	0	8	31	**54**	$P < 0.005$

[a]Log-likelihood goodness of fit test applied to raw data (Zar 1984). NS = not significant ($P > 0.05$). [b]Expected values were obtained through the division of the number of observations by the number of possible height classes. [c]*Aratinga aurea* occurs in open areas where trees higher than 15 m never occur.

whereas the lightest ones are more often found perched below 15 m. Considering as criterion 75 % of perches above or below 15 m, we distinguished two groups of psittacids according to perch height: those occupying inferior strata (*Pyrrhura cruentata* and *P. leucotis*), and those occupying superior strata (*Amazona rhodocorytha* and *A. farinosa*). *Brotogeris tirica* and *Pyrrhura leucotis* were observed in a broad range of height classes, but the former does not seem to prefer any particular stratum. The few data available for *Aratinga aurea*, *Pionus* spp and for *Amazona amazonica* preclude any conclusion.

Diet. We recorded 79 feeding bouts on 22 plant species representing 14 families (table 2); the seeds of all plant species recorded were eaten by the psittacids, but pulp was also ingested in some cases (nine plant species).

Forpus xanthopterygius, *Amazona amazonica*, *Ara nobilis*, *A. maracana* and *Touit surda* were not observed feeding during the study. Data about the diet of the *Amazona* and *Pionus* species are limited partly because they occupy the highest forest stratum which renders direct observations of feeding birds difficult. We have the most feeding observations for *Pyrrhura leucotis* (48 % of feeding bouts, 12 plant species) and *Brotogeris tirica* (27 % of feeding bouts, 8 plant species), two of the most abundant psittacids at RFL.

The most utilized plant families (figure 1) were Cecropiaceae (four species, 36 feeding bouts) and Moraceae (four species, 13 feeding bouts). With the exception of

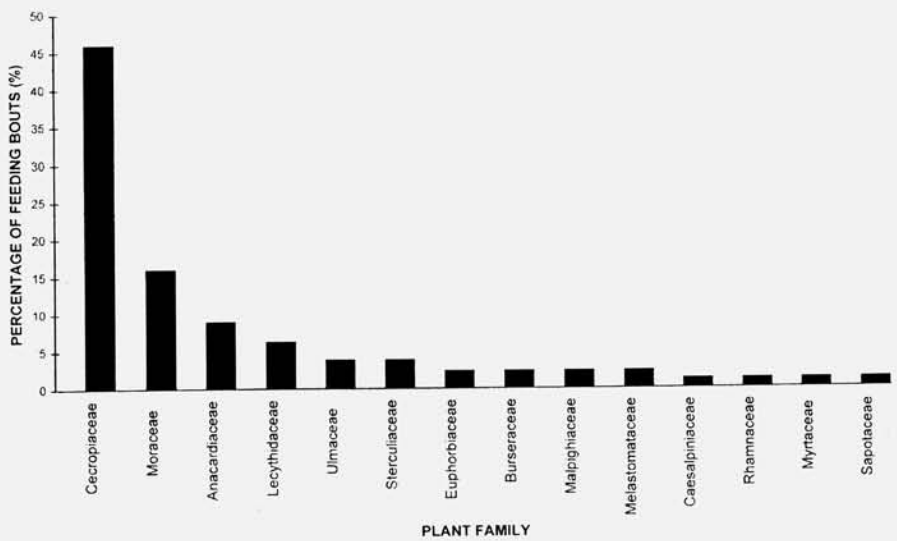

Figure 1. Percent distribution of feeding bouts (N = 79) among the 14 plant families recorded in the diet of psittacids at Reserva Florestal de Linhares.

Table 2. Plant species eaten by psittacids at Reserva Florestal de Linhares. Plant families and species are arranged in alphabetical order.

