THE BREEDING RESULTS OF SNAKES AT THE ROTTERDAM ZOO BLIJDORP (1974-1984).

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Contents: Introduction - Collection - Snakes - Housing and feeding - Breeding - Conclusion - Acknowledgements - References.

INTRODUCTION

In 1974 the reptile collection of Blijdorp Zoo moved from the old reptile house to the Riviera Hall. After the removal, while the animals were housed in temporary accomodation, new terraria were built, the collection was extended and new tenders were contracted. As well as the Riviera Hall, the animals were also placed in special buildings: the crocodile-house (1978), the Amazon Hall (1979) and a department for the reptiles of the Notogaea district (Australia, New Guinea, New Zealand) in the elephant's building (1977). Recently (1983), a new food kitchen and breeding room were put to use, which seems to attract visitors, who can admire (from behind glass) the eggs and young reptiles. The development of the reptile collection of the Blijdorp Zoo is not yet complete: there are plans to enlarge the Riviera Hall.

COLLECTION

General

In 1974 the reptile collection consisted of 253 animals, 77 different species, which included 49 snakes (17 species). Now, ten years later, the collection consists of 443 animals of 97 species. These figures are as of 1 January 1984 and include:

Turtles (*Testudines*)	: 32 species,	187 animals
Crocodiles (*Crocodylia*)	: 5 species,	9 animals
Tuatara (*Rhynchocephalia*):	-	-
Lizards (*Sauria*)	: 32 species,	139 animals
Snakes (*Serpentes*)	: 28 species,	108 animals

To obtain a larger variation in the collection, freshly captured animals were bought and different species were imported by Blijdorp Zoo from Australian Zoos. Later it was decided to fill up the breeding collection with hatchlings from other zoos and private collections. Also animals are lent to and borrowed from other Zoos for breeding. In this way a reasonable part of the Blijdorp Zoo collection contains animals born in captivity: as of 1 January 1984 this number was 147 animals (34 turtles, 2 crocodiles, 70 lizards and 41 snakes).

SNAKES

The accent in the collection is on the *Boidae*. This group has a large number of species with different manifestations: compare *Python reticulatis* with *Liasis childreni*. In addition, these giants are spectacular for visitors (oh look what a fat one). A number of species are also rare and it is worthwhile to try to breed them. When the collection leaned too much to the *Boidae*, the decission was taken to include more *Colubridae* in the collection. Now there are six breeding groups. For various reasons no venomous snakes are kept (the main reason is the safety of the keepers and the public).

HOUSING AND FEEDING

Over the years Blijdorp Zoo has developed a snake terrarium that fulfils the demand of a responsible snake keeping. The natural looking terraria were

given up. How nice decorated landscapes can be for the visitors, but the reality is that sand, peat dust, earth and gravel form a source of infection for the snakes. Alternatives were looked for and via painted concrete and poly-urethane foam covered with polyester, they were found in cement floors covered with epoxy resin. The cement floor, in which a low voltage heating cable is mounted is, after drying, covered with three layers of epoxy with coloured powder. The layers are of different colours, so a good control exists on complete covering of the layers. The heating also keeps the water temperature up to the mark. The back consists of benden triplex plate of 4 mm thick, painted inside with a coloured polyester resin layer. The outside is painted with transparent wood resin. The furnishing consists of some branches treated with polyester, on which plastic plants can be mounted. For small species a cave of limestone can be build. In this way a compromise is attained: the terrarium looks aesthetically and the main goal, hygiene is achieved. Daily, each terrarium is cleaned and the water changed. Once a week the terraria are disinfected with lixivium.
The snakes are fed on rats, mice, guinea-pigs and hamsters, bred in the laboratory. Large species are also given pigeons, chickens and ducks.
No vitamin/mineral preparations are added to the prey animals. A well fed rat is a complete meal, in which all the minerals needed by snakes are present. The animals are encouraged to eat dead prey, to ease oral administration of medicine.
The smaller species at Blijdorp Zoo are fed once every seven to ten days. The giant snakes such as pythons are fed once every four to six weeks. The animals are kept more or less slim. It is our confident conviction that snakes in captivity fatten quickly and are as a consequence less active. Plus there are indications that animals that are too fat, are less fertile.

