Breeding and captive maintenance of the Lesser bamboo rat

Cannomys badius

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We have maintained a small colony of *Cannomys badius* at the National Zoological Park since 1967. Originally the stock consisted of four ♂♂, three ♀♀ and four juveniles obtained from Thailand. Part was given to A. E. Miller-Baker for a detailed investigation of sexual behaviour; the results of her study will be published separately.

Cannomys belongs to the family Rhizomyidae which includes two other genera, *Rhizomys* of Southeast Asia and the strongly fossorial *Tachyoryctes* of equatorial Africa (*16*). *Cannomys* is adapted for a fossorial way of life and tunnels in compacted earth using both forepaws and incisors. In keeping with its fossorial *habitus*, the genus has small eyes, reduced pinnae, an abbreviated tail, a cylindrical body with short limbs and an extremely short neck. The pelage is short, dense and light brown in colour. Frequently the forehead or top of the head is adorned with a white mark, a characteristic shared with *Tachyoryctes*.

Morphologically it resembles other convergently evolved fossorial rodents, including the genera of the African mole rats (family Bathyergidae), the North American pocket gophers (Geomyidae), and the Eurasian mole rat (Spalacidae). Certain cricetid rodents, notably the Asiatic genera *Prometheomys* and *Myospalax*, have evolved a parallel external morphology in their adaptation to a fossorial life and one neotropical caviomorph family, the Ctenomyidae or tucotucos, is similarly adapted.

Captive maintenance: Since three of the adult specimens exhibited recent bite wounds when they arrived together, adults were initially housed separately during acclimatisation. Subsequently the adult animals tended to remain quarrelsome even when held as pairs. Long-term pair tolerance, was tested in a cage 1·2 × 1·5 × 0·6 m, with metal walls, but eight days later when the ♂ inflicted bite wounds on the ♀'s lower back region, we discontinued attempts at sustained pairing. We then adopted the general policy of housing a ♂ and ♀ in adjacent cages with a communicating doorway; pairs could then be allowed together for controlled periods. Although captive-born animals appeared to be less aggressive when held in pairs, we maintained individual housing, allowing access only for breeding over 24–48 hours.

The metal cages had a floor area of 0·36 m² and various floor coverings were used, including earth, tan bark and sawdust. Cardboard nest boxes measuring 20 × 15 × 10 cm, with an entrance hole of 3·7 cm diameter, were originally provided for shelter. Later, wooden nest boxes of the same dimensions were used. The animals were maintained at a temperature of the 21–25°C and around 50% relative humidity.

To facilitate our behavioural observations of breeding, pairs were introduced into a plexiglass fronted cage illuminated by a red light.

Since the incisors are used to construct burrows in hard soil substrates, *Cannomys* can easily gnaw its way out of wooden cages, i.e. metal cages are mandatory. A sheet of 6 mm plywood on the floor gives them a good footing and allows the animals to gnaw, thereby maintaining their incisor wear. Both ♂ and ♀ will construct a nest and use almost any material provided: leaves, torn strips of newspaper and dried grass. Diet consists of commercial rat chow, sliced apple and potato, lettuce, pieces of orange and sliced sweet potato.

General behaviour in captivity: The Lesser bamboo rat shows bouts of activity throughout the 24-hour cycle with morning and evening activity peaks, although the animals sleep a great deal during the day. *Cannomys* employs the incisors to transport food and nesting material, but manipulates these with the forepaws. Small morsels of food are held, but larger pieces are usually eaten from the ground, the forepaws acting as a brace. Food is generally cached near the nest box. Urination takes place in a given corner of the

cage; defaecation occurs indiscriminately. While resting in the nest the animal may bend down and pick up faecal pellets in the incisors as they emerge from the anus. These are tossed away from the nest with a quick flip of the head. Whether coprophagy is practised or different types of faecal pellets produced could not be confirmed but it appears likely.

Upon awakening *Cannomys* generally grooms itself with alternate or simultaneous wiping movements of the forepaws on either side of the face from ears to nose. It also scratches its head with the hind foot, after which it nibbles the nails of the hind foot with its incisors. Ventrum and sides are generally groomed by nibbling with the incisors or combing with the forepaws. The throat and neck region is generally scratched with the hind limb.

