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Breeding and rearing of Woolly monkeys

Lagothrix lagotricha

at the National Zoological Park, Washington

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Until recent years the Woolly monkey *Lagothrix lagotricha* has been a difficult species to maintain and breed in captivity. Between 1965 and 1974, however, a total of 49 births (including three subspecies), of which 55% survived, was reported in the *Yearbook*. In addition, a number of private individuals in the United States have been successful in breeding this species (Gonzalez, pers. comm.) and a second generation birth has been reported at the Murrayton Woolly Monkey Sanctuary in Great Britain (Williams, 1975).

During the past decade, information has become available on the behaviour, husbandry and propagation of captive Woolly monkeys (Williams, 1967, 1968, 1974, 1975; Eisenberg, 1976). In the wild, groups, which ranged in size from 25–75 individuals, have been observed (Izawa, 1976).

The National Zoological Park has maintained a breeding colony of *L. lagotricha* since 1969. This paper includes observations on oestrus and pregnancy and reports on the early physical and social development of a ♀ infant born in the colony in 1976. A summary of the colony's history and factors which seem to play an important role in the establishment and maintenance of a breeding group of captive Woolly monkeys are also discussed.

HOUSING AND FEEDING

The history of the original breeding pair and the current composition of the group are presented in Table 1. The animals are housed in a newly remodelled Monkey House in two glass-fronted indoor cages (4·6 × 3 × 4 m high and 3 × 3 × 4 m high) with two small shift cages (1·5 × 1·2 × 1·4 m high) which offer an escape from public view. The animals also have year-round access to an outdoor enclosure, measuring 4·6 × 5·2 × 2·7 m high. All the cages are furnished with vertical and horizontal wooden logs and metal rods. Hanging ropes are provided for swinging. Non-lead-based paint is used since young animals have died from lead poisoning after consuming toxic paint chips (Zook *et al.*, 1973).

The Woolly monkeys are fed twice daily. Their morning feed consists of Science Brand Marmoset Diet and Purina Monkey Chow, and in the afternoon beans, peas, carrots, apple, banana and bread are provided. Other vegetables and oxtails trimmed of fat are fed from time to time. Once or twice weekly, browse-type items are given, e.g. grass, hay, bamboo, maple, birch, beech, mulberry and elm. Except for hay and bamboo, leafy vegetables and browse cause diarrhoea if fed more than twice weekly. In the complete absence of browse, however, our

	DATE (OR ESTIMATED YEAR) OF BIRTH	LENGTH OF TIME AT NZP	BACKGROUND	BREEDING HISTORY
♀1	1963	6 Jun 1964–3 Jul 1974 died)	pet: reared with unrelated ♂ and ♀. Juvenile when received.	paired with ♂1 in 1969. Four pregnancies: infant born 14 Jul 1970 (neonatal death) ♀ born 22 Aug 1971 (died 25 Oct following fall during fight between mother and ♀2) ♂2 born 22 Oct 1972 early foetus aborted 3 Dec 1973
♂1	1965	30 Apr 1969	pet: background unknown	sired young by ♀1 and ♀3
♀2	1966	28 Feb 1970–Sept 1973 (sent to Philadelphia Zoo)	pet: reared in isolation	none
♀3	1971	20 Jul 1974	pet: reared with ♂ capuchin	♀5 born 11 Apr 1976
♀4	1972	16 Apr 1975	pet: reared in isolation	none
♂2	22 Oct 1972	since birth		juvenile
♀5	11 Apr 1976	since birth		juvenile

Table 1. Colony of Woolly monkey *Lagothrix lagotricha* at National Zoological Park, Washington, showing breeding history since 1969. All but ♀1 and ♀2 are currently housed together as a group.

animals appear to peel and eat paint from the cage walls more frequently.

Each animal also receives one multivitamin pill (Vi-Daylin) daily. This supplement was initiated in 1973 for all neotropical monkeys after a series of abortions, attributed to a vitamin B-complex deficiency, in the Woolly and Panamanian black spider monkey *Ateles fusciceps robustus* colonies.

DATA COLLECTION

Data for the study were obtained from two sources. The keepers in the Monkey House routinely note any sexual or other behavioural changes in daily records, from which length of oestrus, cycles, gestation and inter-birth intervals were extracted.

In addition, two weeks prior to and four months following the 1976 birth, half-hour observations were conducted an average of four times per week, usually during the early afternoon hours. Physical and behavioural growth was recorded as well as each group member's interaction with the newborn.

