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## A FORAGING ASSOCIATION BETWEEN TWO KITE SPECIES (*ICTINEA PLUMBEA* AND *LEPTODON CAYANENSIS*) AND BUFFY-HEADED MARMOSETS (*CALLITHRIX FLAVICEPS*) IN SOUTHEASTERN BRAZIL

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**Key words:** *Ictinea plumbea*; *Leptodon cayanensis*; *Callithrix flaviceps*; primates; foraging association.

Many insectivorous birds, notably those of the Formicariidae (Willis and Oniki 1978), are known to systematically exploit the disturbance of prey caused by the foraging activities of other animals. Recent studies (Fontaine 1980, Terborgh 1983, Boinski and Timm 1985, Boinski and Scott 1988, Siegel et al. 1989) have reported this type of foraging association between a variety of Neotropical bird species and platyrrhine monkeys of the genera *Saguinus* (Callitrichidae), and *Cebus* and *Saimiri* (Cebidae).

The present report describes a foraging association involving both Plumbeous (*Ictinea plumbea*) and Grey-headed (*Leptodon cayanensis*) kites with groups of buffy-headed marmosets (*Callithrix flaviceps*). The association is unusual in being restricted to both a specific type of prey (cicadas) and a particular time of year.

### STUDY SITE AND OBSERVATIONS

The association reported here was recorded during studies of the ecology of the buffy-headed marmoset (adult body weight approximately 0.4 kg), carried out in a privately owned forest reserve on the Fazenda Montes Claros in Minas Gerais, southeastern Brazil (19°50'S, 41°50'W). The study area was composed of hilly secondary and disturbed forest habitats bordered on three sides by open fields and on the fourth by the less disturbed forest of the main body of the reserve. Rainfall at the site averages 1,145 mm annually, with a clearly defined dry season normally spanning the period between April and September. For a more detailed description of both the study site and methodology, see Ferrari (1988).

In addition to the main study, during which the behavior of an habituated marmoset study group (containing between 11 and 15 members) was recorded in detail, less systematic observations of this and other groups were begun in December 1984 and have continued sporadically up to the present day. The main study involved the collection of scan sample records of the behavior of the study group during at least 10 days each month between August 1985 and August 1986 (Ferrari 1988). All observed interactions with other animal species were recorded opportunistically.

### RESULTS

*Callithrix flaviceps* was observed interacting with a range of bird species as both potential prey and predator. The marmosets displayed an extensive repertoire of anti-predator behaviors, a majority of which was related to the avoidance of raptors, whose characteristic flight profile provoked an intense reaction (Ferrari and Lopes Ferrari, in press). Medium-sized birds of prey, including *Micrastur ruficollis* (Izawa 1978), *M. semitorquatus* (Alonso and Langguth 1989), *Spizaetus ornatus* (Dawson 1976, Goldizen 1987), and *S. tyrannus* (Dawson 1976), appear to be the principal predators of callitrichids. *Callithrix flaviceps*, in turn, was observed feeding on eggs of the Rufous-collared Sparrow (*Zonotrichia capensis*) on two occasions and on an unidentified fledgling on a third occasion.

The foraging associations with both *I. plumbea* and *L. cayanensis* represent a third, highly specific type of interaction between the marmosets and birds. As observed in other bird/monkey associations, the kites exploited prey flushed by the marmosets during their foraging activities. Unlike other associations, however, this behavior was both highly seasonal and involved the capture of a single type of prey, large-bodied cicadas (Homoptera: Cicadidae).

Mature cicadas were particularly abundant in the study area during the early wet season month of Oc-

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tober, when they emerged from the ground in large numbers, and declined gradually through November and early December. During this 3-month period in 1985, 8.0% of the identified insects captured by the study group were homopterans (26 of 326 records), while this order contributed only 0.4% of insect prey items identified during all other observation periods (two of 505 records).

The capture of cicadas by the marmosets increased less than expected according to the observed increase in the abundance of this type of prey during the early wet season, however. Unlike their typical insect prey (orthopterans, beetles, and caterpillars made up 91.3% of all identified items), cicadas tend to be found on the bark of trunks and branches, instead of in foliage, and depend on flight rather than camouflage to avoid predation, characteristics which are unfavorable to the foraging techniques of *C. flaviceps* (Ferrari 1988). In general, the monkeys tended to flush cicadas rather than capture them, a tendency which was exploited by both *I. plumbea* and *L. cayanensis*, which were not only highly insectivorous, but typically captured their prey on the wing (Brown and Amadon 1968, Sick 1984).

Between October and early November 1985, Plumbeous Kites were observed in the vicinity of the *C. flaviceps* study group almost daily, either singly or in pairs. As the marmosets concentrated their activities within a "core area" of 18.5 ha (Ferrari 1988), it seems reasonable to assume that the same birds followed the group throughout this period. Associations between the two species were not observed during the remaining 11 months of the main study period.