Intraspecific behaviour: Male and ♀ approach each other slowly, head to head, and, if agonistically inclined, begin to tooth chatter, which may be followed by a lunge and a bite or a threat display. The animals raise their heads, facing each other, and the exposed incisors may touch. If pressed, a threatening animal may growl. If a ♀ is receptive agonistic tendencies grade into courtship, although the courtship behaviour itself is highly variable.

During precopulation, animals frequently make contact by approaching and lifting their heads, while exposing the incisors. Their noses may touch. If the ♀ is attractive to the ♂, he attempts to follow her and if she does not resist too strongly this develops into driving behaviour. The ♂ may rest his chin on the ♀'s rump, nuzzle her in the flanks, and whine. When a receptive ♀ pauses during driving, the ♂ attempts to lick her genital area. Either sex may whine, which appears to be a sign of submission. As the ♀ becomes more receptive, she will pause, assume lordosis and so actively facilitate mounting.

Reproduction: Mating behaviour in *Cannomys* consists of a multiple series of mounts with thrusting. Mount durations average 3–22 seconds (mean = 9·0 sec., N = 22). Many of the short mounts appear to be without intromission. After a period of 10–15 mounts, the ♂ ejaculates, the whole process taking from 30 to 45 minutes. Both ♂ and ♀ groom their genital area after a mount with intromission. Following a successful insemination an ejaculatory plug can be seen in the vagina. It

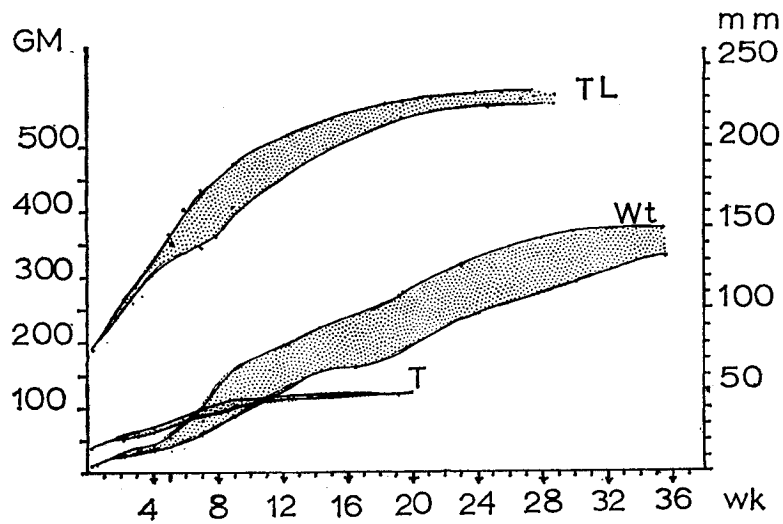

Fig. 1. Growth curves for two litters of Lesser bamboo rats *Cannomys badius* at the National Zoological Park. Extreme ranges for each curve indicate sexual dimorphism in size. Upper range is for a ♂, lower range is for the smallest ♀. Left hand ordinate indicates weight in grams, right hand ordinate displays linear measurements in millimetres. Abcissa display seven-day intervals.

TL = total length, Wt = weight, T = tail length, wk = weeks after birth.

should be noted that a persistent ♂ can usually successfully mount a ♀ whether she is in oestrus or not.

Litter sizes are small, two young being the rule (N = 5). The gestation period ranges from 40 to 43 days (N = 3).

Growth and maturation of young: During their early development the ♀ licks the young, around the anogenital region in particular. If the young are displaced from the nest, the mother will retrieve them. When suckling, she crouches over the young, slightly arching her back.

At birth the young are pink, naked, their eyes and external auditory meatus closed. They may emit a soft 'tick-tick-tick' sound and later, while the mother is grooming them, the high-pitched whine reminiscent of what in an adult context appears to be a sign of submission. Incisors are present at birth. At approximately Day 10, the grey dorsal fur becomes visible. The eyes begin to open at Day 22 and both eyes and auditory meatus are open by Day 28. The young begin to nibble at solid food at approximately Day 23 but apparently are not fully weaned until about eight weeks. They can walk at approximately two weeks and begin leaving the nest at 20–24 days. Initially they follow the mother, returning to the nest when she returns, but begin to forage on their own at about Day 34. At this time agonistic behaviour between litter-mates appears, although at a low intensity. From Days 34 to 44, the young exhibit rearing up, driving and mounting. Fig. 1 shows a growth curve.

