

## Observations on the care, breeding and behaviour of the Giant day gecko

*Phelsuma madagascariensis*

### at the National Zoological Park, Washington

BÉLA J. DEMETER

Keeper, Reptiles and Amphibians, National Zoological Park, Smithsonian Institution, Washington, DC 20009, USA

In October 1972 the National Zoo received four Giant day geckos *Phelsuma madagascariensis* collected in Diego Suarez, the northernmost province of Madagascar. This group of one ♂ and three ♀♀ has produced a total of 11 young, six of which have been raised to sexual maturity. As the literature of *Phelsuma* is limited to taxonomic studies, a paper on captive behaviour (Kästle, 1964) and a note on nutrition and care (Switak, 1966), it is hoped that this discussion of some aspects of the care, breeding, growth and behaviour of our colony over a period of 28 months will contribute towards a greater understanding of the species' requirements in captivity.

#### HOUSING

The fibreglass exhibit, 100×66×100 cm high, has a hinged back, glass front and screen top. The substrate is of pea gravel, and several live plants and numerous bamboo canes provide more habitable space. Plastic leaves attached to the bamboo constitute further optical barriers for the diurnal, visually oriented geckos. Holding cages are 51×26×31 cm aquaria, furnished in a similar manner to the display cage. Exhibit and holding areas receive natural light through a skylight running the length of the room and from fluorescent bulbs overhead. Since November 1974 the exhibit cage has been illuminated by two General Electric Chroma-50 broad spectrum fluorescent lights. The cages are not individually heated and the ambient temperature varies from 23–38°C. A mist spray applied several times a week serves to increase humidity.

#### NUTRITION

Diet consists primarily of crickets powdered with a vitamin–mineral supplement (Pervinal) to

which calcium carbonate has been added, fed two to three times a week; the animals also receive mealworms, maggots and chopped fruit. In addition, the following mixture suggested by Ray Pawley of Brookfield Zoo has been given weekly since April 1974:

- one egg yolk
- 0.5 cc honey
- 0.6 cc molasses
- 0.6 cc brewer's yeast (vitamin B)
- 0.5 cc vitamin D<sub>3</sub> (10,000 iu/cc)
- 2.5 cc calcium lactate
- 2.5 cc multivitamins.

The geckos lick this preparation from the keeper's finger, and they have also eaten ants that are attracted to the honey. *Phelsuma* normally eats its skin as it is shed, and on several occasions the animals have been observed to eat the pea gravel substrate. They appear to exercise considerable care in the selection of the piece to be ingested, often discarding several before making a final choice. No ill effects have been observed from this practice and the gravel is expelled with the faeces. Water is always available in a small dish from which the geckos drink freely; they also lick surfaces wetted during misting.

Nutritional problems have manifested themselves in the breeding and rearing of young. In March and April 1974 the original three ♀♀ died from a calcium deficiency characterised by a lack of firmness in the bony skeleton and a difficulty in shedding. In its early stages the disease was symptomised by weakness, a hump-backed posture and an inability to climb because the toe pads had not shed properly. The eggs laid by these ♀♀ shortly before their deaths were without shell and not viable. There is little doubt that the deficiency was related to the large

number (14 clutches) of calcareous eggs produced in the preceding 12 months, which must have considerably depleted their reserves of mineral salts. The supplementary feed described above was an attempt to provide a greater balance in the diet as well as an extra source of minerals. At the beginning of March 1975 the mixture was further modified by increasing the quantity of vitamin D<sub>3</sub> to 25,000 iu per batch, the augmented dosage being calculated from human nutritional requirements.

Zoo-bred ♀♀ have only recently begun to lay (Table 1). The first two clutches were laid by very young animals, which may account for their poor formation and non-viability. The last two eggs, however, seemed well formed and properly calcified. The data is still too limited to draw any valid conclusions regarding the adequacy of the diet but the indications are promising.

DATE LAID	NUMBER OF EGGS	PROPERLY CALCIFIED	NUMBER HATCHED	INCUBATION PERIOD
26 Nov 72	2	yes	0	—
21 Apr 73	2	yes	2	66
7 May 73	2	yes	2	66
25 May 73	2	yes	2	66
25 June 73	2	yes	2	66
7 July 73	2	yes	0	—
26 Sept 73	2	yes	0	—
17 Jan 74	1	no	0	—
24 Jan 74	2	no	0	—
1 Feb 74	2	yes	2	46, 47
21 Feb 74	1	no	0	—
24 Feb 74	2	yes	1	47
27 Mar 74	1	no	0	—
2 Apr 74	2	no	0	—
12 Feb 75*	2	no	0	—
25 Feb 75*	1	no	0	—
21 Mar 75*	2	yes	0	—

\* laid by zoo-bred ♀♀

**Table 1. Clutch size, incubation period and hatching success of *Phelsuma madagascariensis* eggs at the National Zoological Park, Washington.**

