Fecal Collection in Free-ranging Common Marmosets, *Callithrix jacchus*

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Introduction

The development of techniques to determine steroids in feces has made it possible to obtain data on the biology of reproduction for different species living in natural conditions (Clarke *et al.*, 1991; Van Schaik, 1991; Shideler *et al.*, 1994, 1995; Ziegler *et al.*, 1994; Strier and Ziegler, 1997, among others) with considerable repercussions on the study of endangered species. For *Callithrix jacchus,* the use of fecal steroids to study the reproductive conditions of females was validated by Ziegler *et al.* (1996), while the diurnal variation in progesterone and cortisol – but not for estradiol – in feces was demonstrated by Sousa and Ziegler (1998). In order to establish the use of fecal sampling as a routine procedure for common marmosets, the habits of defecation of the animals, as well as the influence of physiological and environmental variables interfering with sampling, need to be known in order to prevent discontinuity of hormonal monitoring. The aims of this paper therefore are to investigate if parturition and environmental changes such as temperature and rainfall could interfere with the timing of the first fecal discharge in females living in free-ranging groups.

Methods

Animals
Feces were systematically collected from six adult females of two groups: QT (n = 4) and PB (n = 2). The composition of the QT group changed during the two periods of fecal collection, ranging from 12 to 15 individuals of different ages (adults, subadults, juveniles and infants). See Table 1 for details about the groups.

Only the time of first defecation was recorded and considered for statistical data analysis. However, since we were monitoring hormone levels in these females, when the observer was unable to collect the first fecal discharge, the second or third sample was collected, as long as it was excreted before 0900 h.

Another important cautionary measure taken when collecting feces from wild marmosets was the need to monitor where the animals slept the night before fecal collection. In order to collect the first sample, the observer must already be waiting under the sleeping tree when the animals wake up. The observer must be attentive because the animals usually defecate at the beginning of their active phase, and he/she must continue to observe the animals closely until the first defecation occurs. During the first period of fecal collection from the QT group (August, 1996 to November, 1997) the animals slept in the same tree during the entire period, whereas in the second period (April, 1998 to June, 1999) they used five different trees for sleeping.

The other group monitored was the PB group, which used six trees during the period of fecal sampling (December, 1997 to April, 1999). Only two females were monitored at the same time in each group by one observer since they defecated almost at the same time and the observer needed to be aware of where the feces fell. Fecal material was usually collected under the tree where the animals slept, but on some occasions the observer had to use a ladder to pick up feces caught on leaves.

Statistical analysis
The Student *t* test was used to compare the time of first defecation of females living in the wild before and after parturition. The Pearson test was performed to correlate the time of first defecation with the variation in temperature and rainfall. In both tests the p value was set at 0.05.

Results

In the natural environment, fecal collection was not always possible due to the interference of environmental conditions such as heavy rainfall, high trees or a high density of leaves, which sometimes impaired the identification of the animal or the localization of the fecal matter. In fact, during the fruiting season, feces were composed almost entirely of seeds, with the consequent difficulty in obtaining enough fecal material to make up the minute amount of 0.1 g required for the technique. Another problem faced was when the animals changed the tree where they slept, their presence being detected only when they had already defecated from a nearby tree. In these cases, the animals were followed until they produced another sample, while using 0900 h as a time limit for collection. There was relation between the time the animals left the sleeping tree and the time the samples were collected (n = 79; r^2 = 0.033; p = 0.110).

For three females living in the natural environment, the time of first defecation in the morning changed slightly, being late on the day before or the day after parturition. However, these changes were evidently not associated only with parturition, since they occurred independently of this activity. Statistical analysis using the *t* test did not show any differences when the time of sample collection was compared two weeks before and after the birth of the infants (t = 2.87; p = 0.61). We monitored seven parturitions, three from dominant reproductive females and one from a subordinate (probably daughter) female of the QT group, and two from the dominant female and one from a subordinate female of the PB group (Figure 1).

