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ARTICLE

# Artificial incubation and introduction of a Collared Forest-Falcon *Micrastur semitorquatus* chick into a natural nest in Southern Pantanal, Brazil

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**ABSTRACT:** The Collared Forest-Falcon *Micrastur semitorquatus* is a widespread, relatively common species occurring throughout most of Brazil. Very few data exist on its breeding biology, but it is known to nest mainly in natural cavities of large trees, usually made by other bird species. In this study we report a case of a Collared Forest-Falcon that hatched in an artificial incubator and was introduced into a natural nest previously known with three chicks of same species and similar age. The introduced chick was successfully accepted and fed by the adult parents for more than 15 days, until our last visit to the nest. Although the study case presented here required the existence of an active nest of the same species for an introduction of the chick, it was an alternative, low-cost way to ensure the success of the nestling and avoid the probability of imprinting during the time expended rearing the chicks *in situ*.

**KEYWORDS:** behavior, Falconidae, management, nestling and reproduction.

## INTRODUCTION

The Collared Forest−Falcon *Micrastur semitorquatus* is the largest of the seven currently known species of the genus (White *et al*. 1994; Ferguson-Lees & Christie 2001; Whittaker 2002). It ranges from Mexico through Central and South America, inhabiting lowland tropical rainforest, as well as semi−deciduous and second−growth forests (White *et al*. 1994). Very few studies exist on its natural history (Thorstrom *et al*. 1990; Thorstrom *et al*. 2000), and concerning its reproductive behavior the scarce accounts in the literature are mostly from Central America (White *et al.* 1994; Thorstrom *et al.* 2001).

The first published information on a forest−falcon nest date is from the early 1970's (White *et al*. 1994). Species of the genus *Micrastur* are often monogamous, known to nest in pairs and to occupy natural tree cavities for breeding (Sick 1997), although there are a few reports of the species nesting in abandoned human habitations (Carvalho-Filho *et al.* 1998) and natural caves (Vallejos *et al.* 2008). Concerning *M. semitorquatus*, it nests in natural cavities of large mature trees, where it lays one to three eggs, between March and April in Guatemala (Thorstrom *et al.* 1990; Thorstrom *et al.* 2000; Thorstrom *et al.* 2001) and between September and November in Brazil (Guedes 1993; Carvalho-Filho *et al.* 1998; Ferguson-Lees & Christie 2001; Carrara *et al*. 2007; Vallejos *et al.* 2008). In the Pantanal region, the Collared Forest−Falcon is a potential competitor for natural cavities with Hyacinth Macaw *Anodorhynchus hyacinthinus,* Laughing Falcon *Herpetotheres cachinnans*, and other species (Guedes 1993; Guedes 2011; Barbosa *et al*. in press).

The diet of *Micrastur semitorquatus* is known to be composed mainly of small vertebrates, such as mammals, birds, and lizards (White *et al.* 1994; Ferguson-Lees & Christie 2001; Carrara *et al*. 2007). In the Brazilian Pantanal, the crew of the Hyacinth Macaw Project have worked for the past 20 years monitoring *Anodorhynchus hyacinthinus'* nests and have made occasional observations of adults Collared Forest-Falcons feeding their chicks with birds and lizards, whose bones and feathers were left inside the nests (Guedes 1993, 2011). During our study, adults *M. semitorquatus* were observed with lizards such as Giant Ameiva *Ameiva ameiva* and Gold Tegu

*Tupinambis teguixin*, as well as an unidentified nightjar (Caprimulgidae) and many bodies of prey with distinct feathers, some clearly identified as Plush-crested Jay *Cyanocorax chrysops*, Smooth-billed Ani *Crotophaga ani*, and Guira Cuckoo *Guira guira*.

Here we report the introduction of a chick hatched in an artificial incubator into a natural cavity nest occupied by three *Micrastur semitorquatus* chicks. We also present information about eggs, newborn chicks, and their diet both in the lab and field.

## METHODS AND RESULTS

The study was carried out at Refúgio Ecológico Caiman (19º51'–19º58'S, 56º17'–56º24'W), in the Pantanal of Miranda, Mato Grosso do Sul, Brazil, under the auspices of the Hyacinth Macaw Project. On 6 September 2007, we recorded an egg of *M. semitorquatus* in a natural cavity (Figure 1), previously occupied by an *A. hyacinthinus*. We returned to the nest on 3 October and after three days monitoring the nest, we attested that the parents left it unattended and abandoned for unknown reasons. Thus, on 6 October 2007, we collected the egg and transported it to the laboratory for artificial incubation.

