PARENTAL CARE IN THE BUFFY-TUFTED-EAR MARMOSET (*Callithrix aurita*) IN WILD AND CAPTIVE GROUPS

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ABSTRACT

Studies on cooperative care of offspring in callitrichid primates are biased in favor of observations in captivity. In the wild, however, individuals have to deal with environmental pressures, which may influence their social behavior. We compared the individual effort attributed to parental care offered by members of a wild group (couple, plus a subadult helper) and two captive groups (A: couple, plus an subadult helper, B: couple, plus four adult helpers) of the buffy-tufted-ear marmoset, *Callithrix aurita*, from weeks 1-12 after the infants' birth. The carrier (breeding male and female or helper) and the infant's feeding (food sharing and foraging for food) were recorded. Up to week four, while the wild breeding pair shared infant carrying at similar proportions, the male from captive group A carried 100% of the time. Adult helpers from group B were the main carriers. Carrying behavior extended up to week 12 only in the wild group. Food provisioning to the infant was observed earlier in the groups wild and A, but general proportion of feeding records was lower in the wild than in captivity. Energetic cost of travelling and searching for food may be associated with equal division of carrying behavior by the wild breeding pair. Higher proportions of carrying in the groups wild and B may have delayed the development of the infants' motor skills required in foraging. Our data agree with previous studies: the father's lower investment in carrying when adult helpers are present and lower contribution of subadult non-reproductive members.

Key words: parental care, *Callithrix aurita*, carrying, wild, captivity.

RESUMO

Cuidado parental em grupos de sagüis-da-serra-escuros (*Callithrix aurita*) silvestre e de cativeiro

Estudos sobre cuidado parental em primatas calitriquídeos têm sido conduzidos principalmente em cativeiro. Na natureza, os grupos estão expostos às pressões ambientais, as quais podem influenciar o comportamento social. Comparamos a contribuição individual no cuidado parental oferecida por membros de um grupo silvestre (casal com um ajudante subadulto) e dois grupos de cativeiro (A: casal com um ajudante subadulto, B: casal com quatro ajudantes adultos) de sagüis-da-serra-escuros, *Callithrix aurita*, entre as semanas 1 e 12 a partir do nascimento das crias. Foram registrados o carregador (macho e femêa reprodutores ou ajudantes) e os eventos de aquisição de alimento sólido pelo filhote, em partilha ou através do forrageio. Entre as semanas 1 e 4, enquanto o par silvestre dividiu o esforço eqüitativamente, o macho adulto do grupo A carregou 100% do tempo. Os ajudantes adultos foram os principais carregadores do grupo B. O carregamento se estendeu até a semana 12 apenas no grupo silvestre. A aquisição de alimento pelo filhote iniciou-se primeiramente nos grupos silvestre

e A, mas a proporção total do número de registros foi menor na natureza. Os custos do deslocamento e forrageio podem estar associados à divisão igualitária do transporte pelo par silvestre. Maiores freqüências de transporte nos grupos silvestre e B podem ter provocado um atraso no desenvolvimento das habilidades motoras dos filhotes, as quais são necessárias no forrageio. Os dados concordam com estudos anteriores: menor investimento no transporte pelo macho reprodutor na presença de adultos ajudantes e baixa contribuição de ajudantes subadultos no carregamento.

Palavras-chave: cuidado parental, *Callithrix aurita*, transporte, natureza, cativeiro.

INTRODUCTION

Communal care of dependent offspring by group members other than the mother is the most conspicuous social characteristic in callitrichid primates. The evolution of communal care has been explained by the high energetic costs to the breeding female of raising infants twice a year. In most of the births, she bears twins which have nearly 20% of an adult weight (Leutenegger, 1980; Goldizen, 1990). Meanwhile, Caine (1993) believes that the vigilance against predators might have coevolved with cooperative breeding. Infant carrying, the most frequently observed form of parental care, is performed by the breeding pair and helpers (older siblings and others non-reproductive members, including those unrelated to the infants). Studies on captivity on different species of callitrichids indicate that prior to the fourth week, carrying behavior occurs on 85% of the time, and gradually decreases between the fourth and the tenth week of the infant's life (Box, 1977; Tardif *et al*., 1993).