#### REPRODUCTION

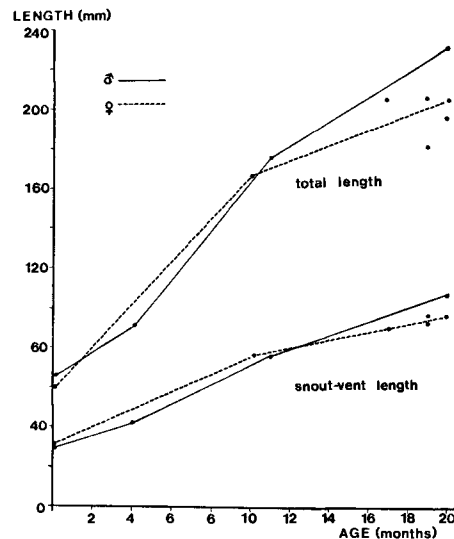
Clutches were laid between January and July, with February, March and April the peak months (Table 1). The late autumn and early winter appear to be the least productive seasons. Clutch size is nearly always two, only four of the 17 clutches consisting of a single egg. The almost spherical eggs were always joined together and

were usually laid under or inside some object such as a leaf or a bamboo cane. They had an average diameter of 14.4 mm and an average weight of 3 g per pair. Hatching success from the original ♀♀ was 44% (11 of 25 eggs) and was closely correlated with the degree of calcification. The incubation varied from 46–66 days. Eggs that were incubated at 29.5°C hatched in an average of 46 days; no temperature records were kept of the earlier, longer incubations. Humidity is apparently not a significant factor with these calcareous eggs. One pair, incubated at a particularly high humidity, showed no corresponding increase in weight or size.

#### GROWTH AND DEVELOPMENT

Four hatchlings had an average birth weight of 1.2 g and snout-vent length of 29 mm. One of them shed and ate its skin within an hour of hatching. The young are similar in appearance to the adults except that the head is proportionately larger, the reddish-orange dorsal bands are always present, pronounced and regular, and the underside of the tail is bright orange.

Growth curves of snout-vent and total length are given in Fig. 1. These curves are composites of data drawn from a restricted sample of six specimens and should be viewed with this



**Fig. 1. Growth rate (snout-vent and total length) of young Giant day geckos *Phelsuma madagascariensis*. The measurements are a composite of data drawn from a sample of six individuals.**

limitation in mind. All four curves show a period of rapid growth for the first 10–11 months, followed by a period of slower growth for the next 9–10 months. The divergence between the ♂ and ♀ graphs reflects the size difference between the sexes in adulthood. With the approach of sexual maturity the ♂ tends to grow faster than the ♀, and as he reaches maturity the growth of the tail is disproportionately accelerated.

Sexual maturity, as determined by the date of the first clutch from the zoo-bred ♀♀, is estimated at about 20 months. The animals at this age corresponded closely in size to our adult geckos and to measurements obtained from preserved specimens in the collection of the Smithsonian Institution. Seven ♂♂ had an average snout-vent length of 95 mm, the largest being 105 mm; 11 ♀♀ averaged 83 mm, with 95 mm for the largest.

#### BEHAVIOUR

Territorial, aggressive and courtship displays observed within our colony are basically similar to those described in other accounts (Greer, 1967; Kästle, 1964). During the courtship phase the ♂ sometimes approaches the ♀ with a very jerky, rhythmic motion, as if he were being viewed under a strobe light. Lateral head swaying (very rapid in ♀♀, slower in ♂♂) frequently precedes the ♂'s overtures and is part of the ♀ ritual. Film of these courtship displays reveals that the head swaying is always accompanied by tongue flicking, sometimes quite vigorous in the ♀.

In copulation the ♂ grasps the ♀'s skin about the head and neck between his teeth. He also darkens considerably in colour, as he does when stressed or ill. Both sexes have been seen licking their vents after separation.

Vocalisation has been noted in three different situations. Like most geckos, *Phelsuma* will emit a distress cry when initially grasped and during subsequent handling. A soft, almost inaudible 'chrr' is detectable as the animal approaches the keeper for food, and a similar sound from the ♀ has been heard during courtship as her partner rests his throat on top of her head.

The original three ♀♀ were kept together with the ♂ but the younger ♀♀ are too aggressive to be housed in the same enclosure. They do not tolerate one another at close quarters and often make a direct attack. While physical damage is

confined to the easily torn skin, the harmful effects of placing the animals in such a stressful situation must be taken into consideration.

#### DISCUSSION

The somewhat unorthodox food preferences that have been reported for captive geckos may be related in some measure to the deficiency problems latent in the production of calcareous eggs. *P. madagascariensis* at Steinhart Aquarium were fed on fresh and canned fruits and juices (Switak, 1966). *Peropus mutilatus* and *Hemidactylus frenatus* have eaten boiled rice, small pieces of fish, ground meat, sugar, honey, bread crumbs and even milk (Church, 1962), while Greer (1967) states that *Lygodactylus* licks the exudate of *Acacia* trees and will also lick jams and jellies.

Our own experience suggests that some form of dietary supplement is essential for maximum survival of captive specimens. While so little is known of either the number of eggs laid in the wild, or of the lifespan of the species, it seems wise to assume a cautious approach to breeding. The original ♂ of the group at the National Zoo is estimated to be at least four years old. With a longevity of four years or more, it seems prudent – at least until we know more about the nutritional requirements of *Phelsuma* – to limit the production of eggs to one clutch per year so that the ♀ might replace her calcium reserves and not overtax her reproductive potential.

The incubation periods of 46–66 days recorded in the present study are quite different from the  $\pm 135$  days reported by Switak (1966) at a temperature of 27°C, which is fairly close to that employed at the National Zoo. The incubation periods of other gecko species vary from 37 days for *Hemidactylus flaviviridis* (Parshad, 1916) to 204 days for *Gekko gekko* (Brodsky, 1969). Even within a single species the eggs may show a wide variation in incubation times. Brodsky reported a difference of nearly 100 days between his slowest and fastest eggs, which were hatched at exactly the same temperature and humidity levels.

#### ACKNOWLEDGEMENTS

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## PRODUCTS MENTIONED IN THE TEXT

**Chroma-50:** a broad spectrum fluorescent light, manufactured by General Electric Co., 1401 Parker Road, Baltimore, Maryland, USA.

**Pervinal:** vitamin-mineral supplement, manufactured by Thayer Laboratories, Inc., Pet Products Division, New York 10017, USA.

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