The *M. semitorquatus* nest was in a Manduvi Tree *Sterculia apetala*, with an entrance roughly 4.5 m from the ground. The color of the egg laid was red–brown, with darker spots, corroborating the observations of other authors (Thorstrom *et al*. 1990; Guedes 1993; Carrara *et al*. 2007; Vallejos *et al*. 2008), measuring 5.69 x 2.37 cm, and weighing 60 g. The egg was maintained in a *Premium Ecológica* IP120 incubator with mean temperature of 37.2ºC and turned 180° each 12 h (according to Burnham 1983, with modifications). On 9 October the egg started to hatch, and on 13 October the chick emerged from the egg, after spending almost 24 hours to conclude the process. On hatching day, the chick weighed 40 grams and its measurements were as follows: 105 mm total length, 20 mm tarsus length, 215 mm wing length, 346 mm head length, and 153 mm bill length (exposed culmen). The chick hatched with closed eyes, although they started to open five hours later.

**FIGURE 1:** *Micrastur semitorquatus* egg laid in a Manduvi Tree *Sterculia apetala* cavity in Miranda, Mato Grosso do Sul, Brazil.

The nestling was fed from the second day on, four times a day, with the first feeding at 7 am and the last at 7 pm. The food offered was based on chicken and beef, with some eggshell powder for calcium supplementation, following the foreknown diet most used in captive Falconiformes and according to the food availability at the moment. The meat was cut in small pieces 1x1 cm and provided freely according to the chick's acceptance. The chick was weighed before feeding (Table 1). On 16 October 2007, three days old and weighing roughly 50 grams, the chick was transferred to a known active nest of *Micrastur semitorquatus* with chicks of similar size and age. During the following visit to the nest, two days after the introduction, the parents were absent but the four chicks appeared healthy (Figure 2a). The following day, one parent was observed inside the nest and all the four chicks had full crops, including the recently introduced chick. On 30 October, almost two weeks later, one parent was nearby defending the nest site and all four young still appeared healthy (Figure 2b).

Our last visit to the nest site was on 10 December, when the Collared Forest-Falcons were no longer present and the nest was occupied by a Muscovy Duck *Cairina moschata*. The successful acceptance of the introduced chick and the continued parental care of all nestlings confirms the effectiveness of the management strategy applied.

