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# Low reproductive success of Campo Suiriri (*Suiriri affinis*) and Chapada Flycatcher (*S. islerorum*) in the central Brazilian Cerrado

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## Summary

We investigated the reproductive success of Campo Suiriri (*Suiriri affinis*) and Chapada Flycatcher (*S. islerorum*) in the Estação Ecológica de Águas Emendadas, Central Brazil. Between June and December 2003, we monitored 25 nests of Campo Suiriri and 20 nests of Chapada Flycatcher. The simple percentage of successful nests was 32% for Campo Suiriri and 10% for Chapada Flycatcher, whereas the reproductive success calculated by the Mayfield method was 19% for Campo Suiriri and 14% for Chapada Flycatcher. The estimated values of daily survivorship rate (DSR) for Campo Suiriri are as follows: egg period 0.971 and nestling period 0.944. For Chapada Flycatcher the figures were 0.964 and 0.930, respectively. No differences in DSRs between species or periods were statistically significant. All nest losses of Campo Suiriri were due to predation, while for Chapada Flycatcher predation accounted for 78% of nest losses and the remaining 22% was due to parasitism by botfly larvae (*Philornis* sp.). The low reproductive success of Chapada Flycatcher is close to the lowest values recorded for Neotropical birds and might be a threat to this species and an important variable in the determination of its conservation status.

## Introduction

Knowledge of the reproductive success and life-history traits of most Neotropical birds is extremely limited (Martin 1996). Although fundamental for planning conservation strategies, such data are almost non-existent for birds in the Cerrado region. The few studies conducted in this biome were restricted to single species, generally with small sample sizes (e.g. Cintra 1988, Alves and Cavalcanti 1990, Marini 1992, Amaral and Macedo 2003). The Cerrado is recognized as a biodiversity hotspot, and is the largest, richest and probably most threatened tropical savannah in the world, with around 80% of its primary vegetation converted to crops and pastures (Myers *et al.* 2000, Silva and Bates 2002). Machado *et al.* (2004) estimated that the Cerrado may disappear by 2030 if the current rate of development is maintained.

Among the 30 recognized Cerrado endemic species (Silva and Bates 2002) one of the most poorly known is Chapada Flycatcher (*Suiriri islerorum*), described recently and with little information on its conservation status (Zimmer *et al.* 2001, Lopes 2005). Chapada Flycatcher is considered a cryptic species, previously confused with Campo Suiriri (*S. affinis*), another species with a range largely confined to the Cerrado region (Zimmer *et al.* 2001).

The nests and reproductive biology of both species were described for the first time by Lopes and Marini (2005), being unknown until then (Fitzpatrick *et al.* 2005). The nest of both species is a delicate basket constructed mainly with vegetable fibres attached to each other by a large amount of spider's web. The whole of the exterior is ornamented with lichens and dry leaf fragments, conferring a highly cryptic effect (Lopes and Marini 2005). In central Brazil, nests of Campo Suiriri are found from early July onwards, and those of Chapada Flycatcher from early September onwards. The reproductive activity of both species ceases in December (Lopes and Marini 2005). Chapada Flycatcher lives in pairs year-round, while Campo Suiriri lives in pairs or family groups of up to five individuals (Zimmer *et al*. 2001, Lopes & Marini (in press)). They are mainly insectivorous (Lopes in press), sedentary, and territorial throughout the year (Lopes & Marini (in press)). In this paper we present for the first time data on the breeding success of Campo Suiriri and Chapada Flycatcher, discussing the implications for the conservation of these species.

## Study area

This study was conducted in the Estação Ecológica de Águas Emendadas (ESECAE), Planaltina, Distrito Federal, central Brazil (15°29′12″–15°36′57″S and 47°31′36″–47°41′19″W), an area of around 10,500 ha. Dwellings and small farms surround the ESECAE and almost all the primary vegetation in its vicinity has been extirpated. The climate is highly seasonal and predictable, with 1500–1750 mm of annual rain, mostly restricted to the period between October and April, which makes winters exceptionally dry (Nimer 1979).

Data collection took place in a 100 ha grid (1 × 1 km) and its vicinity. The local vegetation formed a mosaic ranging from *campos limpos* (a grassland) to *cerrado denso* (a dense and closed woodland). Maps depicting the local vegetation, as well as the home-ranges of 12 Campo Suiriri pairs and 11 Chapada Flycatcher pairs were presented by Lopes & Marini (in press).

