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Diet and foraging behavior of the rufous-tailed jacamar (*Galbula ruficauda*, Galbulidae) in central Brazil

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RESUMO. **Dieta e comportamento de forrageamento da ariramba-da-mata (*Galbula ruficauda*, Galbulidae) no Brasil central**. Neste estudo são apresentados dados sobre dieta e comportamento alimentar da ariramba-da-mata em uma mata de galeria e áreas adjacentes de cerrado no Brasil central. Itens observados na dieta incluem: Hymenoptera, Lepidoptera, Orthoptera, Hemiptera (cigarras apenas), Odonata e Diptera, além de muitos insetos voadores pequenos (não identificados). Uma comparação envolvendo as freqüências das ordens de insetos consumidas por machos e fêmeas não mostrou qualquer diferença significativa entre sexos. Animais acompanhados no campo mostraram uma forte tendência de repetir rotas e utilizar os mesmos poleiros nos mesmos horários e em dias consecutivos. Também pareceu evidente que diferentes setores da mata de galeria são utilizados por um único animal apenas, o que sugere que estas aves apresentem um comportamento territorial.
PALAVRAS-CHAVE: *Galbula ruficauda*, ariramba-da-mata, dieta, comportamento alimentar, floresta de galeria, cerrado.

KEY WORDS: *Galbula ruficauda*, jacamars, diet, foraging behavior, gallery forest, cerrado.

Galbula ruficauda is a neotropical insectivorous bird commonly found in forest habitats from Mexico to Argentina and Brazil (Sick 1993). Previous reports on the diet of this jacamar are relatively abundant, but fragmentary (Skutch 1937, 1963, 1985; Moojen *et al*. 1941; Berla 1944; Slud 1964; Schubart *et al*. 1965; Fry 1970a,b; Sherry 1983; Chai 1986; Sick 1993; Poulin *et al*. 1994; Novaes and Lima 1998; Tobias *et al*. 2002). These reports indicate that wild birds usually take a variety of winged insects that are either intercepted in the air or snatched from the vegetation, including Hymenoptera, Odonata, Lepidoptera, Diptera, Orthoptera and other insects. Fry (1970a) found a larger amount of Hymenoptera and advanced the hypothesis that jacamars' bill length is primarily adapted to handle venomous wasps, by keeping stings away from the face. Skutch (1963) stressed the importance of Odonata and Lepidoptera in jacamar's diet and suggested that breeding jacamars usually take larger prey items (for efficiency of transport to nestlings) than non-breeding birds. Sherry (1983) also observed this pattern at a nest in Costa Rica, but according to this author, the female tended to return to nest with larger prey items than the male. In spite of all these reports and suggestions, differences between sexes on the diet of breeding or non-breeding jacamars remain largely uninvestigated and, except by Fry (1970a), most records obtained on jacamar's diet are restricted to Central America. In a similar fashion, most studies on jacamars bring descriptions of their preferred habitats (Skutch 1937, 1963, 1985; Fry 1970b; Slud 1964; Sick 1993), but data involving dispersion and habitat use by birds are scarce. In this note we present some data on the diet of wild, non-breeding adult jacamars (*Galbula ruficauda rufoviridis)* in central Brazil. Potential differences between sexes were investigated and observations on the feeding behavior and dispersal of birds are also reported.

Field work was conducted in January-February 1996 in a gallery forest along a tributary of the *Maranhão* river 40 km north of Brasília, central Brazil (15º30'S, 47º10'W) and the nearby cerrado vegetation (a dry plant formation that includes several physiognomic types such as open savannah woodlands, open scrub and grasslands; see Goodland 1971). The forest is relatively narrow (2 to 10 m) at a large extension and becomes higher and denser toward the stream mouth in the upper Maranhão river. Observations were taken mostly on three males and one female found along 400 m in the gallery forest and a few other males and females more rarely observed down the stream. The birds were located by their vocalizations, or by checking their favorite perches (perches regularly visited by birds where they usually spent a long time – from 20 min to 4 h daily – hunting insects). Afterwards, they were followed until they could no longer be kept in sight. Birds were observed with an 8x30 Karl Zeiss binoculars, usually within a range of 5-15 m. Birds were usually observed from 9:00 to 16:00 hs. Total observation time was 29 h for males and 9 h for females, accumulated over 21 nonconsecutive days. Observations of attacks on insects included: the habitat (cerrado or forest), distance and success of each attack, the location of capture (air, leaves, branches, trunks) and prey identity (insect orders).

