

Z. Säugetierkunde 53 (1988) 1–6
© 1988 Verlag Paul Parey, Hamburg und Berlin
ISSN 0044-3468

Reproductive reorganization in incomplete groups of the common marmoset (*Callithrix jacchus*) under laboratory conditions

By A. KÖNIG, H. ROTHE, MARGARETHA SIESS, K. DARMS, DAGMAR GRÖGER,
UTE RADESPIEL and J. ROCK

Institute of Anthropology, University of Göttingen

Receipt of Ms. 22. 12. 1986

Abstract

Incomplete groups of *Callithrix jacchus* which exclusively consist of genetically related members show a rather considerable frequency of inbreeding. Therefore, the incest taboo seems to be realized at a very low level, eventually due to the laboratory environment. *C. jacchus* daughters are able to conceive in the presence of their mother. This result confirms to some extent the previous assumption upon a hierarchy dependent monogamy in the common marmoset. The reproductive reorganization of groups which have genetically unrelated members exclusively relies on these animals.

Introduction

Most authors believe marmosets to be monogamous (e.g. ROTHE 1979). BISCHOF (1985) describes their mating and reproductive organization as 'aristogamy' since only the highest ranking group members (= parents) are allowed to interact sexually and to reproduce. Only from one species, i.e. *Saguinus fuscicollis*, we have some information from field observations that tamarins might be organized in cooperative polyandrous groups (TERBORGH and GOLDIZEN 1985).

Following the loss of one or both parent(s) monogamous groups are at first confronted with a temporary or even permanent loss of their ability to reproduce. The reproductive reorganization can be achieved by a subsequent breeding of the remaining parent with one of the adult offspring, however, undergoing by this all risks and disadvantages of inbreeding. On the other hand, reproduction can be continued by integration of a strange adult conspecific.

Reproduction of the group ceases completely if neither inbreeding nor integration of a strange conspecific occurs. The same is true if the group dissolves by emigration of single family members or even subgroups.

Up to now we do not have any detailed information on the strategy free ranging groups will follow when afflicted by the loss of one or both parents. Under laboratory conditions incomplete families as a rule cannot decide for a strategy of reproductive reorganization which includes gene flow by integration/immigration of a strange conspecific. That mode of regaining reproductive ability is only possible by interference of the investigator (ROTHE et al., in press).

In this paper we confine to a description of inbreeding in the common marmoset and mechanisms of its avoidance.

Material and methods

The data were taken from the diary of our marmoset colony and from observations during the daily routine work (e.g. observations on sexual behaviour). Informations on stability/instability of the respective families exclusively refer to those contexts which led to the expulsion or removal of one or even more group members (for details see ROTHE et al., in press).

We analyzed 20 *Callithrix jacchus* groups which lived at least for another two months following the loss of their mother or at least two months after the last delivery of the mother in groups, whose α -male has died. The period of two months has been determined empirically, that is, we have made the observation that groups experienced dissolution shortly after the death of the α -female or the α -male (some days up to half a month). Therefore the chance to observe sexual behaviour has been very low. Furthermore all groups we describe in this paper had adult and fertile offspring.

According to group composition we distinguish three categories: 1. groups which consisted of related members only (parents and their offspring) ($n = 15$). 2. groups with nonrelated members: a. by integration of hand- and/or foster mother reared infants/juveniles ($n = 4$); b. by integration of an adult male in an all-female group (mother and four daughters) ($n = 1$).

Additional informations are given on two special groups which showed different basic parameters compared to the other families, but which revealed inbreeding as well.

Results

With the exception of the special groups six families (30 %) showed further reproduction (one to three litters). In two families we at least observed sexual behaviour.

Groups with related members exclusively ($n = 15$)

Reproduction continued in four groups. One of these became unstable after the loss of a parent whereas this was true for 75 % of those incomplete families which have ceased reproduction (Table 1). One group experienced unstable periods following the next delivery (Table 1). Table 1 refers to the group composition as well as to the dates of the breeding females' conceptions. It is quite obvious that the unstable groups showed the longest break in reproduction. Group M is characterized by a special history (s. Table 1). The α -female has been sick for the last six months preceding her death. During that time she got rather regularly medical therapy. Already during her mother's illness an adult daughter has been impregnated by her father. The resulting delivery occurred three months following the α -female's death. EPPL (1967) refers to a similar event in her *C. jacchus* colony.