Bird-nest predators commonly recorded in the area included Southern Caracara (*Caracara plancus*), Yellow-headed Caracara (*Milvago chimachima*) and Curl-crested Jay (*Cyanocorax cristatellus*). Among mammals, White-eared Opossum (*Didelphis albiventris*) seems to be common in the area (L. E. L. pers. obs.). Maned Wolf (*Chrysocyon brachyurus*) is also occasionally observed while domestic dogs are a common presence, both being potential predators of nests near ground level (Aragona and Setz 2001, Lopes *et al*. 2004). Snakes were rarely recorded (L. E. L. pers. obs.). Details of the ESECAE flora and fauna are presented, respectively, by Silva Jr and Felfili (1996) and Marinho-Filho *et al.* (1998).

## Methods

Nest-searching was performed by following adult birds from June to December 2003 (see Lopes and Marini 2005). Nests were monitored at intervals of 1 to 4 days, and the reproductive success was calculated in two ways: (1) as a simple percentage of successful nests and (2) as daily survival rates (DSRs) and period survival rates (PSRs) during the egg and nestling period (Mayfield 1961, 1975). Nest survival from the start of incubation to fledging was calculated as the product of the PSRs during the incubation and fledging periods (Mayfield 1961, 1975). A nest was considered successful if at least one young fledged. Partial losses were ignored because, in general, the entire nest content is taken during predation (Ricklefs 1969, Martin 1993).

The length of the intervals (incubation and nestling periods) was estimated assuming that alterations in nest status (hatching, fledging, and predation) occurred at the midpoint between the penultimate and final checks. Some small adjustments were made when comparisons with other nests with known age, or the presence of fresh blood or carcass (evidence of recent predation), indicated that they were necessary.

The incubation of both species starts only when the clutch is complete, and eggs are laid 2 days apart (Lopes and Marini 2005). Because it is often difficult to distinguish between predation during the egg-laying and incubation periods, we pooled data from both periods, following Robinson *et al.* (2000). This period was named the egg exposure period (hereafter egg period), and was considered as the time from laying of the first egg to hatching of the first egg. In this way, to the 15.2 incubation period of both species (Lopes and Marini 2005) we added the mean egg-laying period, which was 3.3 days for Campo Suiriri (clutches of two or three eggs) and 2 days for Chapada Flycatcher (clutches of two eggs). The nestling period was considered as the time from hatching of the first egg to fledging of the last young, and was estimated as 18.9 days for Campo Suiriri and 18.3 days for Chapada Flycatcher (Lopes and Marini 2005).

A nest was considered successful if it was found empty without signs of predation (e.g. nest damaged, presence of feathers or blood) at the next observation, and the young had reached a stage of development sufficient for them to leave the nest (Mason 1985). We considered a nest to have been predated if its contents disappeared before the young birds had reached a stage that would allow them to leave the nest. Nestlings found dead that were highly parasitized by botfly larvae (*Philornis* sp.) were considered victims of parasitism.

We also calculated the mean annual production (fledgings per pair of adults) by the pairs monitored. Although this measurement is fundamental to the development of conservation strategies, such data are rarely directly measured in the field, because intensive monitoring in a highly controlled situation is needed (Ricklefs and Bloom 1977). This was possible in our study because many birds were colour-banded, and all home ranges in the grid area were demarcated (Lopes & Marini in press).

After observing high rates of parasitism by botfly larvae, we collected some inactive nests and placed them in closed plastic bags. The nests were stored in a laboratory at a mild temperature until flies emerged. The flies were identified (Higgins *et al.* 2005) and are now deposited in the Entomological Collection of the Departamento de Zoologia, Universidade de Brasília.

### *Statistical analyses*

The variances of DSRs and PSRs were estimated, respectively, by the method described by Hensler and Nichols (1981) and by the equation presented by Mason (1985). Differences between the DSRs and PSRs for the two species were tested using the method of Hensler and Nichols (1981). For a comparison between the simple percentage of successful nests, we performed Fisher's exact test (Zar 1996) using Statistica software (StatSoft 1995). For all tests we adopted a significance level of 5%.

## Results

We found and monitored 25 nests of Campo Suiriri and 20 nests of Chapada Flycatcher. Two additional nests of each species were apparently abandoned prior to egg-laying. Another Chapada Flycatcher nest, found at the start of its construction, was also abandoned. One nest of Campo Suiriri was lost to observer interference. The 16-day-old nestlings prematurely left the nest several minutes after being colour-banded. These nestlings remained perched near the nest until dusk, but were gone the next morning. Nests that were abandoned or that failed because of observer interference were excluded from the reproductive success analyses.

