

## Reproduction in the Ring-tailed mongoose *Galidia elegans* at the National Zoological Park, Washington

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The Ring-tailed mongoose *Galidia elegans* is a small graceful viverrid of the subfamily Galidiinae, one of two viverrid subfamilies endemic to Madagascar. In appearance *Galidia* resembles

the other Galidiinae, *Salanoia*, *Mungotictis* and *Galidictis*, in being small (about 350 mm head and body length), elongate and generally rather weasel-like. The pelage is a deep chestnut

| COPULATION DATE | BIRTH OF YOUNG            | GESTATION (days)* | REINTRODUCTION OF ♂ |
|-----------------|---------------------------|-------------------|---------------------|
| 1976            |                           |                   |                     |
| 21, 31 Mar      |                           |                   |                     |
| 12, 25 Apr      |                           |                   |                     |
| 19, 21 May      |                           |                   |                     |
| 1, 13, 25 Jun   |                           |                   |                     |
| 3 Aug           | 25 Sep<br>(died at 1 day) | 53 (92)           | 27 Sep              |
| 1977            |                           |                   |                     |
| 10, 22 Jan      | 9 Apr<br>(died at 2 days) | 77 (89)           | 14 Apr              |
| 28 Apr          |                           |                   |                     |
| 1, 11, 25 May   |                           |                   |                     |
| 18 Jun          | 9 Aug<br>(hand-reared)    | 52 (76)           | 2 Sep               |

\* Calculated from the last observed copulation date (= day 0) and, in parenthesis, from the second to last copulation date.

**Table 1. Chronological breeding history of a pair of Ring-tailed mongooses *Galidia elegans* which has produced three litters at the National Zoological Park, Washington.**

typical of other forest dwelling mammals and the tail is relatively long with five to six transverse black rings. *Galidia* is reported to be primarily terrestrial. However, its semi-digitigrade gait and fleshy digital pads allow it to climb with great facility and it has been reported to frequent trees in search of small vertebrates and insects (Rand, 1935; Alagnac, 1974). Although previously believed to be solitary, recent field and captive studies by Alagnac (1974) have demonstrated that groups of two and three are common and probably represent mated pairs and extended family groups.

Malagasy viverrids have always been rare in captivity and *Galidia* is no exception, with only one other group, besides that at NZZ, presently reported outside of Madagascar (at Montpellier Zoo, France). At the National Zoological Park the present collection consists of three ♂♂, collected near Ranomafana in 1966, an adult ♀ of unknown origin on loan from the New York Zoological Society since 1974, and a juvenile ♀ born in August 1977.

#### REPRODUCTION

Between 1966-1974 the three ♂♂ were exhibited as a group in the Small Mammal House. In March 1974 one of them was introduced to the newly acquired ♀ in an off-exhibit enclosure where mating occurred sporadically, but without

conception, over the next two years until both animals were returned to exhibition. A pairing with a second ♂ was arranged on 20 March 1976, this time in a separate on-exhibit enclosure, and mating took place the following day and thereafter repeatedly and regularly (Table 1).

Prior to copulation there is considerable pursuit of the ♀ by the ♂. Both animals mark prominent objects (logs, rocks, etc.) with the cheek and submandibular glands and the ♂ frequently sniffs the ♀'s anogenital region. Mating occurs after the ♀ has solicited the ♂ to mount by making an approach with head and forequarters lowered as she turns, raises and moves her tail to one side. This posture is usually accompanied by tail quivering and slow treading of the hindquarters. After a brief inspection of her anogenital region, the ♂ mounts by grasping her about the abdomen. Mounts last approximately 10-30 seconds with intravaginal thrusting at the rate of two to three thrusts per second. There is no neck bite and the absence, at the end of most mounts, of anogenital licking by the ♂ indicates that ejaculation does not occur at each intromission. As long as the ♀ remains in a receptive lordosis posture the mounted ♂ continues pelvic thrusting. The mount/intromission sequence terminates when the ♀ either moves quickly away, rolls on her back or side, or turns and attacks the ♂. There are usually between

7-12 mount sequences over a 30-80 minute period before the animals tire, separate and engage in anogenital autogrooming.