DISCUSSION

Since wild-caught adult *Cannomys badius* behaved rather aggressively toward one another, adult pairs were kept separately except for breeding. Individual occupancy of a burrow system by an adult appears to be the rule for many fossorial rodents: *Thomomys bottae* (*13*),*Geomys bursarius* (*15*), *Spalax ehrenbergi* (*8*; *10*; *17*;), *Ctenomys torquatus* (*14*). Some fossorial rodent species do appear to live in colonies but, even then, the burrow systems of adults appear to be individually occupied, e.g. *Pappogeomys gymnurus* (*12*).

The courtship of *Cannomys* resembles that reported for *Spalax ehrenbergi* (*8*), e.g. threat behaviour involving mutual facing with incisors exposed, tooth chattering and growling occur in both species. Copulation in *Cannomys* consists of a series of mounts of varying duration, averaging around nine seconds; a terminal mount with intromission and ejaculation seems to occur only after a series of mounts with or without intromission. This behaviour is also reminiscent of that reported for *Spalax* (*8*) but differs markedly from that of *Thomomys bottae* (*13*), where after a series of attempted mounts, the mount with intromission and thrusting is prolonged, lasting up to four minutes. In this aspect *Thomomys* resembles several unrelated species which show long mounts with intromission, e.g. the kangaroo rats *Dipodomys* (*2*) and the spiny rat *Proechimys semispinosus* (*5*).

In spite of a long gestation period of 40–43 days, the young are extremely altricial at birth. The tendency toward an extended gestation coupled with the production of altricial young is shared by three genera of the family Bathyergidae, *Bathyergus*, *Heterocephalus*, *Heliophobius* (*3*), and one of the genus of the Rhizomydae, *Tachyoryctes* (*3*; *11*). The trend apparently does not hold for the geomyid species, *Thomomys bottae*, where the gestation is 19 days (*13*), although as might be anticipated the young are extremely altricial. The fossorial, caviomorph rodent *Ctenomys* has a prolonged gestation, 103–107 days, but produces rather precocial young. This long gestation period and the production of precocial young is in keeping with its phylogenetic affinities, since this characteristic of all caviomorph rodents studied to date (*1*; *4*; *18*).

The litter size in many fossorial rodents appears to be rather small. *Cannomys* with one to two young per litter resembles *Bathyergus suillus*, *Tachyoryctes splendens* (*3*), *Cratogeomys castanops*, *Heterogeomys hispidus* (*1*), *and Geomys bursarius* (*15*). *Thomomys bottae* and *Ctenomys talarum* appear to have slightly larger litters, averaging around four to six (*7*; *18*).

The altricial condition of the young at birth and their slow development is parallelled by the closely related *Tachyoryctes ruanda* and *Rhizomys sumatrensis*. Ogilvie (*9*) noted that newborn *Rhizomys* were very altricial and did not begin to develop the dorsal pelage until 10–13 days of age, the eye did not open until 24 days, and the young continued to nurse the mother occasionally until the age of three months. Rahm (*11*) found that the young of *Tachyoryctes* were altricial after a 42–48

day gestation and eye opening was delayed until at least Day 22.

Reduction in litter size characteristic of *Tachyoryctes*, *Heliophobius*, *Bathyergus*, *Geomys*, *Spalax* and *Cannomys* may be the selective result of reduced predation on the young in these fossorial rodents. Fossorial rodents have low basal rates of metabolism which appears to be an adaptation to reduce the probability of overheating in a burrow system where evaporative and convective cooling are greatly reduced (*6*). Perhaps a lower rate of basal metabolism results in a prolongation of gestation. Extreme altriciality at birth in spite of the long gestation may indicate a reduced rate of intra-uterine development. It is hoped that further data will be forthcoming concerning developmental rates, litter size and degree of altriciality for other fossorial rodents. It is highly likely that in these animals litter size and rate of development are related to the evolution of a lower basal metabolic rate.

PRODUCT MENTIONED IN THE TEXT

Rat Chow: Manufactured by Ralston Purina C., St Louis, Missouri, USA.

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