A weakly negative correlation was found between the time of first fecal discharge and environmental temperature for both groups (QT: r^2 = -0.267; p = 0.000; PB: r^2 = -0.213; p = 0.018). On the other hand, a positive correlation was detected between rainfall and first defecation, but only for the QT group (r^2 = 0.150; p = 0.006; PB: r^2 = 0.060; p = 0.506).

Discussion

The results of this study demonstrate that there is homogeneity in the time of first defecation in common marmosets, a fact that facilitates long-term hormonal monitoring using fecal material from wild animals. This finding is similar to that obtained by Sousa and Ziegler (1998) for captive females, and the highest frequency of defecation at the beginning of the day is probably associated with feeding activities which are very frequent at this time. According to Alonso and Langguth (1989) common marmosets begin the day eating fruits, followed by foraging of animal prey. Camarotti and Monteiro da Cruz (1997), studying the activity patterns of common marmosets, found that around 30% of the time was spent in foraging and feeding during two hours immediately before the groups went to the sleeping tree and two hours after leaving the sleeping tree.

Table 1. Free-ranging group compositions of *Callithrix jacchus* in the beginning of fecal collection of females.

	Animal	Sex	Age Months	Relatedness	Birth month	Period of fecal collection
QT group 1	GRE	F	>24	Reproductive female	_	10/08/96 - 20/09/97
	GOE	M	>24	Reproductive male	_	
	GIO	F	>18	_	_	21/08/96 - 12/11/96
	GAB	F	>18	_	_	
	GUS	M	>18	_	_	
	GRA	F	>18	_	_	04/09/96 - 24/09/97
	GILD	F	17	Offspring of GRE/GOE	Apr/95	
	GAR	F	17	Offspring of GRE/GOE	Apr/95	
	GIG	F	11	Offspring of GRE/GOE	Oct/95	
	GIS	F	6	Offspring of GRE/GOE	Mar/96	
	GER	F	6	Offspring of GRE/GOE	Mar/96	
	GIOV	M	>1	Offspring of GRE/GOE	Aug/96	
	GEO	M	>1	Offspring of GRE/GOE	Aug/96	
	GOD	M	*	Offspring of GRE/GOE	Jul/97	
QT group 2	GRE	F	>40	Reproductive female	_	20/04/1998 - 04/06/99
	GOE	M	>40	Reproductive male	_	
	GUS	M	>18	_	_	
	GER	F	25	Offspring of GRE/GOE	Mar/96	20/04/98 - 08/05/99
	GIS	F	25	Offspring of GRE/GOE	Mar/96	16/12/98 - 15/02/99
	GIOV	M	20	Offspring of GRE/GOE	Aug/96	
	GEO	M	20	Offspring of GRE/GOE	Aug/96	
	GOD	M	9	Offspring of GRE/GOE	Jul/97	
	GIL	M	4	Offspring of GRE/GOE	Dec/97	
	GIB	M	4	Offspring of GRE/GOE	Dec/97	
	GAB	M	*	Offspring of GRE/GOE	Jun/98	
	GLE	F	*	Offspring of GRE/GOE	Jun/98	
	GED	M	*	Offspring of GRE/GOE	Jan/99	
	F2	?	*	Offspring of GRE/GOE	Jan/99	
	F3	?	*	Offspring of GER	Feb/99	
	F4	?	*	Offspring of GER	Feb/99	
PB group	PAT	F	>24	_	_	18/12/1997 - 06/10/98
	PAL	F	>24	_	_	24/12/97 - 01/08/98
						11/10/98 - 08/04/99
	PIT	F	>18	_	_	
	PLA	M	>18	_	_	
	PIT	M	>18	_	_	
	PTO	M	1	Offspring of PAT	Nov/97	
	PAM	F	1	Offspring of PAT	Nov/97	
	F1	?	*	Offspring of PAT	Mar/98	
	F2	?	*	Offspring of PAT	Mar/98	
	PIA	M	*	Offspring of PAT	Apr/98	
	POP	M	*	Offspring of PAT	Apr/98	
	PLI	M	*	Offspring of PAT	Feb/99	
	PIN	M	*	Offspring of PAT	Feb/99	