Copulation at NZP has taken place between January and October, and births in April, August and September (Table 1). In Madagascar mating occurs between April and November, with September and October the modal months, and births occur between August and February, with peaks in December, January and February (Albignac, 1974).

Albignac (1969) reported the gestation period of *Galidia* to lie between 74-90 days (mean=82.6; n=11). At NZP births occurred, respectively, 52, 53 and 77 days following the last observed copulation (Table 1). Because the copulation immediately preceding birth, in two instances, followed that preceding it by a period considerably greater than the length of the modal oestrous cycle (12 days), there is a possibility that this last mating may have occurred during a false oestrus. If this is considered and all gestations are calculated from the *second to last* copulation preceding birth, then periods of 76, 89 and 92 days (mean=85.6) are obtained. In all cases single young were born and mating was usually resumed within three weeks of the infant's removal or death.

Three births have occurred at NZP. The first was unexpected and the pair remained together during and after parturition. We were alerted to the presence of an infant by the unusual amount of screaming and squealing arising from the enclosure as the ♀ gave chase to the ♂; even though *Galidia* appears to live in mated pairs and small family groups, the ♀ drives the ♂ from the nest and keeps him away for several days post partum (Albignac, 1969). After removal of the ♂, the ♀ returned to the infant, but only for brief intervals of about 30 seconds duration while she continued to pace about the enclosure. Although it appeared active and vocal in emitting a 'peep' contact call, the cub was never seen to nurse. It was found dead 24 hours after birth and autopsy revealed that it had not suckled.

The ♂ was removed from the enclosure three weeks prior to the next anticipated birth. As before, the ♀ showed no signs of impending parturition. She ate normally and did not construct a nest or frequent nestboxes or crevices any more than usual. After this birth the ♀

stayed with the infant in a secluded and inaccessible part of the enclosure which made it impossible to determine if nursing had occurred. Little was seen of her, she ate normally, and two days later, when the infant's cries had ceased, it was found dead—again, of inanition. Examination showed that the ♀ had well developed mammarys that produced milk with minimal stimulation.

In anticipation of the third birth the ♂ was removed well in advance and the ♀'s enclosure covered to provide olfactory, visual and auditory seclusion from public and staff. After birth she spent only a few minutes at a time with the infant and no nursing was observed; it was removed for hand-rearing after four hours.

#### INFANT DIET

To allow the infant, a ♀, to adjust safely to the artificial nipple, the first two feeds consisted of 50% dextrose and distilled water. Subsequently, the dog milk replacer, Esbilac, diluted with water in a ratio of 1:6, was fed every four hours. On day 5 the solution was strengthened to 1:3, and on day 10 a small amount of egg yolk was added to counteract the loss of weight which had resulted from a bout of diarrhoea. This formula was maintained until day 22, when a small quantity of strained beef was also offered at each feed. At day 44 the infant began to eat small pieces of cooked chicken and raw ground beef, and to drink water and milk from a shallow dish; bottle-feeding was now discontinued.

During the first week the infant consumed between 2-4 g formula/feed and gained 1.1-1.5 g in body weight every four hours. This rate of growth continued until the addition of the strained beef, whereupon consumption rose to between 6-7 g/feed, with a resultant four-hourly net gain in weight of 2.0-2.5 g.

Both urination and defaecation required manual stimulation until about day 14. Urination occurred before every feed but, until about three weeks, bowel movements took place only every one to two days. The diarrhoea and weight loss experienced on day 10 was accompanied by a general listlessness and loss of appetite. Within 24 hours the infant's weight had fallen by 8 g, or about 11% of total body weight. However, after two doses of 2 ml 5% dextrose and 2 ml feline serum on day 11, improvement was