From mid-January 1976 until the birth on 11 April, urine was collected from the breeding ♀ and tested for pregnancy, using the Subhuman Primate Pregnancy Test Kit, developed by Dr Gary Hodgen at the National Institutes of Health, which responds positively to high levels of chorionic gonadotrophin in the urine.

OESTRUS, GESTATION AND INTER-BIRTH INTERVALS

The adult ♂ rarely interacted with the ♀♀ except when they were in oestrus. During these short periods (ranging from 1–8 days) a consort relationship was formed and the ♂ followed the ♀, often sniffing her anogenital region. A description of the sequence of behaviour preceding and during copulation was described by Eisenberg (1976).

Data on copulations, consort behaviour and presumed oestrous periods for the two adult ♀♀ currently in the colony are shown in Table 2. The non-breeding ♀ was never observed to assume a proper mating position while being mounted and thus prevented intromission and completion of copulation.

From June to the end of August 1975, the average interval between oestrous periods of the breeding ♀ was just under three weeks, whereas

the other adult ♀ cycled about every fourth week. Williams (1967, 1968) reports intervals of three weeks between oestrus in his colony of *L. lagotricha*.

No further copulation was observed following the mount on 30 August 1975 by the juvenile ♂. Although it is highly unlikely that this resulted in conception since this animal was not sexually mature, the juvenile was occasionally observed to mount a ♀ either prior to or following a consort relationship between the adults. The last copulation shown on Table 2 (as well as that preceding it on 11 August) probably represents the beginning or end of one of these periods and the date of conception may therefore be estimated as 30 August ± 8 days.

The birth occurred sometime during the night of 10/11 April 1976, 225 days (7½ months) following 30 August 1975. Williams (1967, 1968) reported gestations of similar length.

The first oestrous period since the birth was some 11 months later on 3 March 1977. The former breeding ♀ of the colony (see Table 1) had intervals of one year between births when young did not survive and *c.* 1½–2 years when the young survived. Eisenberg (1973, 1976) has also noted this trend in *Ateles*.

PREGNANCY

From January 1976, the results of the Sub-human Primate Pregnancy Test confirmed the pregnancy. All urine samples tested were positive even as late as four days prior to the birth. This last point is worth noting since in Rhesus monkeys *Macaca mulatta* (Hodgen & Ross, 1974), baboons *Papio anubis* and *P. cynocephalus* (Hodgen & Niemann, 1975) and Common marmosets *Callithrix jacchus* and tamarins *Saguinus* spp (Hodgen, Wolfe *et al.*, 1976), positive responses are not seen for several weeks prior to parturition as levels of chorionic gonadotrophin decrease towards the end of pregnancy. In *L. lagotricha* (this study), chimpanzee *Pan troglodytes* (Hodgen, Niemann *et al.*, 1976) and orang-utan *Pongo pygmaeus* (Hodgen, in press) positive responses persist up until the birth (see also Clift & Martin, pp. 165–173 on gorilla *Gorilla gorilla*).

The ♀ was lethargic during pregnancy and urinated frequently and copiously. The last few weeks prior to parturition she isolated herself from the rest of the group and frequently rested

PRESUMED OESTROUS PERIOD	BREEDING BEHAVIOUR	CYCLE
♀$_3$ (breeding)	Copulation with adult (♂$_1$) or juvenile (♂$_2$)	
1974		
3–6 Oct	juv	
1975		
22–23 Mar	ad	
11–16 Jun	ad 11 Jun 16 Jun	
7–14 Jul	ad 7 Jul 9 Jul 12 Jul 14 Jul	26 days
24 Jul	ad	17 days
11 Aug	juv	18 days
30 Aug	juv	19 days
pregnancy & birth		
1977		
3 Mar		
♀$_4$ (non-breeding)	Consort behaviour (Cn) or mounting (Mt)	
1976		
11–12 Jan	ad 11 Jan Cn 12 Jan Mt	
22 Feb	ad Mt	42 days
14–15 Mar	ad Mt	20 days
12–14 Apr	ad 12 Apr Mt (dried semen on flanks) juv 14 Apr Mt	30 days
9 Jun	juv Mt	66 days (or 2 cycles av 33 days?)
2–15 Jul	juv Mt on 2, 5, 7, 8, 15 Jul (adult out of colony)	23 days
6–10 Aug	ad 6 Aug Cn 7 Aug Mt 8 Aug Cn juv 9 Aug Cn 10 Aug Mt	35 days
27 Aug	ad Cn (dried semen on flanks)	21 days
1 Oct	juv Mt	35 days
30 Oct	ad Cn (dried semen on flanks)	29 days
20 Nov	juv Mt ad Cn	21 days
30 Dec	ad Mt	41 days