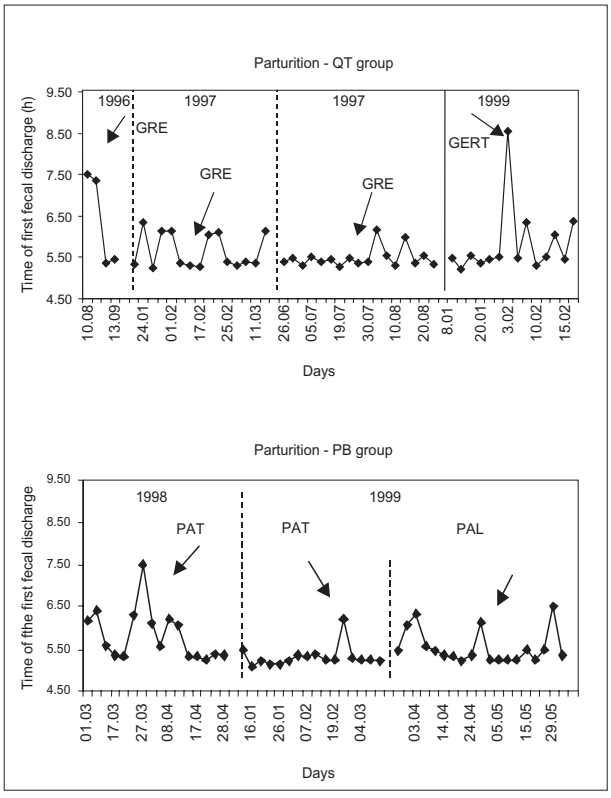

Figure 1. Mean time [+ SEM] of the first fecal discharge of females 2 weeks before and after parturition of females living in free-ranging groups. Arrows indicate the day of parturition. For group QT three parturitions were of female GRE (dominant female) and one of GERT (subordinate female). For group PB, the two first parturitions were of female PAT and the last one of PAL (subordinate female).

Torii *et al.* (1998) stated that the selection of the sampling method for hormonal studies is essential, and they suggest urine collection from common marmosets as an excellent source of endocrinological data. However, for studies in the wild it is not possible to collect urine because these animals are small and the voided urine usually drops on the branches or cannot be collected because it is rubbed during scent-marking behavior. Common marmosets are small primates and use the middle strata of the forest (Stevenson and Rylands, 1988), preventing the systematic collection of urine. As such, fecal sampling is the best alternative for monitoring endocrine parameters in small primates for extended periods. During this study, we were able to collect feces from common marmosets living in an experimental plantation area or on forest edge. Feces are more difficult to collect in closed forest areas.

Delay in the first defecation is related to a drop in environmental temperature and rain. Although day length does not vary in the tropics as it does in temperate regions, it has been found to affect activity patterns in these marmosets (Moreira *et al.*, 1996; Sousa *et al.*, 1999; Menezes *et al.*, 2000), and environmental cues may be influencing the expression of physiological functioning (Moore-Ede *et al.*, 1982), in this case defecation patterns. Besides lower temperatures and rain, defecation may be slightly advanced or delayed during the peri-parturition interval, but not to the extent that it interferes with extended data monitoring in free-living common marmoset females.

In conclusion, our findings demonstrate that fecal collection can be used for long-term endocrinological studies on free-ranging common marmosets females. This method is useful for small primates, and can contribute to hormonal monitoring in species which are difficult to maintain in captivity, and for endangered species contributing to an understanding of reproduction and reproductive patterns, vital for demographic management.

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Neotropical Ethnoprimatology: An Annotated Bibliography

Bernardo Urbani

This bibliographic review was compiled after the introduction of the word "Ethnoprimatology" by Leslie E. Sponsel (1997). I am including papers which take in Sponsel's concept, all of them restricted to the Neotropics. In annotating these reference, the following entries are included: Ethnic group(s) / Primate species / Key word(s) / Locality(ies) / and Country(ies). The selected works are only those which have ethnoprimatology as a central theme, other ethnozoological studies which mention primates among other mammals are not listed.

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