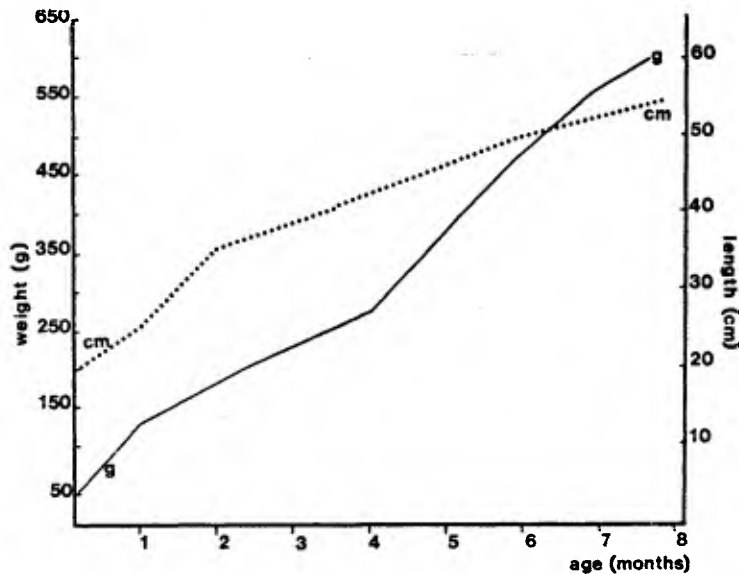


Fig. 1. Growth and weight increase in the first eight months in a hand-reared ♀ Ring-tailed mongoose *Galidia elegans* bred at the National Zoological Park, Washington, in 1977.

immediate and she soon returned to normal feeding routine and activity levels.

#### GROWTH AND DEVELOPMENT

*Galidia* infants are fully furred at birth. The pelage is identical to that of the adult and the fur is glossy and greasy to the touch. The eyes are closed, the ears conspicuous and the auditory canal open. Mystacial vibrissae are conspicuous and approximately 8 mm in length. The muzzle is pointed and no teeth have erupted. In the hand-reared infant, eyes opened on day 4 and the incisors and premolars began to erupt on days 8 and 21 respectively. At seven months the deciduous dentition is still intact and the animal's weight 593 g, about 75% of that of the adult ♀. According to Albignac (1969, 1974), physical maturity occurs at about one year, and sexual maturity at two years.

On day 1 the cub was already able to drag herself about the nestbox by her forelegs, hang upside down from a keeper's finger, and right herself when placed on her back. A variety of vocalisations, ranging from twitters and purrs to squeaks and spits, were emitted from birth. The twitter occurred most frequently and is similar to contact calls in other carnivore species. With the eyes opening on day 4, the first unco-

ordinated attempts at autogrooming were made, and on day 15 the first scent mark with the perineal gland. Scent marking with the facial glands occurred later but its initial incidence was not recorded. The following response was very strong almost immediately after the eyes opened and at seven months continues so. At two weeks the infant was beginning to play with objects, either by grabbing them in her mouth and shaking her head vigorously with typical viverrid prey-killing motions, or by pawing at them in characteristic play posture, the head raised and tilted to the side and the mouth open.

By two weeks the cub was also walking about the nestbox for most of the waking day, and was able to climb in and out of the box with ease. By this time too she was capable of urinating and defaecating without manual stimulation and had begun rubbing her anogenital region on objects. By six weeks scent marking was copious, every new object encountered being marked first with the facial glands and then with the perineal. At the time of her introduction to solid food, a high pitched squeal entered the vocal repertoire.

Food was often taken to a water dish, submerged, and manipulated, with both forepaws simultaneously, under water. Often the food