Table 2. Record of sexual behaviour of ♀$_3$ between October 1974 to March 1977 and ♀$_4$ from January to December 1976. There are no overt signs of oestrus in these ♀♀ and the oestrous period was presumed from the observed mating and consort behaviour. The cycles, which are calculated from the first day of presumed oestrus, are therefore approximate. Before June 1975 insufficient data were recorded on ♀$_3$ to calculate the cycle. Note: completed copulation has never been observed with ♀$_4$ (see text).

on top of a vertical log with her head in her lap and hands over her head.

GROWTH OF YOUNG

A ♀ was born on 11 April 1976. During the first four months the growth of the infant was slow and her co-ordination and agility were poor.

After the first month, the hair on the head lengthened noticeably. The forearms, forelegs and the dorsal side of the tail were covered with fur by the end of the second month. During the 15th week thicker tufts of hair were noticed on the forearms and forelegs. The following week fur on the chest and stomach began to appear.

During the first week the baby spent most of the time on the ventral surface of her mother in a nursing position. The tail of the infant curled around all objects but usually around the hind leg of the mother. The baby began riding on the mother's side during the third week and was observed riding on her back as early as the fifth week. Whenever the infant was in a dorsal position, the tail curled around the upraised tail of the mother. By the tenth week the baby was mainly carried on the back 'jockey' style, sitting up straight and leaning back against the mother's upraised tail.

The infant was first observed on the ground, completely off her mother (including tail), during the eighth week. For the next eight weeks she spent only very short periods off the mother, either hanging on the bars or sitting on the ground, and then rarely more than a foot away from her.

The infant began grabbing at objects during the fifth week and started biting and putting objects into her mouth around the seventh week. She did not start chewing and swallowing until later. Straw and insect wings were found in the faeces during the tenth week and the infant was observed eating solid food (marmoset diet) by the 11th week.

The growth pattern of young *Lagothrix* closely corresponds to the growth of young in the two other large New World cebids (*Ateles* and *Alouatta*) (Table 3). The young of these three New World genera develop slowly in comparison to most primate species of similar size, requiring perhaps one year to develop complete co-ordination of the limbs and remaining dependent on the mother for six months to one year. All three species are totally arboreal and their locomotion depends on the co-ordination of shoulder and limb structure and the prehensile tail. Both latter points probably favour slow development of young and prolonged dependence on mother.

During the first two weeks following parturition, the mother was very protective, placing both arms around her baby as it clung to her ventral surface. She rarely positioned the infant, even when she got up and moved around.

The first week following the birth the juvenile ♂ approached the mother often and placed his head next to the infant. The mother did not interfere with his attempts to play with and touch the baby and during the fifth week he was 'play biting' and pulling at the infant's head. By week seven he was actually pulling the baby off the mother despite the infant's shrieking.

SPECIES	GESTATION	NURSING	CARRIED OR REMAINED CLOSE TO MOTHER	LOCOMOTION UNCO-ORDINATED
Lagothrix lagotricha	7½ months (Williams, 1967, 1968; this study)	9–12 months (Williams, 1967)	min. 6 months (Williams, 1968; this study)	min. 9 months (pers. ob.)
Ateles fusciceps and *A. geoffroyi*	7–7½ months (Eisenberg, 1973)	12–20 months (Eisenberg, 1973)	min. 10 months (Eisenberg, 1976; pers. obs.)	12 months (pers. obs.)
Alouatta palliata	180–186 days (Glander, 1975)	12 months (Baldwin & Baldwin, 1973)	12 months (Baldwin & Baldwin, 1973)	12 months (Baldwin & Baldwin, 1973)

Table 3. Growth of young of the three largest New World cebids.

During the ninth week the mother began approaching the father frequently. They spent much time huddling together with the juvenile ♂. During these periods the infant would reach out and crawl over the adult ♂, who ignored her as she roamed freely over his body. At the end of the 11th week the adult ♂ was removed from the group for treatment of chronic diarrhoea. The juvenile showed a marked increase in aggression towards the ♀♀ once the ♂ was removed.