Families/plant species	Fruiting season	Part eaten[a]	Psittacid[b]	Feeding bouts (% of records for each bird species)
ANACARDIACEAE				
Tapirira guianensis	Mar-May	s	Pc	5 (62)
			Pl	2 (5)
BURSERACEAE				
Protium heptaphyllum	Dec-Jan	s	Ar	1 (50)
			Af	1 (20)
CAESALPINIACEAE				
Dialium guianense	Mar-May	s	Bt	1 (5)
CECROPIACEAE				
Cecropia glazioui	Feb-Mar	p,s	Pl	1 (3)
			Bt	3 (14)
C. pachystachya	Apr-Nov	p,s	Pl	7 (18)
			Bt	1 (5)
C. hololeuca	Jun-Dec	p,s	Pl	18 (47)
			Bt	5 (24)
Pourouma velutina	Apr	s	Af	1 (20)
EUPHORBIACEAE				
Alchornea triplinervia	Nov-Jan	s	Pl	1 (3)
Pera glabrata	Apr-Jun	s	Pl	1 (3)
LECYTHIDACEAE				
Eschweilera ovata	Apr-May	p,s	Pt	2 (100)
			Pm	1 (50)
			Af	2 (40)
MALPIGHIACEAE				
Byrsonima sericea	Jun-Sep	s	Aa	1 (100)
Byrsonima sp.	May-Aug	s	Pc	1 (12)
MELASTOMATACEAE				
Mouriri glazioviana	May-Aug	s	Pc	1 (12)
			Pl	1 (12)
MORACEAE				
Artocarpus integrifolia[c]	Nov-Jan	p, s	Bt	4 (19)
Ficus nymphaeifolia	Feb-Mar	p, s	Pl	1 (3)
F. gomelleira	Jun-Dec	p, s	Pl	1 (3)
			Bt	3 (14)
F. guianensis	Feb-Oct	p, s	Pl	2 (5)
			Bt	2 (9)
MYRTACEAE				
Eugenia cumini[c]	Dec-Jan	s	Pl	1 (3)
RHAMNACEAE				
Ziziphus platyphilla	Mar-May	s	Pm	1 (50)
SAPOTACEAE				
Micropholis crassipedicelata	Jun-Jul	s	Ar	1 (50)
STERCULIACEAE				
Sterculia speciosa	May-Jul	p, s	Bt	2 (9)
			Af	1 (20)
ULMACEAE				
Trema micrantha	Feb-Mar	s	Pc	1 (12)
			Pl	2 (5)

[a] Part eaten: p = pulp, s = seeds. [b] Psittacids: Aa = *Aratinga aurea*, Pc = *Pyrrhura cruentata*, Pl = *P. leucotis*, Bt = *Brotogeris tirica*, Pt = *Pionus menstruus*, Pm = *Pionus maximiliani*, Ar = *Amazona rhodocorytha*, Af = *Amazona farinosa*. [c] Exotic species

Euphorbiaceae and Malpighiaceae (two species each), only one species was recorded for the remaining plant families.

DISCUSSION

Roth (1984) also reported that seven of the 15 psittacid species he studied at an Amazonian forest site could be assigned to vertical strata of the forest: amazons and macaws perched over than 25 m; *Deroptyus accipitrinus*, *Aratinga weddellii* and *Pionopsitta barrabandi* perched between 15-30 m; and two *Pyrrhura* species were most frequently observed perching below 25 m. In Roth's study there was also a group of species (*Pionus menstruus* among them) that occupied all strata almost equally. In our study, although *Aratinga aurea* occupies the same stratum as *Pyrrhura* spp (table 1), it occupies different habitats. At RFL *A. aurea* is found only in opened areas with scattered small trees ('campos nativos' and 'várzea' forests), whereas *Pyrrhura* spp lives in 'terra firme' and 'mussununga' forest.

The strata occupied potentially influence not only the fruit species but also the fruit type (if dry or fleshy) eaten by the psittacids. Fruit-bearing plants of different species obviously differ in height, and dry fruits tend to be better represented in the canopy than in the lower strata in semideciduous forest like the RFL forest (Morellato 1991, Morellato and Leitão-Filho 1992). Many of the data reported here were collected when the psittacids were feeding.

Concerning to the food items, Desenne (1995) and Pizo *et al.* (1995) have been recorded elsewhere the predominance of seeds in the diet of neotropical psittacids. Pulp, however, is also an important food item for some psittacids (e.g., *Ara severa*; Desenne 1995) or when the psittacids are feeding on particular plant species (e.g., *Euterpe* fruits, Palmae; Strahl *et al.* 1991, Pizo *et al.* 1995). We do not know if the pulp swallowed when the psittacids fed on *Ficus* and *Cecropia* species was ingested intentionally or accidentally as a result of ingesting the tiny seeds enveloped by the pulp.