Groups with genetically unrelated members ($n = 5$)

One group which had altogether three (2.1) integrated members (hand and foster mother reared infants) did neither show sexual nor reproductive behaviour. This group was remarkably unstable, however, we also recruited group members for pair formation. In two groups we observed copulations. Both families have been unstable periodically. After the death of the α -male copulations occurred between the α -female and one of the genetically unrelated, meanwhile adult male group members. However, we could not detect any sexual intercourse between the mother and her adult sons. In another group a young female (11 months old) which had been integrated as infant into this family became pregnant after 45 days. This female was considerably younger than an adult daughter of the α -male, with whom the male did not interact sexually. In a third group we observed copulations between an adult male which has been integrated into the family some months ago and one of the oldest females shortly after the death of the α -female. About seven months after the death of the mother the female gave birth to triplets (see also ROTHE et al., in press).

Table 1. Groups with related members exclusively

<http://www.biodiversitylibrary.org/>

group	loss	α-f	preg- nant	age group (mo)	sex	age/sex ratio	ad	yad	sub	iuv	inf	expulsion of GM: before loss n days	after birth days	conception: days after loss (mo)	birth n	remarks			
M	α-f	--	33	6.2	m*	mf*mf	mm			m	-	-	2	100 174	8 82	2	conception approx. 50 days before loss of α-f		
N	α-f	--	36	3.2	m*	mf*	-			-	-	-	-	-	-	1	father unknown, group dissolved		
C	α-f	--	97.5	5.6	f ^m *m mf*	ff	mf			-	3	112 77 152 43	3 2 164	--	187	75	last delivery one month before loss of α-m; at first expulsion hunter caught; two GM recruited		
CF	α-m	--	--	1.1	-	m*f*	-			-	-	-	-	26	20	1	mf descended from special group, see text; α-f died 10 mo before; mf not yet fertile		
B2	α-m/f	--	66	3.6	f ^m f mf	ffff	mm			-	-	-	4	8 89 107	--	--	-	group was divided after fighting; on day 8 two GM expelled; comp. diss.: 10 mo	
F1	α-m/f	--	29	1.2	f	fm	-			-	2	12	6	--	--	--	-	ad f daughter from F; α-f died 7 days after loss of α-m and some GM; comp. diss.: 2.5 mo	
G	α-f	--	29	4.1	m	mmf	-			-	-	-	2	9 48	--	--	-	comp. diss.: 24 mo	
J	α-f	--	51	4.3	mm	mfmf	-			-	-	-	1	5	--	--	-	at first expulsion hunter caught; α-m died two mo after α-f; comp. diss.: 6 mo	
M1	α-f	--	16	3.2	mm	-	mf			f	-	-	-	1	19	--	--	ad m son from M; at first expulsion hunter caught; comp. diss.: 10 mo	
X	α-f	--	16	3.2	m	-	ff			-	mm	-	-	-	-	-	-	comp. diss.: 24 mo	
CB	α-f	--	32.5	3.6	m	ffmf	mf			ff	-	-	3	3	--	--	-	on day 5 two hunters caught; one GM recruited; comp. diss.: 11.5 mo	
CC	α-f	--	32.5	2.4	m	ffff	-			m	-	-	-	-	-	-	-	after 14.5 mo m and one f recruited; comp. diss.: 17 mo	
CP	α-f	--	22.5	2.2	m	ff	-			m	-	1	8	--	--	--	-	comp. diss.: 11 mo	
CE	α-m	x	51	8.4	f ^m mm	mfmm	mf			-	-	-	4	123 126 125 170 170	122 125 125 170 170	--	--	1	delivery one day after loss of α-m; comp. diss.: 9.5 mo
V	α-m	x	20	3.4	f	ff	mf			mm	-	-	-	-	--	--	--	1	after 12 days vad ff recruited; delivery 59 days after loss; comp. diss.: 5.5 mo

mo - month(s); m - male; f - female; mf - α-animal before loss; * - new α-animal; GM - group member(s); comp. diss. - complete dissolution; ad > 35 mo; yad - 35 to 45 mo; sub - 15 to 10 mo; iuv - 10 to 5 mo; inf < 5 mo; expulsions only up to approx. 170 days before/after loss/birth included (one interbirth interval).

mg - month(s); m - male; f - female; m - α-animal before loss; * - new α-animal; GM - group member(s); comp. diss. - complete dissolution; ad > 35 mo; vad - 35 to 40 mo; sub - 15 to 10 mo; iuv - 10 to 5 mo; inf < 5 mo; expulsions only up to approx. 170 days before/after loss/birth included (one interbirth-interval).