The snake droppings are examined four times a year by the veterinary department for eggs of parasites. Possibly infected animals are treated directly after the result of the examination. Thereafter the droppings are examined again. If the result of the examination is twice negative, the snake is presumed healthy. Apart from that, since the use of the completely hygienic terraria, the number of infected snakes is decreased. Amoebiasis and worm infections are rare, considering the snakes that are acclamatize in the collection. By way of precaution for each block of about four terraria different tools (brushes, leather etc.) are used, thus reducing the chance of carrying diseases to a minimum.

BREEDING

Of course, the above described hygienic method has a positive effect on reproduction. The animals, rarely ill, are in a good condition and do not need to be disturbed for treatment. One of the rules in Blijdorp Zoo is: touch the animals as little as possible. There are some animals that make light of handling; (e.g. adult tiger pythons) even look for contact, but this seems to be dependent on the individual and, these snakes can function normally without any bodily contact. Since the move from the old reptile building to the Riviera Hall, the breeding results of snakes has advanced (see table). The old building was always very warm and humid. On sunny days the temperature went above 30^{0}C, and there was hardly a fall in temperature at night. In the Riviera Hall the temperature during the main part of the year is close to 20^{0}C; only on very warm days does it pass 25^{0}C. The nocturnal fall in temperature is substantial. A terrarium that is kept at 30-32^{0}C by 250 Watt heating light during the day, can be

Table 1. Bred species 1974-1984.

Boidae	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*[1]
1. *Liasis childreni*	X	X			●						●
2. *Python molurus bivittatus*						●	●		●		
3. *Python sebae*	X	X	X	X	●						X
4. *Boa constrictor*				●		●	●	●	●		●
5. *Corallus enydris*							●				
6. *Epicrates angulifer*	X	X	X							●	
7. *Epicrates cenchria maurus*	X		●				●	●		●	
8. *Eunectes notaeus*	X	X	X	X	X						●
Colubridae											
9. *Cyclagras gigas*	X	X	X	X	X	X				●	●
10. *Elaphe guttata*	X	X	X			●	●	●	●	●	●
11. *Elaphe obsoleta quadrivittata*	X	X			●	●		●	●		
12. *Natrix sipedon* *[2]	X	X	X	X	X	X	X	●	X	X	X
13. *Thamnophis radix brachystoma*	●	●				X	X	X	X	X	X

*[1] upto August
*[2] pregnant at arrival
X = not present in the collection during that year
● = breeding results

cooled to about 18°C at night if required. This temperature management together with better hygiene, a changed feeding rule, extension of the number of supporters and an increase in the size of the collection, has led to better results. In the old reptile building, the young born were predominantly from viviparous species: *Boa constrictor*, *Sistrurus catenatus* and *Thamnophis radix brachystoma*. The gaboon vipers (*Bitis gabonica*) that were born in the early '70, were from a

pregnant imported snake.

Table I shows the number of species bred since 1974.

This table shows that three of the twelve species that were bred, have disappeared from the collection. Regarding *Python sebae*; the female had retained the sperm in her body for about four years! The female *Natrix sipedon* was given to us by a private individual and appeared to be pregnant. *Thamnophis* was got rid of as the species was no longer needed in the collection, neither was *Python sebae*.
The breeding of *Python molurus bivittatus* was going well. As the number of hatched animals was increasing all the time, we decided to fall in with the request of the State University Leiden to supply eggs from this species for embryologic investigation. All eggs of reptiles are put into an incubator. Clutches of giant snakes are kept intact and placed as a whole in a separate incubator on wet tissues. These eggs are sprayed daily. Attempts to hatch the eggs in the mothers cage failed due to disturbance by other snakes. Also damage by cockroaches could happen. Eggs of smaller pythons (e.g. *Liasis childreni*) and colubrids are put in plastic bags on wet tissue (*Elaphe guttata, Elaphe obsoleta*) or on sand (*Cyclagras gigas, Malpolon*).
Stimulation of sexual activity by separation of the sexes, fluctuations in day-length and temperature are not used, in so far that the collection is housed in a partly glassed hall, where there is difference in day-length and summer and winter temperature. Probably, these small fluctuations are sufficient for the temperate species.
Here follows reports of successful breedings in Blijdorp Zoo, compared with the results of others.