Eight nests of Campo Suiriri were successful (32%), producing 16 fledglings, while only two nests of Chapada Flycatcher were successful (10%), producing two fledglings. Differences between species were not significant (Fisher exact test, $P = 0.15$). Mayfield success rates were 19% for Campo Suiriri and 14% for Chapada Flycatcher.

Daily survival rates and PSRs did not differ between egg and nestling periods for either species (Table 1). The DSRs during the egg period were higher than during the nestling period for both species; nevertheless, the differences between DSRs and PSRs were not significant (Campo Suiriri: $Z = 1.37$; $P = 0.17$; Chapada Flycatcher: $Z = 1.29$; $P = 0.20$). All 17 nest losses of Campo Suiriri were due to predation, seven of them occurring during the egg period and 10 during the nestling period. Of the 18 nest losses recorded for Chapada Flycatcher, 14 were due to predation (nine during the egg period and five during the nestling period) and four to parasitism.

*Philornis* larvae or pupae were observed in eight of nine nests of Campo Suiriri and in nine of 10 nests of Chapada Flycatcher that we examined. Two adult females of Campo Suiriri mist-netted during the reproductive period (October) also showed several injuries typical of parasitism by botfly larvae. Two other adult females, one of each species, were observed in October with a botfly larva lodged in their chin. Males were never recorded as parasitized. A high number of flies emerged from the nests that had been kept in plastic bags. In two nests of Chapada Flycatcher in which nestlings died due to parasitism, a mean of 42 and 43 flies emerged per nestling from the nest. The highest number of flies recorded per nestling of Campo Suiriri was 24, apparently without causing a severe threat to nestling survivorship.

We systematically monitored 14 pairs of Campo Suiriri and 11 pairs of Chapada Flycatcher, enabling the determination of the exact number of fledgings produced by these pairs. Thirteen fledglings of Campo Suiriri (0.93 fledgings per pair) and four fledglings of Chapada Flycatcher (0.36) were produced. Two of those fledglings, one per species, were never observed after they left the nest, suggesting that they died shortly after that. All the other young were continuously observed in the study area until mid-January 2004, one and a half months after the end of the reproductive season.

Table 1. Mean ± standard error estimated for the daily survival rates (DSRs) and period survival rates (PSRs) of Campo Suiriri and Chapada Flycatcher.

| Period | Campo Suiriri | | | Chapada Flycatcher | | | Z | P |
|---|---|---|---|---|---|---|---|---|
| | Nest days | Losses | DSR ± SE<br>PSR ± SE | Nest days | Losses | DSR ± SE<br>PSR ± SE | | |
| Eggs | 242.5 | 7 | 0.971 ± 0.01<br>0.582 ± 0.120 | 250 | 9 | 0.964 ± 0.012<br>0.532 ± 0.113 | 0.44<br>0.30 | 0.66<br>0.76 |
| Nestling | 177.5 | 10 | 0.944 ± 0.02<br>0.334 ± 0.118 | 128 | 9 | 0.930 ± 0.024<br>0.263 ± 0.121 | 0.47<br>0.42 | 0.64<br>0.67 |

Data are from 25 and 20 nests, respectively, monitored in the Estação Ecológica de Águas Emendadas, Distrito Federal, Brazil.

## Discussion

The reproductive success of the two species studied is among the lowest recorded for Neotropical tyrant flycatchers. Nevertheless, the small sample size in this study gives some uncertainty in the estimates of reproductive success. A review of several studies on the reproductive success of this family revealed a mean simple percentage of success around 43% (Table 2). This mean must be interpreted with care, because those studies did not employ the Mayfield method and, consequently, bias in the methods adopted by the authors is often common. No differences were observed between the reproductive success of species that build open or closed nests ($\chi^2 = 0.07$; d.f. = 1; $P = 0.79$). The 32% success of Campo Suiriri is near the lower limit observed for those species for which 20 or more nests were monitored. Although the simple percentage of successful nests did not differ statistically between the two species, the success observed for Chapada Flycatcher (10%) was the lowest value recorded for a Neotropical tyrant flycatcher (Table 2). Studies conducted in temperate regions found a simple percentage of success for tyrant flycatchers ranging from 40% to 80% (Ricklefs 1969, Martin 1993, Skutch 1997). The success estimated for Chapada Flycatcher using the Mayfield method (14%) is similar to the 13% estimated by Mermoz and Reboreda (1998) for the Brown-and-yellow Marshbird (*Pseudoleistes virescens*, Icteridae), one of the lowest values recorded for Neotropical passerines.