Different mechanisms have been described to explain the effort of group members on infant carrying. For instance, it has been suggested that the extent to which the breeding male participate on infant carrying might change according to the presence of helpers. It has been documented a negative correlation between the number of adult helpers and infant transport by the father (McGrew, 1988; Tardif *et al*., 1990; Price, 1992a; Santos *et al*., 1997). The engagement on infant carrying by the breeding female, on the other hand, may be affected by litter size, maternal condition, and parity (Price, 1992a; Tardif *et al.*, 1984). Helpers' age and their previous experience on infant care can affect their performance on carrying behavior (Ingram, 1977; Cleveland & Snowdon, 1984; Price, 1992b). Studies on *Callithrix jacchus* have shown that, in general, the patterns of infant carrying are similar in free-range and captive groups, but helpers must be an important resource for wild pairs (Yamamoto *et al.*, 1996; see Snowdon, 1996, for a review).

Food provisioning, another form of communal care among callitrichids, has been described as an important adaptation which increases the chances of infant's survival (Terborgh & Goldizen, 1985; Ferrari, 1987; Feistner & Price, 1991). Differences in the social environment could play a role on food provisioning, and on infant development as well. In this context, it has been suggested that group size has a favorable effect on infant independence and acquisition of solid items throughout food sharing, since more individuals in a group would mean more opportunities for the infant to be cared (Ferrari, 1987; Feistner & Price, 1991; Price, 1992a). Meanwhile, the skills needed to search, capture and manipulate food items, especially invertebrate prey, must be developed by the infant during the first months of life. For instance, Ferrari (1987) reported that young *Callithrix flaviceps* were first observed capturing animal prey only at their seventh month of age.

Environmental conditions may influence the social behavior. In the wild, individuals have to deal with costs of locomotion, foraging for food, competition for resources and seeking protection against predators and during harsh weather conditions, which are absent in captivity. Intraspecific comparative analyses of parental care between captive and wild groups are rare. In the present study we analyzed the influence of social and environmental conditions on the patterns of parental care of a wild and two captive groups of the buffy-tufted-ear marmoset, *Callithrix aurita*. We hypothesized that the reproductive male's investment on carrying should be lower in groups with at least one adult alloparent than in groups formed by the couple and an young alloparent. We also expected that captive infants should feed on solid food earlier than wild ones, since in captivity individuals have

food items at their disposal and do not deal with food searching. Our results are compared to previous studies on callitrichid cooperative breeding.

MATERIAL AND METHODS

Studied Groups

The social composition of the three observed groups is described on Table 1. All individuals from the captive groups were related to each other, but kinship relations among members from the wild group were unknown. Data on the free-range group were obtained during a 12-month ecological study. This group occupied a secondary semideciduous forest fragment in Fazenda Lagoa, Minas Gerais, south-eastern Brazil. Both captive groups were maintained in cages (4 x 3 x 2 m) at the Rio de Janeiro Primate Center (CPRJ), situated in Guapimirim, Rio de Janeiro, south-eastern Brazil, managed by State Environmental Foundation (FEEMA). Food and water were supplied twice daily to the captive groups. Morning feeding consisted of bread enriched with vitamins, proteins, cereal, and milk; in the afternoon fruit and mealworms were provided.

TABLE 1

Description of the studied groups.