Table II. Breeding results with *Liasis childreni* in Blijdorp Zoo, compared to those in the Institute for Herpetological Research (Ross, 1983) and Melbourne Zoo (Dunn, 1979).

	Blijdorp I	II	III	IV
Copulations in	oct/nov	oct/nov		dec/jan
Number of eggs	13	6	11	14
Eggs laid in	dec	dec	apr	feb
Infertile	2	-	7	2
Died	3	3	4	3
Incubation time	42 d	41 d	-	46-49 d
Incubation temperature	30°C	30°C	30°C	30°C
Substrate	paper	paper	paper	paper
Hatched	jan	feb	-	apr
Number of young	8	3	-	9

Ross	Dunn I	II	III	IV	V
sep/feb	apr-aug		apr	apr	apr/may
9	9	9	12	12	5
apr	nov	dec	oct	oct	nov
2?	3	4	?	?	-
1	1	-	?	?	1
65 d	66 d	66 d	61 d	54 d	54 d
28,8°C	28°C	28°C	28°C	30°C	30°C
* paper	vermi-culite	vermi-culite	vermi-culite	vermi-culite	vermi-culite
jun	feb	feb	dec	dec	jan
6	5	5	9	9	4

*beneath snake

Liasis childreni - Children's python.
On 26 November 1976, Blijdorp Zoo received four adults from Melbourne Zoo. The animals were housed in a terrarium measuring 80x80x80 cm. In December 1977 two clutches were laid: one of thirteen eggs (clutch I) and one of six eggs (clutch II).
Two eggs of the first clutch, laid on 15 December 1977, turned mouldy early. These eggs were not removed and did not affect the other normal developing eggs. On 16 and 17 January 1978 eight eggs hatched, the other three eggs when opened contained dead young. The mouldy eggs were infertile.
From the second clutch, one torn egg containing a living embryo, hatched on 4 February 1978. Two embryos were dead and three eggs hatched. Unfortunately, all the young of the first clutch died soon after the birth. The reason for this is unknown. Possibly, the reason was a bacterial infection. One of the second clutch ate on 2 March 1978 for the first time. In 1980 and 1982 infertile eggs were laid. In 1983 we obtained from mr. Marx a new male on loan. On 20 April 1983 eleven eggs were laid. Four were infertile. The remaining eggs died on 3 May and 8 June; the latter ones were completely developed.
On 14 February 1984, fourteen eggs were found in the terrarium. The female was unable to lay the last eggs and was treated with oxytocine, and within two hours she finished laying. The first egg hatched on 31 March 1984, the last on 3 April. Nine young were born, three eggs died and two were infertile. For more breeding information see Table II.

Python molurus bivittatus - tiger python
In 1971 Blijdorp Zoo obtained a young pair of tiger pythons from a private source. They grew well and the female laid (infertile) eggs in 1977. The group was enlarged with one female and two

males and after a successful copulation on 8 March 1979, thirty two eggs were laid (clutch I of table III). The eggs were incubated at a temperature of 30°C and a relative humidity of 100%. The eggs were sprayed regularly. After an incubation period of sixty-one days the first egg hatched; after seventy-two days the last one. The total number was thirty-one; one egg was infertile. The weight at birth of the young was 120-135 g with a mean length of 58 cm.
The young were housed individually in small plastic aquaria and reared the hygienic way (tissues on the floor, small plastic throw-away tank as drinking- and bathing device and a piece of brick for hiding and an aid for sloughing).
All young snakes in Blijdorp Zoo are housed this way in the first months or sometimes years of their lives (see figure). No young died and all have been housed at other zoos and with private individuals.
Clutch II was less successful. No copulation was seen, but the female started refusing food on 13 March 1980. On 8 April 1980 thirty-two eggs were laid by the same female as in 1979. During the incubation period nine eggs died. After sixty-two days the first egg hatched, after sixty-nine days the fourth and last one hatched. At least nineteen eggs appeared infertile. This remarkably poor result is possibly due to the fact, that in 1980 there were no copulations, the eggs being fertilized by sperm, stored by the female. In 1981 copulations were observed - by the older couple - but no eggs were laid. At 22 January 1982, copulations were again observed. This time thirty-five eggs were laid, again by the same female (clutch III). Twenty-three eggs were donated to the Leiden University for the purpose of embryonic research into warm receptors ('pits') in the lip of *Boidae*
The remaining twelve eggs developed well and in this case the breeding time was sixty-three to

Table III. Breeding results with *Python molurus bivittatus* in Blijdorp Zoo, compared to those from Seattle Zoo (Wagner, 1976), Mr. Foekema (1975) and with *Python molurus molurus* in Washington Zoo (Walsh, undated).