The results obtained on the jacamar's diet are shown in figure 1. As a whole, the frequency of different insect orders attacked and consumed by birds did not differ significantly between sexes (G test: $G = 1.82$, $P > 0.05$; orders more rarely

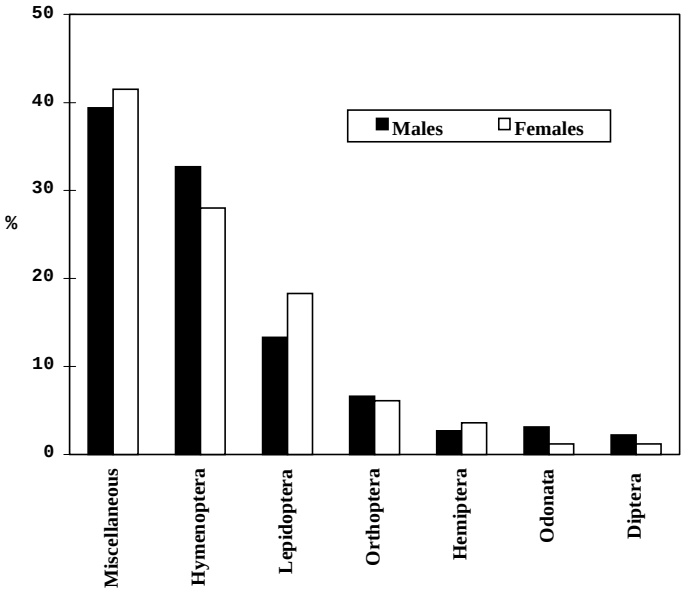

Figure 1. Insect orders consumed by jacamars in central Brazil (n = 226 items for males and 86 for females; miscellaneous = very small, not identified).

found – Hemiptera, Odonata, and Diptera were pooled into a single class). The most common items in the jacamars' diet were many small insects (< 1 cm) not identified at distance, but probably including species of Diptera and Hymenoptera. These insects were usually captured at short range and, sometimes, only through fast bill movements, without leaving the perch. Larger Hymenoptera, especially vespids, were also frequently attacked and consumed by jacamars, but handling wasps was often more time consuming than most other items. They were pecked more times and usually knocked against the perch until the abdomen (and the sting) was completely or partially removed. Lepidoptera was the third preferred food item of both male and female jacamars. Most of them consisted of butterflies (Papilionoidea), with only four moths being observed in the jacamars' diet. Other items found were several Orthoptera (especially Tettigoniidae and Gryllidae), Odonata, Hemiptera (cicadas only), and a few large Diptera.

Most Hymenoptera, Diptera, Lepidoptera, and Odonata were attacked in flight and sometimes were detected by birds perched as far away as 12 m. Other Lepidoptera, especially moths, and all Orthoptera and Hemiptera were captured on the vegetation, usually between 2 and 6 m of a birds' perch. Unsuccessful attacks accounted for 43% of all attacks by males and 35% of attacks by females. In some cases, however, it was not possible to distinguish between an unsuccessful and a successful attack on a small prey.

The large amount of Hymenoptera obtained in this study supports the observations of Fry (1970a) on the importance of these insects for jacamars. Although data in Fry's study were obtained in the dry season (Sept.), which reinforces this assertion, it is well known that insect abundance often changes seasonally in the cerrado region, and the relative importance of this and other insect orders in jacamars diet could also change in a similar fashion. Long term studies are clearly needed to understand seasonal variations in the diet of jacamars.

A surprising result obtained in this study is that jacamars, often associated to the forest vegetation, also forage in the cerrado *sensu strictu* and may constitute important predators for several insects that occur in this kind of vegetation. This is for example the case of the butterflies *Hamadryas februa* and *H. feronia* (Nymphalidae), which may occur in both habitats, but are often more abundant in the cerrado vegetation (Pinheiro and Ortiz 1992). These butterflies perch on tree trunks in a peculiar way (head down and the wings fully open, tightly pressed against the trunk) and where their colors match the background. From time to time, they perform a fast, erratic flight, returning to the same or a nearby spot on the trunk. Some jacamars seemed to be aware of *Hamadryas* behavior and waited on a nearby tree to attack them in flight.

A very impressive characteristic observed in male jacamars followed for relatively long periods is a strong tendency to repeat routes and visit the same perches at the same time each day and on different days along the study (see also Skutch 1985; Melo-Júnior 2001; Tobias *et al*. 2002). Moreover, several perches may be utilized in a relatively small area (maximum linear distance between extreme perches along the gallery forest recorded for a male reached only 100 m), which suggests a restricted home range for this jacamar.

Although birds were not marked in our study in central Brazil, we also had the impression that each section of the gallery forest was utilized by a single bird only. This pattern was especially evident from birds' vocalizations late in the afternoon, when all birds in the area vocalized at the same time in a loud and fully developed sequence of vocalizations. By this time it was possible to recognize distinct birds singing along adjacent sections of the gallery forest. Whether this kind of spatial distribution is related to territoriality (disputes or aggressive behavior among birds were not seen), as already suggested for two other jacamars studied in the Peruvian Amazon by Terborgh *et al*. (1990), constitutes an important and interesting subject for future investigation.

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