Groups	Group size[1]	Number of helpers[2]	Number of born infants
Wild	4	1SAF	1
A (Captive)	4	1SAF	1
B (Captive)	8	4AM	2

1. Includes the breeding pair, helpers and infants.
2. SAF = subadult female; AM = adult male.

Procedure

Individuals in the three groups were recognized by their distinctive natural features such as size and fur pigmentation. In the field, observations were made during the whole activity period of the group during 6-10 days each month, whereas captive groups were subjected to observation sessions of thirty minutes twice a week in varied daily hours. Data on parental behavior were collected from the first to the twelfth week after birth. Difficulties in the field prevented observation on the seventh and the eighth weeks.

Scan sampling (Altmann, 1974) at one and five-minute intervals was used throughout the study, respectively on the captive and wild groups. The infant was considered as being carried when most of its body was clinging on the carrier's body. On each sample, the carrier was identified as the breeding male and female, or helper. Feeding records of infants either eating by itself (foraging) or sharing food with another individual were recorded. Data collection were grouped in six blocks of two weeks each (1-2, 3-4, 5-6, 7-8, 9-10, 11-12), and the percentages of carrying and feeding records were calculated for each block.

RESULTS

Scores for carrying of a single infant are not strictly comparable with those of two infants. Yet, our general interest is the relative envolvement of each category of carrier in each birth. The wild breeding pair was observed sharing infant carrying at similar proportions until the sixth week (Fig. 1a). During the first and second blocks of weeks (1-2 and 3-4) the male carried, respectively 58% and 40%, while the female carried 40% and 57%. The contribution from the one-year-old subadult to carrying was only 5.8% on 5-6 weeks, and no carrying was observed for this individual during the previous weeks. Although the social composition and litter size were similar between the wild and the captive group A, equity on infant transportation between the male (40%) and female (33%) was only observed on weeks 5-6 (Fig. 1b). During the first two blocks of weeks, the adult male from group A was observed carrying the infant 100% of the time. Like in the wild group, the subadult sibling in group A had a small participation on carrying; it was observed engaged in this activity only 7% during weeks 7-8. As for the captive group B, the male adult helpers were the main carriers along all blocks of

weeks, varying from 42% to 87%. During weeks 1-2, the three categories of carriers showed almost similar frequencies of infant carrying (Fig. 1c).

Infant transportation extended up to the 12th week in the wild group, whereas in the captive groups (A and B) infants were fully independent in locomotion by that time (Fig. 1a, b and c). Meanwhile, from the fifth to the tenth weeks, the infants of group B were carried at a higher frequency than either the infant of group A and the wild group.

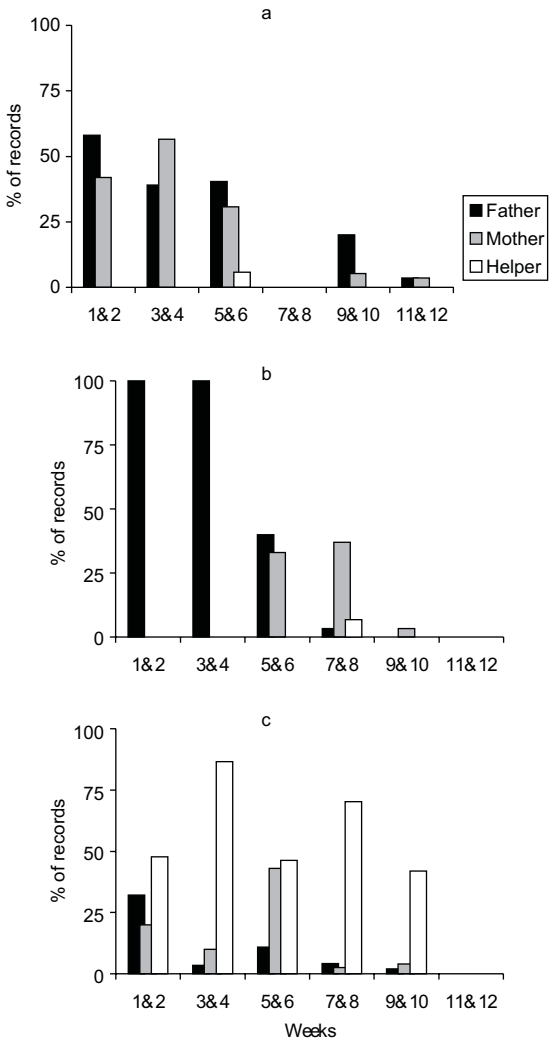

Fig. 1 — Percentage of records of infant carrying behavior by members category in the groups a) wild, b) captive A, and c) captive B.