	Blijdorp I	II	III
Copulations in	jan	-	jan
Number of eggs	32	32	35
Eggs laid in	mar	apr	apr
Infertile	1	19	1
Died	-	9	-
Incubation time (days)	61-72	62-67	63-69
Incubation temperature	30°C	30°C	30°C
Substrate	paper	paper	paper
Hatched in	may	jun	jun
Number of young	31	4	11*3

*1 eggs bred beneath female

*2 *Python molurus molurus*

*3 most of the eggs are granted to the University of Leiden

IV	V	Wagner (1976)	Foekema (1975)*1	Walsh ( )*2
jan	jan	jan	-	nov-feb
25	19	30	13	22
apr	may	mar	mar	mar
-	-	?		
many	4	?		
-	-	60	58-61	61-85
30°C	30°C	30,5°C	30°C	30°C
paper	paper	sand/ peat	beneath snake	
-	-	?	may	may-jun
-*3	-*3	42 (two clutches)	11	16

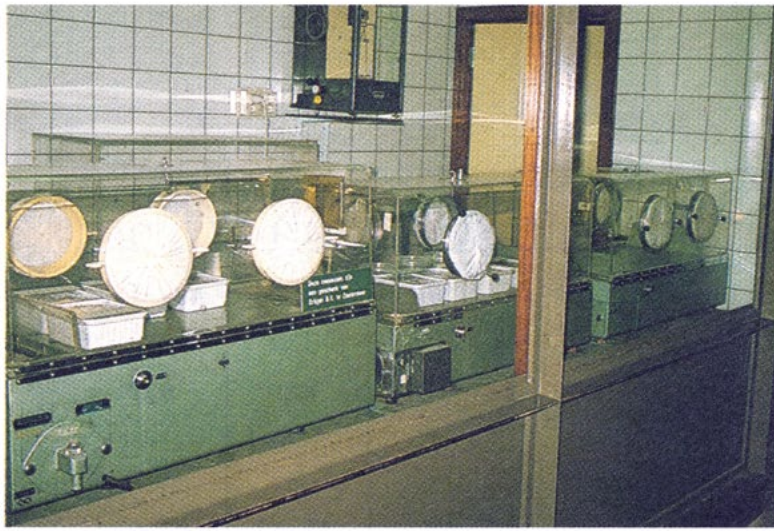


Fig. 1. Broedruimte / Incubators reptile eggs.
Foto: G.J. Visser.

Table IV. Dimensions and weight of eggs and young of *Python molurus bivittatus* and *Python molurus molurus*.

	Blijdorp Zoo	Foekema	Walsh *
Weight eggs (g)	180-200	-	245.9
Dimension eggs (mm)	94x60	-	100.9x68.7
Birth weight (g)	120-135	about 150	141.7
Birth length (cm)	58	-	-

* = *Python molurus molurus*.

sixty-nine days. Eleven young hatched; one egg was infertile. Five normal eggs were measured and weighed shortly after they were laid; mean size was 94.3x59.6 mm, mean weight was 187.2 g. In 1983 almost all the eggs were granted to Leiden because the housing of young was becoming more and more difficult. This year (1983) both females produced clutches; female 2 for the first time. This clutch (IV) was laid on 8 April 1983, after copulations observed on 26 January 1983. All twenty-five eggs appeared to be bad and none hatched. Clutch V of female 1 was laid on 2 March 1983 and was small, only nineteen eggs; fifteen were sent to Leiden. The remaining four eggs all died. In 1984 the eggs were laid, in the water tank and all died. Table III contains the data from several breedings with *Python molurus bivittatus* and *Python molurus molurus*; while in table IV weights and lengths are compared.