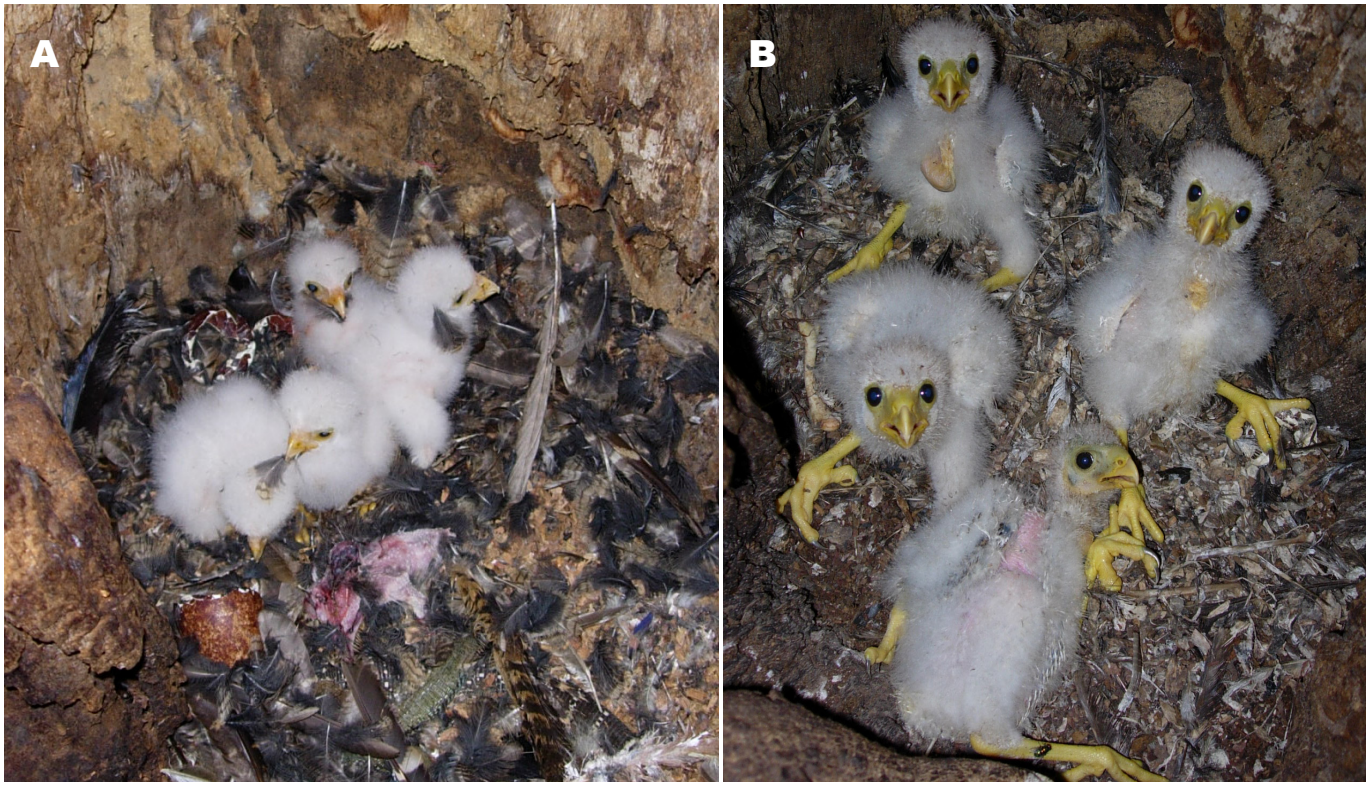


**FIGURE 2:** A) *Micrastur semitorquatus* chicks on the day of introduction. B) *Micrastur semitorquatus* juveniles two weeks after the introduction.

**TABLE 1:** Description of the time and food item offered for the chick of Collared Forest−Falcon (*Micrastur semitorquatus*) hatched in an artificial incubator.

| Date | Time | Chick weight (g) | Food type | Food (g) |
|---|---|---|---|---|
| 14/out | 07:30 | 38 | Chicken | 3 |
| 14/out | 10:38 | 40 | Chicken | 1 |
| 14/out | 14:20 | 40 | Chicken | 2 |
| 14/out | 18:40 | 41 | Chicken | 3 |
| 15/out | 06:30 | 40 | Chicken | 5 |
| 15/out | 10:30 | 44 | Chicken | 4 |
| 15/out | 12:50 | 48 | Ground beef | 3 |
| 15/out | 17:10 | 50 | Ground beef | 6 |
| 16/out | 05:45 | 51 | Ground beef | 6 |

## DISCUSSION

The egg transported to the lab for incubation was observed for a period of 37 days from our first observation of the nest in the wild until the chick emerged from the egg, a period longer than observed in Brazil by Guedes (1993) and in Ecuador by López-Lanús (2000), which was 30 and 27 days, respectively. However, the incubation period in Guatemala was even longer, lasting from 46 to 48 days (White *et al.* 1994; Thorstrom *et al.* 2000). Another difference observed between the artificial incubated egg and a natural one was the time expended for the nestling to open its eyes, which occurred five hours after hatching and has been observed to last roughly three days in the wild (Thorstrom 2001).

*M. semitorquatus* is known to lay one to two eggs per clutch (Guedes 1993; Carrara *et al.* 2007). However, in this study we recorded a natural nest with three chicks. Unfortunately we were not able to make more frequent monitoring trips to the nest with the four chicks, but the absence of the almost two-month-old fledglings indicates that the young likely left the nest naturally. Even though the nesting success could not be estimated (see protocol in Mayfield 1961), the evident acceptance of the introduced chick indicates the effectiveness of the method employed.

The Pantanal is under constant pressure of deforestation and slash and burn activities, which changes the natural environment and affects the survivorship of all biotic communities (Harris *et al.* 2005). One of the effects is the lack of natural cavities in big trees, an important nesting resource for many bird species, notably the large ones like macaws and raptors (Guedes 2011). The use of the same natural cavity by three different bird species (Hyacinth Macaw, Collared Forest-Falcon, and Muscovy Duck) in the same reproductive period, emphasizes the importance of such cavities for the reproduction of many species in the region. For this reason, the observation reported herein demonstrates the need for more studies on the breeding behavior of cavity-nesting species in the Pantanal.

Although the procedure of introducing a chick into a natural nest requires the existence of other active nests of the same species—with foster parents as well as eggs and nestlings in the same stage of development—it also emphasizes the importance of reintroducing a species in nature at an early age. It is a low-cost management strategy that avoids problems inherent to the re-introduction of captive-reared birds, such as imprinting, *ex situ* rehabilitation work, juvenile survival, and individual stress levels (Brown *et al.* 2006; Evans *et al.* 2009; Massei *et al.* 2010). The majority of studies of translocation, rehabilitation, and re-introduction of raptors were conducted with species that were listed as threatened or endangered and were very costly (Fischer & Lindenmayer 2000; Nicoll *et al.* 2004; Campbell-Thompson *et al.* 2012). Although, some smaller-scale, lower-cost cases have been effective, like the successful translocation of an Ornate Hawk-Eagle *Spizaetus ornatus* nest with its nestling after the flooding of the nesting site (Joenck *et al.* 2013). While not currently listed as a threatened species, this case of the Collared Forest-Falcon fits as an excellent model for the development of more elaborate protocols for the rehabilitation of raptor chicks rescued without a natural parental care option.

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