Contrary to the findings of Roth (1984), Scherer Neto (1989), Martuscelli (1995) and Pizo *et al.* (1995), we did not observe psittacids eating flowers, nectar or leaves. Flower-eating is common among some species of neotropical psittacids (e.g., *Brotogeris chrysopterus*; Roth 1984, Desenne 1995) or in areas with a prolonged dry period (Galetti 1993, Olmos 1996). Additional field observations would probably result in flower-eating records, but this behavior is definitely not common among the psittacids at RFL, at least during the study period.

Curiously the most used plant families do not figure among the ten most common families occurring at RFL (Peixoto and Gentry 1990). This may indicate that the psittacids did not exploit the fruits according to their overall abundance in the area, but rather that some sort of food choice occurs. At this point, a survey about vegetational structure and fruit abundance, in each habitat of the site, would be very useful to get more conclusions about the ecology of the resource exploitation by the psittacids.

The high consume of *Cecropia pachystachya* (eight feeding bouts) and *C. hololeuca* (23 feeding bouts) may be a consequence of three factors: (1) *Cecropia* spp. are pioneer species especially common in the second-growth vegetation occurring along the road margins where the diet surveys were conducted, (2) *Cecropia* architecture facilitates visualisation of feeding birds, and (3) psittacids may be attracted to the *Cecropia* infructescences, because of their abundance in neotropical second-growth forests and/or because of the net energy reward they offer. Wherever the reason, our results corroborate earlier studies showing that *Cecropia* infructescences are highly used by psittacids as food (Pizo *et al.* 1995, Whitney 1996).

It is also worthwhile to note the occurrence of two exotic fruits in the diet of psittacids: *Artocarpus integrifolia* ('jaca' - Moraceae) and *Eugenia cumini* ('jamelão' - Myrtaceae), both introduced from India. These species are well adapted in Brazil and at RFL they are common in an orchard; moreover the genus *Eugenia* is represented at the site by at least 23 native species, that represents a potential food resource to psittacids. The utilization of these species are indicative of the opportunistic behavior of some psittacids which are able to exploit relatively new and uncommon resources to enrich their diet.

ACKNOWLEDGMENTS

We are grateful to R.M. de Jesus, the Director and to A. Garcia the Vice-director of RFL, for permission to work at the reserve and for the help during field work; to S. Rosas and the staff of RFL for friendly assistance in the field or in analyzing data; to J. Vasconcellos for the facilities used during the initial phase of the study; to J. Vielliard who helped in the identification of psittacids; to J. Semir and J. Tamashiro for plant identifications and fruit characterizations. I. S. was supported by a fellowship from Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP. M. Foster greatly improved the final version of the manuscript.

REFERENCES

Brandt, A. and R. B. Machado (1990) Área de alimentação e comportamento alimentar de *Anodorhyncus leari*. *Ararajuba* 1:57-63.

Collar, N. J., L. P. Gonzaga, N. Krabbe, A. Madroño-Nieto, L. G. Naranjo, T. A. Parker III and D. C. Wege (1992) *Threatened birds of the Americas.* The ICBP/UCN Red Data Book, 3rd ed. Cambridge: International Council for Bird Preservation.

Da-Ré, M. (1996) Reintrodução de um exemplar fêmea de Ararinha-azul *Cyanopsitta spixii* à natureza, p. 118-124. *In*: J. M. E. Vielliard, M. L. Silva and W. R. Silva (eds.) *Anais V Cong. Bras. Orn.* Campinas: Ed. UNICAMP.

Desenne, P. (1995) Preliminary study of the diet of 15 species of psittacids in an evergreen forest, Tawadu river basin, El Caura forest reserve, state of Bolivar, Venezuela, p. 26-43. *In*: G. Morales, I. Novo, D. Bigio, A. Luy and F. Rojas-Suarez (eds.) *Biología y Conservacion de los psitácidos de Venezuela.* Cambridge: Birdlife Intern.