Special groups (n = 2)

In one group the father has been so severely attacked by his son that he had to be removed from the family. He died some minutes later due to a severe shock. We do not know why the father has been attacked. Subsequently the son interacted sexually with his mother. This pair produced altogether six litters. In the second case a sexually experienced male (father of 13 litters) got for social companion one of his adult daughters (mother of 7 litters). The female gave birth to male/female litter (see also FRENCH et al. 1984 for *S. oedipus*) which reproduced as well after removal of their parents (Table 1).

Discussion

The rather high frequency of inbreeding in incomplete groups cannot be interpreted as a mere accidental event. It is striking how often the groups violate the incest taboo, supposed such a phenomenon actually exists. The expulsion of the α -male in Gr. F (s. Table 2) (a similar situation was observed by SPICHIGER-CARLSSON, 1982) may indicate that the incest taboo is only weakly realized in the common marmoset, and eventually influenced by the laboratory condition.

No less important seems to us the sexual interactions of a female with her father and the onset of pregnancy whilst the mother was sick and had to be treated medically (see also EPPLE 1967). This observation confirms the findings of ABBOTT (1984) and EVANS and HODGES (1984) according to which the daughters may ovulate in the presence of their mother. Besides this the mere physical presence of their mother (= highest ranking female in the family) does not seem to be sufficient to prevent sexual behaviour of the α -male with his daughter(s). The result of this 'longterm study' contrasts to the observations in a 'shortterm study' of ANZENBERGER (1983), in which the presence of the mother and her offspring prevented sexual behaviour of the father and a strange female in a neighbouring cage, to which only the father and the strange female had access. However, we cannot exclude that the sickness of the α -female might have influenced the result, for example due to the eventual loss of her α -status because of her physical inability. On the other hand ROTHES (1974) hypothesis that marmosets are monogamous by status and not by emotional bond would be confirmed by that event.

Most striking to us has been the fact that in groups with unrelated members the reproductive reorganization was not incestuous but was based on the integration of the genetically unrelated group members, even when they were younger than the offspring of the remaining parent. We had, however, to prove, whether there has possibly existed a dominance-subordination relationship between the integrated and the family-born group members. In this case the avoidance of inbreeding could only be interpreted as a secondary phenomenon. But if incest avoidance must be regarded as a primary event, then the cognitive capacity of the common marmoset must be highly valued, especially since no group odor could be made responsible for that result (EPPLE, pers. comm.), except it would be genetically determined by a single Mendelian gene locus. To what extent young females experience an accelerated sexual maturation when becoming α -female cannot be answered at the moment (see also TARDIF 1984).

We do not know whether infant transfer and/or infant-emigration/-immigration can be regarded as a regular event in the life of a marmoset group in order to offer a proper strategy for the reproductive reorganization of an incomplete family. However, DAWSON (1976) observed a rather frequent migration of juvenile *Saguinus oedipus geoffroyi* between neighbouring groups. At least in this tamarin species infant transfer seems to be a regular behaviour in the natural habitat.

Zusammenfassung

Reproduktive Reorganisation in unvollständigen Gruppen des Weißbüschelaffchens (Callithrix jacchus) unter Laborbedingungen

Die vorliegende Arbeit beschreibt Inzucht und deren Vermeidung in unvollständigen *Callithrix jacchus*-Gruppen. Untersucht wurden 20 Gruppen, die in drei Kategorien gegliedert wurden: 1. Gruppen, die ausschließlich verwandte Mitglieder enthalten; 2. Gruppen mit genetisch fremden Tieren a. entweder durch Integration infantiler/juveniler Tiere oder b. durch Integration eines adulten fremden Männchens in eine Weibchen-Gruppe (Mutter und vier Töchter). Insgesamt sechs Gruppen setzten die Reproduktion nach Verlust eines Elters fort. Die relativ große Anzahl von Familien (4 von 15 Gruppen), in denen nach Verlust des Elters Inzucht auftrat, kann nicht mehr als ein rein zufälliges Ereignis gewertet werden. Sehr auffällig ist die Einbeziehung der genetisch nicht verwandten Tiere in die reproduktive Reorganisation, in solchen Gruppen ($n = 5$), in die genetisch fremde Tiere integriert worden sind.