|                         | <i>Mungotictis</i>   | <i>Galidia</i>                     | <i>Eupleres</i>     | <i>Fossa</i>                   | <i>Cryptoprocta</i>          | <i>Herpestes</i> | <i>Suricata</i>                                |
|-------------------------|----------------------|------------------------------------|---------------------|--------------------------------|------------------------------|------------------|--|
| Eyes open (days)        | birth                | 4-8                                | day 1               | birth                          | 15-21                        | 10-12            | 10-12  |
| Ears open (days)        | birth                | birth                              |                     | 8                              |                              |                  |  |
| Crawling (days)         | birth                | birth                              | birth               | birth                          | 1                            | birth            | birth  |
| Walking (days)          | 3                    | 16                                 | 1-3                 | birth                          | 15                           |                  |  |
| Running (days)          | 27                   | 21                                 | 8                   | 5                              | 45                           |                  |  |
| Eating solids (days)    | 15-20                | 44                                 | 60                  | 33                             | 90                           | 22               | 25-30  |
| Sexual maturity (years) | 2                    | 2                                  |                     | 2?                             | 3                            | 1                | 2  |
| Pelage at birth         | adult                | adult                              | dark                | adult                          | white                        | sparse           | sparse   |
| Weight at birth (g)     | 50                   | 40-50                              | 150                 | 70                             | 100                          | 25               | 25-40  |
| No. of young            | 1                    | 1                                  | 1                   | 1                              | 2-4                          | 2-5              | 2-6  |
| Gestation (days)        |                      | 74-92                              |                     | 80-89                          | 90                           | 70-75            | 70   |
| Reference               | Albignac, 1971, 1973 | Albignac, 1969, 1973<br>this study | Albignac 1973, 1974 | Albignac, 1973<br>Wemmer, 1971 | Albignac, 1970, 1973<br>1975 | Powell, 1913     | Dücker, 1962<br>Ewer, 1963<br>Roberts, unpubl. |

Table 2. Comparative reproductive and developmental data in several of the Viverridae.

item was retrieved and returned to the water where the entire sequence was repeated. A similar type of two-handed object manipulation was noted with objects sited in crevices or beneath something larger. In many cases the animal would place the item with apparent purpose out of reach in such a location and attempt to retrieve it with the forefeet. In nature *Galidia* reportedly catches fish, frogs and crustaceans in shallow water using this method of prehension (Albignac, 1969) which is very similar to that commonly observed in captive raccoons *Procyon*.

Occasionally small hard objects and some food items were gathered into the body with all four paws while the animal lay on her side and, while the forefeet held the object loosely, the gathered hind feet would fling it, often in a high arc, sometimes as far as 2-3 m. This 'egg-breaking' behaviour is also reported in other Galidiinae (Albignac, 1971), but differs from that described in the Herpestinae in that it is the hind limbs which fling the object, rather than the forefeet which raise it and then drop or throw it behind the animal.

#### DISCUSSION

Reproduction, birth and development of *Galidia elegans* at the National Zoological Park appears to be identical to that reported for wild and captive *Galidia* in Madagascar (Albignac, 1969).

In nature, the Galidiinae are found primarily in dry or wet forest and are largely carnivorous but,

with the possible exception of *Galidictis*, they appear to be opportunistic and readily eat what is available. All species in the subfamily are small (less than 1000 g), semi-arboreal, cryptically coloured and suffer predation mainly from raptors and large snakes. In general the Galidiinae resemble and occupy the same broad ecological niche as do the Herpestinae in Africa and Asia. In reproductive and social habits, however, the Galidiinae and the Fossinae (*Eupleres* and *Fossa*) (Wemmer, 1971) are unique among the Viverridae in being pair-bonded, territorial and in giving birth to a single well developed young per year. There also appears to be a degree of paternal investment in infant rearing found only in the colonial *Suricata* and *Helogale* (Ewer, 1963; Rasa, 1972) (but see Aquilina & Beyer, pp. 185-188 on *Arctogalidia*—Ed.). The young live in the family group until the birth of the next litter, at which time they disperse with sexual maturity being reached at two years of age (Albignac, 1969).

*Galidia* appears to be typical of the Galidiinae in all respects. The copulatory behaviour differs little from that of the Fossinae and Herpestinae but greatly so from that of *Cryptoprocta* (Albignac, 1974, 1975). The single young is less precocial and develops less rapidly than that of the Fossinae, but is somewhat more precocial and faster growing than the Herpestinae and considerably more so than *Cryptoprocta* (Table 2). Specialised submandibular, cheek and perineal glands are used frequently and the species has a number of

distinct vocalisations, as might be expected in a forest dwelling, social and territorial species. In general, *Galidia* has occupied a generalised, omnivorous feeding niche, and because of low predation pressures and abundant food resources exhibits low fecundity and a pair-bonded social system with the maintenance and defence of territories.

PRODUCT MENTIONED IN THE TEXT

**Esbilac:** dog milk substitute manufactured by Borden Chemical Company, Norfolk, Virginia 23501, USA.

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