During association, the kites chose perches in relatively open tree crowns at 15–20 m, frequently the same ones in which the marmosets were foraging, and closely accompanied the group's activities until a cicada was flushed. Cicadas were captured in the feet after a short flight, rarely exceeding 10 m, and usually were taken back to the take-off perch to be eaten. The kites were not observed capturing other types of insects during this period and it seems likely that these cicadas constituted a significant proportion of their diet at this time of year.

Observation conditions did not permit a detailed quantitative analysis of *I. plumbea* behavior but the kites generally maintained more or less close contact with the marmoset group for periods of between 2 and 6 hr each day, predominantly during the early part of the day, i.e., up to 12:00. The kites were rarely observed in the afternoon, during which the marmosets normally spent less time foraging and tended to utilize much lower levels in the forest, keeping to the dense vegetation of the undergrowth. Both factors probably reduced the flushing of cicadas significantly. In addition, the behavior of the marmosets tended to be highly cryptic from approximately 14:00 onwards and activity normally ceased between 15:00 and 16:30.

During a week of observation between September and October 1989, a similar association was observed in the study area, this time involving a pair of Grey-headed Kites (*L. cayanensis*) and a group of 11 marmosets which utilized an area of approximately 15 ha. Behavior patterns were as those described for *I. plumbea*.

Despite the fact that *C. flaviceps* normally exhibited

alarm in the presence of raptors, a high degree of tolerance was shown towards both *I. plumbea* and *L. cayanensis* during foraging associations. The marmosets would often move to within 1 m of perched birds, although alarm calls and avoidance behaviors were occasionally observed when they flew overhead.

## DISCUSSION

There are few records of foraging associations between birds and platyrrhine monkeys, although they have been observed at sites ranging from Costa Rica to southeastern Brazil. While avian associates include cuckoos, woodcreepers, trogons, and tanagers, associations with raptors, especially *H. bidentatus*, are most frequently reported (see Terborgh 1983, Boinski and Scott 1988).

While the phenomenon is probably more widespread than the available records indicate, it may be restricted to the smaller, highly insectivorous platyrrhine genera. There are no reports involving the much larger-bodied folivorous/frugivorous *Alouatta*, for example, which is by far the best studied of the 16 platyrrhine genera (for literature, see Neville et al. 1988). In contrast with *Callithrix*, *Cebus*, *Saguinus*, and *Saimiri*, which are all highly active, *Alouatta* does not forage for insects and spends the majority of its daily activity period at rest (Neville et al. 1988).

In Costa Rica, Boinski and Scott (1988) found that *H. bidentatus* clearly preferred to associate with *Saimiri oerstedii* rather than with *Cebus capucinus*, while Grey-headed Tanagers (*Eucometis penicillata*) and Tawny-winged Woodcreepers (*Dendrocincla anabatina*) only approached *C. capucinus* groups when these were in association with those of *S. oerstedii*. In addition to forming much smaller groups (<15 vs.  $\pm 40$ ) which presumably flush less arthropod prey (Willis and Oniki 1978, Terborgh 1983), subadult *C. capucinus* were observed attempting to capture perched birds. Associations with callitrichid groups, which rarely exceed 15 individuals, are probably also relatively less profitable for insectivorous birds.

In addition to group size, differences in foraging techniques may be important. While *Saimiri* and *Cebus* typically forage manipulatively for immature arthropod prey in the midcanopy, both *Callithrix* and *Saguinus* are more stealthy, pouncing on large, mature insects, especially orthopterans, in dense foliage, mainly in the lower levels of the forest. Apart from specific cases, such as that reported here, it seems likely that routine associations between canopy-perching raptors and callitrichids will be relatively rare.

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## SURVIVAL OF BREEDERS IN SANTA CRUZ ISLAND AND MAINLAND CALIFORNIA SCRUB JAY POPULATIONS<sup>1</sup>

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The Santa Cruz Island Scrub Jay (*Aphelocoma coerulescens insularis*) is the most morphologically differentiated member of the southern California Channel Islands' endemic avifauna (Johnson 1972). Furthermore, its isolation from mainland Scrub Jay populations provides an opportunity to examine various factors associated with the species' social evolution (Atwood 1980b, Woolfenden and Fitzpatrick 1984).

Although Scrub Jays in general are permanently monogamous throughout their breeding range (Woolfen-

den 1974, Atwood 1980b, Verbeek 1973), other aspects of their social behavior vary dramatically between populations. The Florida Scrub Jay, *A. c. coerulescens*, has a well-developed system of cooperative breeding, in which groups of related birds defend year-round territories and nonbreeders help raise offspring that are not their own (Woolfenden and Fitzpatrick 1984). The principal factor associated with the evolution of this social system is the lack of suitable breeding space within the population's rare, patchy, oak scrub habitat (Woolfenden and Fitzpatrick 1984). All suitable habitat always seems to be occupied by established breeders, which prevents young, subordinate individuals from acquiring nesting space. Consequently, breeding by 1-year-old Florida Scrub Jays is extremely rare (Woolfenden 1974, 1975; Woolfenden and Fitzpatrick 1978, 1984).

In contrast, western mainland Scrub Jay populations

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