Forshaw, J. M. (1978) *Parrots of the World*, 2nd ed. David and Charles Ltd, Brunel House, Newton Abbot, Devon; UK.

Galetti, M. (1993) Diet of the Scaly-headed Parrot (*Pionus maximiliani*) in a semideciduous forest in southeastern Brazil. *Biotropica* 25:419-425.

___ (1997) Seasonal abundance and feeding ecology of parrots and parakeets in a lowland Atlantic forest of Brazil. *Ararajuba* 5:95.

Jesus, R. M. (1987) Mata Atlântica de Linhares: aspectos florestais, p. 35-71. *In*: *Anais do seminário 'Desenvolvimento econômico e impacto ambiental em áreas do trópico brasileiro: a experiência da CVRD, Linhares'.* Rio de Janeiro: SEMA, IWRB, CVRD.

Martin, T. E. (1985) Resource selection by tropical frugivorous birds: integrating multiple interactions. *Oecologia* 66:563-573.

Martuscelli, P. (1995) Ecology and conservation of the Red-tailed Amazon *Amazona brasiliensis* in southeastern Brazil. *Bird Cons. Int.* 5:405-420.

Morellato, L. P. C. (1991) *Estudo da fenologia de árvores, arbustos e lianas de uma floresta semidecídua no sudeste do Brasil.* Ph. D. Thesis. Campinas: UNICAMP.

___ and H. F. Leitão-Filho (1992) Padrões de frutificação na Serra do Japi, p. 112-140. *In*: L. P. C. Morellato (ed.). *História natural da Serra do Japi.* Campinas: Ed. UNICAMP.

Munn, C. A. (1988) Macaw biology in Manu Nat. Park, Peru. *Parrot Letters* 1:18-21.

Olmos, F. (1996) Distribuição e ecologia de *Pyrrhura pfrimeri* (Psittacidae): primeiras observações, p. 93-94. *In*: J. M. E. Vielliard, M. L. Silva and W. R. Silva (eds.) *Anais V Cong. Bras. Orn.* Campinas: Ed. UNICAMP.

Pasquier, R. F. (1982) *Conservation of New World parrots*, 2nd ed. Smithsonian Inst. Press, Washington D.C.: Int. Council Bird Preserv. Tech. Publ.

Peixoto, A. L. (1982) Considerações preliminares sobre a flora e a vegetação da Reserva Florestal da CVRD (Linhares, ES). *Cadernos de Pesquisa 2 (Série Botânica 1)*:41-48.

___ and A. Gentry (1990) Diversidade e composição florística da mata de tabuleiro na Reserva Florestal de Linhares (ES, Brasil). *Rev. Bras. Bot.* 13:19-25.

Pizo, M. A., I. Simão and M. Galetti (1995) Diet and flock size of sympatric parrots in the Atlantic forest of Brazil. *Orn. Neot.* 6:87-95.

Roth, P. (1984) Repartição do habitat entre psitacídeos simpátricos no sul da Amazônia. *Acta Amazônica* 14:175-221.

Sazima, I. (1989) Peach-fronted Parakeet feeding on winged termites. *Wilson Bull.* 101:656-657.

Scherer Neto, P. (1989) *Contribução à biologia do papagaio-de-cara-roxa Amazona brasiliensis (Linnaeus, 1758) (Psittacidae, Aves).* M. Sc. Thesis. Curitiba: Univ. Fed. Paraná.

Strahl, S. D., P. A. Desenne, J. L. Jimenez and I. R. Goldstein (1991) Behavior and biology of the Hawk-headed Parrot *Deroptyus accipitrinus* in southern Venezuela. *Condor* 93:177-180.

Whitney, B. M. (1996) Flight behaviour and other field characteristics of the genera of Neotropical parrots. *Cotinga* 5:32-42.

Yamashita, C. and P. M. Valle (1993) On the linkage between *Anodorhynchus* macaws and palm nuts and the extinction of the glaucous macaw. *Bull. Brit. Orn. Club.* 113:53-61.

Zar, J. H. (1984) *Biostatistical analysis.* London: Prentice-Hall Intern. Ed.