Python sebae - rock python

A snake that became famous in The Netherlands was the female rock python of Mr. Munnig Schmidt of Hilversum with which he had bred for the first time in 1972. In 1977 he decided to stop keeping these snakes, and offered us his specimens, we readily accepted. On 4 March 1978 the female appeared to be laying on eggs and paying attention to the regular muscle contractions she was brooding well. On 12 May she laid partly aside of the eggs. The eggs were expected to be infertile, as Mr. Munnig Schmidt had assured us that the female was kept without a male for four years or more and also Blijdorp Zoo had no male. The eggs were removed, twenty-three were infertile, but the remaining ten looked surprisingly well. One was opened and appeared to be fertile! The eggs were incubated and young hatched on 19, 21, 29 and 30 (2x) July. From this, it appears that female

Table V. Breeding results with *Python sebae* in Blijdorp Zoo, compared to those in the Transvaal Snake Park, South Africa (Patterson, 1974), Mr. Munnig Schmidt (1971, 1973) and Melbourne Zoo (Dunn, 1979).

	Blijdorp	Patterson I
Copulations in	-	-
Number of eggs	33	23
Eggs laid in	may	nov
Infertile	23	-
Died	5*	12
Incubation time	76-87 d	81-88 d
Incubation temperature	30°C	25-32°C
Substrate	paper	paper
Hatched in	jul	jan
Number of young	5	11

* = 1 opened

Patterson II	Munnig Schmidt I	Munnig Schmidt II	Dunn
-	mar	feb-mar	nov
33	17	36	37
nov	jun	apr	jan
-	3	2	2
33?	14	5*	1
-	-	83-89 d	75-81 d
-	25-27°C	25-30°C	30-33°C
-	beneath snake	beneath snake	vermi-culite
-	-	jul	apr
-	-	29	34

Python sebae can store fertile sperm in their body for longer than four years. The young slough-ed for the first time between 2 August and 15 August. Later, all the young were placed with other zoos and private collectors.
See Table V.

Boa constrictor - boa
In Blijdorp Zoo copulations are observed almost all the year round being more frequent in August and September, with the young born late in winter (January and February). Not so often April and May copulations result in young being born early in winter (November and December). Once when winter copulations occurred young were born in June. The breeding has never been very productive. While in the old reptile building litters of thirty and thirty-three young were known, since moving to the Riviera Hall the largest litter was nineteen (1981). The female often gives birth to about thirty young, but many of them are not completely developed, so that the number of live young re-mains below ten (see table VI). The reason for this is not clear at all. According to Huff (1980) the high age of the breeding females can be the

Table VI. Number of young *Boa constrictor* in Blijdorp Zoo per year.

1977	:	4 young
1979	:	2 young
1980	:	10 young
1981	:	19 young
1982	:	6 young
1984	:	3 young

cause of many infertile eggs and dead young.Bloxam and Tonge (1981) consider the possibility that the monotonous and static circumstances of captivity causes some animals to become inactive, fat and resulting in loss of breeding potential. Indeed, our present breeding female is too fat and a rather inactive snake.

Corallus enydris - slender tree boa
Only once have we bred with this species - in 1980. At Blijdorp Zoo until recently two females and two males were kept. Lately it was decided to stop keeping this species, in preference of the more attractive *Corallus caninus*, that we had on breeding loan from Ouwehand's Zoo. Copulations were rarely observed: once in November and once in February, which is in agreement with Abuys (1981). The young were born on 15 June, completely unexpected. The litter consisted of three live young, one dead young and eight infertile eggs. The young absolutely refused to eat litter mice, but ate half grown mice. The same occurred with young born in 1983 in the Ouwehand's Zoo (v. Kuilenburg, pers. comm.) and also with the young of other boids. The young grew well and were sent to the Leipziger Zoo on 5 May 1981.