The small number of studies conducted in the Neotropical region that used the Mayfield method revealed DSR values near those obtained here. Mezquida and Marone (2001) estimated for Gray-crowned Tyrannulet (*Serpophaga griseiceps*), in a study conducted in Argentina, an incubation DSR of 0.942 and a nestling DSR of

Table 2. Simple percentage of successful nests of several Neotropical tyrant flycatchers.

| | *N* | % success | Country | Habitat | Source |
|---|---|---|---|---|---|
| **Open nests** | | | | | |
| *Elaenia chiriquensis* | 39 | 28.2 | Costa Rica | Antropic | Skutch 1985 |
| *Elaenia chiriquensis* | 110 | 30.0 | Brazil | Cerrado | Surrage 2004 |
| *Elaenia flavogaster* | 36 | 41.7 | Costa Rica | Antropic | Skutch 1985 |
| *Euscarthmus meloryphus* | 22 | 59.1 | Ecuador | Arid | Marchant 1960 |
| *Lathrotriccus euleri* | 26 | 58.0 | Brazil | Humid forest | Aguilar *et al.* 1999 |
| *Muscigralla brevicauda* | 36 | 38.9 | Ecuador | Arid | Marchant 1960 |
| *Pyrocephalus rubinus* | 188 | 49.5 | Ecuador | Arid | Marchant 1960 |
| *Serpophaga griseiceps* | 82 | 31.7 | Argentina | Arid | Mezquida and Marone 2001 |
| *Tyrannus niveigularis* | 29 | 72.4 | Ecuador | Arid | Marchant 1960 |
| Tyrannidae spp. | 118 | 47.5 | Various | Various | Various[a] |
| Partial total | 686 | 43.3 | Various | Various | Various[a] |
| **Closed nests** | | | | | |
| *Leptopogon amaurocephalus* | 68 | 47.1 | Brazil | Humid forest | Aguilar 2001 |
| *Zimmerius vilissimus* | 31 | 35.5 | Costa Rica | Antropic | Skutch 1985 |
| *Mionectes oleagineus* | 33 | 12.1 | Costa Rica | Antropic | Skutch 1985 |
| *Mionectes oleagineus* | 33 | 51.5 | Panama | Humid forest | Robinson *et al.* 2000 |
| Tyrannidae spp. | 161 | 49.7 | Various | Various | Various[a] |
| Partial total | 326 | 44.2 | Various | Various | Various[a] |
| **Total** | 1012 | 43.6 | Various | Various | Various[a] |

For species with fewer than 20 monitored nests, results were pooled under the name Tyrannidae spp.
[a]Sources: Marchant (1960), Oniki (1979), Skutch (1985), Aguilar *et al.* (1999, 2000), Robinson *et al.* (2000), Aguilar (2001), Mezquida and Marone (2001), Surrage (2004).

0.949 (these authors estimated separately the DSRs during the egg-laying and incubation periods). The same authors estimated for the many tyrant flycatchers they studied mean incubation and nestling DSRs of 0.922 and 0.950, respectively. Also in Argentina, Mason (1985) found an incubation DSR of 0.940 for the Vermilion Flycatcher (*Pyrocephalus rubinus*).

Birds of the Cerrado region usually have low reproductive success. Cintra (1988) found for Ruddy Ground-Dove (*Columbina talpacoti*) an incubation DSR of 0.956 and a nestling DSR of 0.962 ($n = 177$ nests). For White-banded Tanager (*Neothraupis fasciata*), Alves and Cavalcanti (1990) estimated an incubation DSR of 0.985 and a nestling DSR of 0.927 ($n = 14$). Surrage (2004), studying Lesser Elaenia (*Elaenia chiriquensis*) in the ESECAE during the same period, found an incubation DSR of 0.948 and a nestling DSR of 0.944. The percentage of successful nests, estimated by the Mayfield method, was 21%. Amaral and Macedo (2003) estimated for Curl-crested Jay (*Cyanocorax cristatellus*) a simple percentage of successful nests of 25% ($n = 8$).

The two methods of estimating reproductive success used in this study showed large differences between their results. The largest difference was observed for Campo Suiriri, with an estimated reproductive success of 32% calculated as a simple percentage and 19% by the Mayfield method. Such disparity is due to the fact that 24% of Campo Suiriri nests already had nestlings when found, which resulted in an overestimate of reproductive success. The differences observed between the two methods were smaller for Chapada Flycatcher because all nests were found during their construction or soon after the start of incubation, reducing the bias associated with the simple percentage method (Mayfield 1961, 1975).