In groups with similar social composition (wild and A), the initiation into eating solid items was observed earlier than in a more socially complex group (B, Fig. 2). General proportion of infant feeding records was lower in the wild group (6.6%) than in the captive group A (28.5%) and B (11.2%).

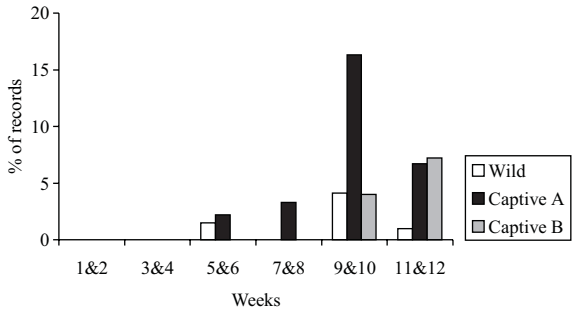

Fig. 2 — Percentage of infant's feeding record in the groups Wild, and captive A and B.

DISCUSSION

Despite the small sample size, which precluded a statistical analysis, our results showed tendencies in agreement with previous studies. Social composition interferred in the participation of fathers and helpers in transportation of infants. The father's lower investment in carrying when adult helpers were present, demonstrated for captive groups of other callitrichid species (McGrew, 1988; Tardif *et al*., 1990; Price, 1992a; Santos *et al*., 1997), were also observed here at group B. Similarly to the result obtained for free-range (see Terborgh & Goldizen, 1985; Goldizen, 1987; Yamamoto *et al*., 1996) and captive callitrichid groups (Ingram, 1977; Price, 1992b; Yamamoto *et al*., 1996; Santos *et al*., 1997), lower contribution to carrying by subadult alloparents (groups wild and captive A) relative to adult helpers (group B) was also recorded in our study. It is reasonable to expect that environmental pressures would cause wild breeding pairs without an adult helper to share equally the carrying burden, as it was recorded here. However, wild groups formed by a breeding pair and a sibling are rare among callitrichids, commonly regarded as extended families (see Ferrari & Digby, 1996). In this scenario, we may speculate that the male and female from the wild shared the infant transportation due to costs of locomotion during daily activities, whereas the captive female from group A held it almost exclusively during the suckling bouts.

In the present study, social conditions seem to interfere in the start of the process of food acquisition. Observations on both the wild and captive group A (one non-adult helper besides the breeding pair), revealed that infants were more motivated to obtain food by sharing and to forage for food by themselves earlier than in group B, which had many adult helpers. The higher number of potential carriers on group B appeared to create more opportunities for the infants to be carried until the tenth week, but not to increase their frequencies of food sharing or food searching. Although the infant from the wild group has shown solid food ingestion as early as the infant in the captive group A, the general feeding proportion of the former was the lowest recorded among all observed groups. We may speculate that, in both wild and captive B groups more carrying due to travelling and more individuals to take care could have caused a delay on acquisition of solid food by the immature infants. Our suggestion disagrees with Ferrari (1987) and Price (1992a) who inferred that more helpers must increase the chances of food sharing by the infant with its caretakers. Because data on food sharing and foraging were both considered here, an alternative view can be proposed. Infants carried longer may also show a delay on locomotion, which in turn could affect the development of the necessary skills, especially on food searching and manipulation. Few studies have been conducted on this species until now. The results presented here suggest that more investigations on callitrichid infant development are needed, since social and environmental differences may act on the performance of parental care.

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