References

- ABBOTT, D. H. (1984): Behavioral and physiological suppression of fertility in subordinate marmoset monkeys. *Amer. J. Primatol.* 6, 169–186.
- ANZENBERGER, A. A. (1983): Bindungsmechanismen in Familiengruppen von Weißbüschelaffchen (*Callithrix jacchus*). Inaugural Diss., Zürich.
- BISCHOF, N. (1985): Das Rätsel Ödipus. Die biologischen Wurzeln des Urkonfliktes von Intimität und Autonomie. Piper: München.
- DAWSON, G. (1976): Behavioral ecology of the Panamanian tamarin, *Saguinus oedipus*. University Microfilms Int., p. 1–164, Ann Arbor, Michigan.
- EPPEL, G. (1967): Vergleichende Untersuchungen über Sexual- und Sozialverhalten der Krallenaffen (*Hapalidae*). *Folia primatol.* 7, 37–65.
- EVANS, S.; HODGES, J. K. (1984): Reproductive status of adult daughters in family groups of common marmosets (*Callithrix jacchus*). *Folia primatol.* 42, 127–133.
- FRENCH, J. A.; ABBOTT, D. H.; SNOWDON, C. T. (1984): The effect of social environment on estrogen excretion, scent marking, and sociosexual behavior in tamarins (*Saguinus oedipus*). *Amer. J. Primatol.* 6, 155–167.
- ROTHER, H. (1975): Some aspects of sexuality and reproduction in groups of captive marmosets (*Callithrix jacchus*). *Z. Tierpsychol.* 37, 255–173.
- (1979): Das Ethogramm von *Callithrix jacchus* Erleben, 1777 (Primates, Ceboidea, Callitrichidae). Eine morphaktische Analyse des Verhaltens mit besonderer Berücksichtigung des sozialen Umfeldes. Habil.schrift, Göttingen.
- ROTHER, H.; KÖNIG, A.; DARMS, K.; SIESS, M. (in press): Analysis of litter size in a colony of the common marmoset (*Callithrix jacchus*).
- ROTHER, H.; KÖNIG, A.; SIESS, M.; RADESPIEL, U.; DARMS, K. (1987): Integration adulter *Callithrix jacchus*-Männchen in Rumpfguppen. (in press).
- SPICHIGER-CARLSSON, P. (1982): Beziehungen unter Familienmitgliedern bei Weißbüschelaffchen. Lizentiatsarbeit, Universität Zürich.
- TARDIF, S. D. (1984): Social influences on sexual maturation of female *Saguinus oedipus oedipus*. *Amer. J. Primatol.* 6, 199–209.
- TERBORGH, J.; GOLDIZEN, A. W. (1985): On the mating system of the cooperatively breeding saddle-back tamarin (*Saguinus fuscicollis*). *Behav. Ecol. Sociobiol.* 16, 293–299.

Authors' address: ANDREAS KÖNIG, HARTMUT ROTHE, MARGARETHA SIESS, KURT DARMS, DAGMAR GRÖGER, UTE RADESPIEL, JENS ROCK, Institut für Anthropologie, Universität Göttingen, Bürgerstraße 50, D-3400 Göttingen

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Mammalian Biology \(früher Zeitschrift für Säugetierkunde\)](#)

Jahr/Year: 1988

Band/Volume: [53](#)

Autor(en)/Author(s): König Andreas, Rothe Hartmut, Siess Margaretha, Darms Kurt, Gröger Dagmar, Radespiel Ute, Rock Jens

Artikel/Article: [Reproductive reorganization in incomplete groups of the common marmoset \(*Callithrix jacchus*\) under laboratory conditions 1-6](#)