The high level of botfly parasitism seems to be common in ESECAE birds. Many other passerines were also observed to be parasitized during this study: Southern Scrub-flycatcher (*Sublegatus modestus*), Fork-tailed Flycatcher (*Tyrannus savanna*), Chalk-browed Mockingbird (*Mimus saturninus*), White-rumped Tanager (*Cypsnagra hirundinacea*) and White-banded Tanager. In one case, we removed around 110 pupae lodged in a nest of Southern Scrub-flycatcher. Such high parasitism resulted in the death of the two nestlings.

However, among 110 nests of Lesser Elaenia monitored in the study area during the course of this study, only one nest was infested (Surrage 2004). These nestlings were in deplorable health, with wounds covering their bodies and clear signs of undernourishment. All species mentioned above were parasitized by intradermal haematophagous botfly larvae, accordingly to the classification of Couri (1999). Cases of botfly parasitism in *Suiriri* species have not previously been reported (Teixeira 1999).

The mean number of Diptera larvae infesting each nestling is very difficult to determine, because during the brief examination conducted in this study we were only able to verify whether the bird was or was not infested. Furthermore, larvae in different stages of development were simultaneously observed, which precluded a precise count. Keeping nests in sealed plastic bags proved to be an alternative tool for estimating the mean number of parasites per nestling. The only precaution that must be taken is not to pack damp nests, because this could promote a large fungal growth that may preclude fly emergence.

It is probable that parasitism was responsible for even higher nest losses, because this fate may be confounded with nest predation. In two nests of Chapada Flycatcher considered as predated (nestlings disappeared) a high level of parasitism was also observed – around 30 larvae per nestling in one nest. Another problem was that Campo Suiriri nests were sited in taller trees than those of Chapada Flycatcher (Lopes and Marini 2005), which made monitoring them substantially more difficult. As a consequence some losses due to parasitism might have been overlooked, because dead individuals could be eaten by a scavenger or, if they fell to the ground, be buried by beetles or termites (L. E. L. pers. obs.). A high impact of botfly parasitism among passerines was also demonstrated by Arendt (1985a, b) in Puerto Rico, suggesting that new studies are necessary to appraise the real impact of *Philornis* flies on the reproductive success of *Suiriri* species.

Both species were tolerant to the presence of the researchers and even to egg and nestling handling. As a consequence, no nest was abandoned during the egg or nestling period. Nevertheless we do not recommend handling of nestlings aged 15 days or older because they could leave the nest prematurely and die. There are some doubts whether nests considered as abandoned had experienced such a fate. In the four nests found at the end of construction, we observed a female perched in the same tree, carrying vegetable fibres in its bill. For all these pairs we found another nest being constructed less than 1 week later. A possibility that could not be discarded is that these nests were found soon after predation, and that adults were removing nest material for reuse – a common habit of both species (Lopes and Marini 2005). In the only case where a nest was abandoned in the early stages of construction, the Chapada Flycatcher female disappeared and was promptly replaced by an unbanded one.

The low reproductive success experienced by both species, especially Chapada Flycatcher, which is a rare and locally distributed species (Lopes 2005), causes concerns about their conservation status. Given the small sample size obtained here, only long-term demographic studies, with a larger sample size and in other locations, will allow us to determine whether such low reproductive success may represent a threat for these birds. Besides nest predation and botfly parasitism, another possible threat to this species is nest parasitism by the Shiny Cowbird (*Molothrus bonariensis*) that parasitizes natural nests in the borders of ESECAE (França and Marini in press), where we did not sample.

Chapada Flycatcher, in contrast to Campo Suiriri, which also breeds in the urban area of Brasília, seems to show a high sensitivity to habitat disturbance. We did not record Chapada Flycatcher in several disturbed areas where Campo Suiriri was observed, such as Padre Bernardo municipality (Goiás state) and Pedro Afonso (Tocantins state). Furthermore, we did not detect Chapada Flycatcher in large areas of apparently suitable habitat, such as the Jalapão State Park (Braz *et al*. 2003), one of the largest and best preserved Conservation Units in the Brazilian Cerrado. The absence of the Chapada Flycatcher from many areas of the ESECAE also suggests that it might have subtle habitat requirements for feeding or breeding.

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