The infant was observed on the other adult ♀ once but soon returned to its mother. Interactions between the two adult ♀♀ were infrequent at any time.

The growth rate of the infant Woolly monkey at the National Zoological Park was similar to those of infants born in the colony at Murrayton (Williams, 1967, 1968). More interactions occurred between the newborn and the other group members in the Murrayton colony as many of the animals there were wild-caught and better socialised.

BREEDING COLONY MANAGEMENT

Between 1970 and 1976 the *Lagothrix* colony at the National Zoological Park has been housed in a variety of sizes and types of cages, some of which appeared quite stressful. Yet, breeding has occurred in most of these conditions—twice with successful rearing. Likewise, private individuals (Gonzalez, pers. comm.) have maintained and bred Woolly monkeys in rather small quarters. This suggests that there are more important factors in their maintenance and breeding in captivity than just their physical environment.

Table 1 shows that the two ♀♀ who have bred in our collection originated as pets. These two animals were housed with other monkeys (in one case a ♂ capuchin *Cebus* sp) while still juveniles, whereas the two non-breeding adult ♀♀ were reared to adulthood in isolation from other monkeys. Interactions between the isolated and socialised adult ♀♀ were rare. However, fighting occasionally occurred and in one case caused the death of an infant (see Table 1).

Other institutions report successful reproduction and rearing of young by animals raised in isolation to adulthood (Gonzalez, Reynolds, Aragon, pers. comm.), although they also report a higher incidence of failure to adjust and breed in the colony. Williams (1968) reported that adult Woolly monkeys reared as isolates to adulthood failed to reproduce in the Murrayton Woolly Monkey Sanctuary. It seems reasonable to conclude that although it is possible to rehabilitate an adult pet, its chances of adjusting and breeding successfully in a colony are much less than those of a younger animal raised in a group. It appears particularly important to use relatively young and/or well-socialised animals to found a breeding group.

Once a colony has been established, it is important not to remove dominant animals, particularly ♂♂. When circumstances have forced the temporary or permanent removal of the alpha ♂ from a colony of *L. lagotricha, A. fusciceps, M. nigra* and *M. sylvana* in the Monkey House, serious conflict has often resulted among the remaining members of the group. This seems to be particularly true if the beta ♂ is a young inexperienced older juvenile or subadult as in the case of the Woolly monkey colony.

Both young ♂ and probably young ♀ Woolly monkeys should be kept in the group into which they were born at least until the animals approach sexual maturity (three to five years (Williams, 1968)) to ensure proper socialisation. As early as two years of age ♂♂ show an interest in oestrous ♀♀ and attempt to copulate with them. They also pay close attention to copulations between adult ♂♂ and ♀♀ (pers. obs.; Williams, 1967, 1968). Within a colony, ♂ Woolly monkeys seem to form consort groups (pers. obs.; Williams, 1968) like *Ateles* (Eisenberg, 1976). Such experiences are important in the social development of the young ♂.

If a subadult or adult ♂ is removed from a colony, reintroduction to the original group or introduction to another colony containing a mature ♂ may prove impossible, as the established ♂ may attack the newcomer. This was observed in *Ateles* as a juvenile ♂ was attacked by the alpha ♂ when reintroduced. Also, unrelated adult or subadult ♂ Woolly monkeys housed together will fight each other in earnest (Gonzalez, Reynolds, pers. comm.). As a final note, it should be emphasised that Woolly monkeys of either sex should be kept in pairs or groups as much as possible, since long-term isolation often constitutes a severe stress for these animals.

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PRODUCTS MENTIONED IN THE TEXT

Purina Monkey Chow: pelleted monkey diet manufactured by Ralston Purina Company, St Louis, Missouri 63188, USA.

Science Brand Marmoset Diet: manufactured by Hill's Division Riviana Foods, POB 148, Topeka, Kansas 66601, USA.

Subhuman primate pregnancy test kits: obtainable from Hormone Distribution Officer, Office of the Director, NIAMDD, Bldg 31A, Room 9A47, National Institutes of Health, Bethesda, Maryland 20014, USA.

Vi-Daylin Cherry Flavored Multivitamin: vitamin supplement manufactured by Ross Laboratories, Division of Abbott Laboratories, Columbus, Ohio 43216, USA.

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