Epicrates angulifer - cuban boa
In recent years these rare and threatened species have been bred more than previously (Huff, 1976; Bloxam and Tonge, 1981). In Blijdorp Zoo we have succeeded only once, in 1983. The adult animals arrived on 29 April 1977 from the Zoo in Havanna (Cuba). The first shipment consisted unfortunately of four males. It took four years before two females were sent from Havanna Zoo. These were however, young animals, so that attempts to breed had to be postponed. In 1982 the first copulations

were observed but these produced no results.
In 1983 the animals copulated between January to May often and for lengthy periods. Sometimes the animals remained in copula the whole day. The last copulation was observed on 18 May 1983. The breeding group existed at that moment of three males and two females. Unfortunately one male died in 1982. The females continued eating normally until about the beginning of August and from then at least one female stopped eating. More and more the females were to be on branches that were situated about 60 cm from the two warming lamps. On 19 October at two o'clock p.m. the largest female gave birth to four live young and one dead one. The other female produced, on 17 November, four infertile eggs. The young were strikingly large and thick. Huff (1976) compares the sizes of new born *Epicrates angulifer* with *Epicrates subflavus*. Young *Epicrates angulifer* were 71.8 cm long and weighed 174.9 g, compared with 48.9 cm and 14.6 g for *Epicrates subflavus*!
Two young sloughed for the first time on 3 November, the other two on 7 November. The young animals ate very irregularly in the beginning. In November and December everything was tried and often eaten: litter rats, half grown mice, and young chickens. From March 1984 live young chickens were regularly eaten and in May we started again with half grown mice. Since July 1984 all the young feed weekly on half grown mice.
In 1984 in the same months as in the former year many copulations were observed. These occurred almost daily and copulation time was very long. The last copulation was observed on 28 May. We eagerly await to see if young will be born in 1984.

Epicrates cenchria maurus - rainbow boa
In 1975 two animals (of different sex) were bought. In 1976 young were born, probably for the first

time in The Netherlands for this species. Since then young were born in 1976 (10), 1980 (3), 1981 (9), and in 1983 (13). Copulations occur throughout the whole year, but are most frequent in spring and summer. Young were born in autumn and early in winter. One exception was the litter of 1980. This occurred in the month of May. This litter was also exceptional in its result: three live and three dead young and one infertile egg. In recent years the breeding group consists of one male and two females, of which probably one female has young. In 1984 copulation has been observed. To give an idea of the frequency, I list below the dates of observed copulations, listed by month:
March: 16, 17, 19, 20, 22
April: 6, 13, 14, 17, 19, 24
May: 6, 9, 11, 14, 20, 21, 24, 25
June: 20, 30

It is difficult to say how long gestation is in this species. Also with *Epicrates agulifer* and the yellow anaconda (*Eunectes notaeus*) many copulations are observed making it unclear how long the gestation actually is. To all appearances the last copulation seems to be crucial, but more data over a greater number of years is necessary to be sure of this.

Eunectes notaeus - yellow anaconda
This species has been bred at Blijdorp Zoo for the first time in 1984. On 29 August fifteen young were born. It is pleasing to report that this is the second generation born in captivity. The parents were born in Bronx Zoo (New York) in 1979. Remarkable is the difference in litter size. In New York the sizes were twelve, ten and six young (Holmstrom, 1981).

Elaphe obsoleta quadrivittata - yellow rat snake and *Elaphe guttata* - corn snake.
The breeding results of these two species have been reported in the "Breeding Results" column in Volume 4 (1984) of Litteratura Serpentium. Since the reports we decided to stop keeping the yellow rat snake as the breeding ran so well that it became difficult to house all the young, the demand for young yellow rat snakes becoming almost zero.
It is curious that the demand for corn snakes bred in this Zoo did not decrease. All animals born in 1984 (thirty specimens) were placed without a problem; several people had to be disappointed.
The eggs of both species were incubated at 30°C, usually on humid towels. The incubation lasted 50-58 days for both species.

CONCLUSION

We still have many hopes. We have not yet bred the Montpellier snake (*Malpolon monspessulanus*). However, a female on breeding loan to Mr. C. de Haan in Amsterdam, produced fertilized eggs in 1984, of which several hatched. We are working hard to breed *Python regius*, *Chondropython viridis*, and several *Liasis*-species at our Zoo. A step forward is that one female *Python regius* produced fertile eggs for the first time at the end of 1984. As soon as new breeding results occur, we will report them in Litteratura Serpentium.

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Fig. 3. *Epicrates angulifer*, in copula. Foto: G.J. Visser.



Fig. 4. *Hydrodynastes (= Cyclagras) gigas*, in copula. Foto: G.J. Visser.

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