

Leopard Tortoises Breeding

The last tortoise species whose newborn young we could celebrate at the Brno Zoo is the Leopard tortoise, *Stigmochelys pardalis babcocki* (Loveridge, 1935).

Description of the Species

The Leopard tortoise is the second largest tortoise in Africa, after the African spurred tortoise [*Stigmochelys sulcata*]. According to the data available, the largest male recorded measured 65,6 cm and weighed 43 kg, while the largest female measured only 49,8 cm with a weight of 20 kg. Individuals of the nominate subspecies *Stigmochelys pardalis pardalis* (Bell, 1828) reach such dimensions. Tortoises of the *S. pardalis babcocki* subspecies are significantly smaller. Their length ranges within 35–45 cm and their weight doesn't exceed 15 kg.

The carapace of Leopard tortoises is always longer than it is wider, and its back edge is dentated more distinctively compared to the front edge. Its colour is yellow, with irregular dark brown to black patches. The plastron may be whole yellow with a dark stripe pattern. The head and legs are yellow to olive brown. The front legs are covered by shingle-shaped, firm scales. In the youth the carapace has a half-domed shape. The colouration is lighter and the pattern is more obvious in young tortoises. Differences can be seen in both subspecies even at that time. The nominate *S. p. pardalis* has two dark patches on every vertebral scute while the *S. p. babcocki* sub-species has only one. In adulthood, the subspecies can be distinguished on the basis of the length of their shell. The carapace of the nominate subspecies is flat in the centre and its length corresponds to two and a half times its height. The carapace of the *S. p. babcocki* subspecies is domed evenly in the centre and its length is slightly greater than twice its height.

The gender can be easily recognized at the age of 4–5 years when the individuals reach a length of 18–20 cm. The males' tail will start to lengthen and the plastron will sink into a markedly concave shape. At the same time, the males are narrower and longer while the females are shorter and wider. In adulthood, the differences are really distinct and no mistake can be made in the gender of Leopard tortoises.

Zoogeography and Biology

The Leopard tortoise inhabits central, eastern and southern Africa. While the distribution of the nominate subspecies is limited to south-west Africa and the Cape



Young Leopard tortoise right after hatching

Photo by Michal Balcar

Province, the home of *S. p. babcocki* stretches from southern Sudan to southern Ethiopia, through south-eastern Africa, southern Namibia up to the north of Cape Province.

This tortoise is a typical animal of the belt of the African steppe and savannah regions. It lives in bushy places and on edges of acacia forests, from lowlands up to heights of almost 3000 m above sea level. It has also been observed in such extreme climatic areas as the Kalahari Desert, and not only this desert but also other biotopes which the Leopard tortoise inhabits are known for very sharp fluctuations of temperatures during the day. During an exceptionally hot dry period, the day temperatures can climb up to 40 °C in the shade and drop to 15 °C and even less at night. The Leopard tortoise survives these extremely unfavourable living conditions buried in holes, termite mounds, in the banks of dried-out rivers or in rock crevices.

The tortoise feeds on various plants, mainly grasses and also succulent plants which are a great source of water. The Leopard tortoise can also occasionally put up with occasionally found fruits, animal remains, bones, dry excrement and vomit. While looking for suitable food, it overcomes great distances in arid areas. The following of marked individuals in Tanzania revealed that these tortoises managed to cover a distance of 70 to 100 km. One tortoise walked 12 km in two months.

Adult Leopard tortoises have only a few natural enemies. However, they are harmed indirectly by huge herds of goats and sheep which graze on the grass they eat, and many of them die before their time on roads and tracks under the wheels of cars. Their young and eggs are even worse off. Small tortoises are attacked by monkeys, African wild dogs, genets, ostriches, vultures, marabouts, secretary birds, ravens and other predators. Monitor lizards or jackals excavate the eggs with joy and ants also often destroy the clutch.

In the wild, mating takes place in the spring months, the female lays eggs from May till October. The number of eggs in a clutch ranges from 5 up to 30. 8 to 18 months after egg-laying, the young hatch and their size is 38–50 mm.

Beginnings of the Breeding of Leopard Tortoises

We gained a breeding pair of Leopard tortoises [*Stigmochelys pardalis babcocki*] in June 1998. Animals with the carapax length of 20 cm at the age of

four to five years came from Zambia. During years the tortoises have lived in several types of expositions, but also in the background. Since 2002 the couple has lived with a trio of Rhinoceros iguanas [*Cyclura cornuta*] in the exposition vivarium with the area of 15 m². Common cohabitation of tortoises and iguanas seems to be highly tolerant. The area is appropriately divided by a thick stem and several roots. A 50 cm layer of sand is used as a substrate on the bottom of the terrarium. In addition to illumination (HQI discharge lamps, halogen radiator heaters and lamps with an UV component), daylight which penetrates through the glass wall of the pavilion reaches the exhibit. The temperature under the above-mentioned heaters rises to 40 °C, in the remaining area, temperatures range from 25 to 30 °C. Night temperatures drop to 18–25 °C.

Food is offered six times a week; one day per week is a fasting day. In the vegetation season, the basis of their diet is field plants, mainly leaves and blossoms of dandelions and clover. From time to time, various kinds of vegetables and seasonal fruit are added. In the winter, the tortoises receive a mixture of Chinese cabbage, garden lettuce, grated carrots and quality meadow hay, chopped into 1–2 cm long pieces. Food of animal origin is not served at present. Even in the period of their maximum growth and adolescence, the tortoises showed no particular interest in it (however, they accept it commonly in the wild). We always sprinkle the food with a vitamin and mineral preparation (Roboran, Plastin or Vitamix). A bowl of clear water is a matter of course.

Sexual Behaviour and the First Clutches Laid

Land tortoises do not live in fixed partnerships. They couple randomly. During the mating season, as soon as a male discovers a female or captures her smell, he tries to follow her and mate with her. While the females remain on the spot or continue walking their own way, a passionate lover develops in the male. He often develops surprising speed and an active style of movement. If the female continues in her journey, he tries to stop her by running in front of her and pushing her. Via this behaviour, and also by biting her limbs, the male tries to force the female into copulation. If the effort is crowned with success, the male steps on the shell of the female from the back. During the copulation itself, the male emits an intensive wheezing sound. We

heard such sounds for the first time in the year 2003, and we have observed the highest frequency of wheezing in May and June every year. Attempts at mating also took place in the summer months, occasionally up until September. The female's first egg-laying took place in September 2004. Since then, one to three egg-layings have taken place every year, mostly from September till November. The female is usually restless before egg-laying and looks for a suitable place to lay the eggs. In this period, she can drink up to 0,5 l of water within a very short period of time. During egg-laying she releases urine and thus moisturises the hole which she has dug and where the eggs are laid. This hole is a unique piece of work. It is up to 25 cm deep, thinner at the top and wider at the bottom. It reminds one of a mushroom with the head at the bottom. The egg-laying takes place over 2-5 hours and then the female covers up the hole. Sometimes, she digs more holes, and then the egg-laying stretches over several days. In this case, the holes are never covered up.

Some egg-laying only contained three eggs, others up to eight. We have also had an egg-laying with 13 eggs. Up to half of the laid eggs were unfertilized; the embryonic development in the fertilized eggs unfortunately always stopped prematurely.

In 2007, we decided, for the first time, to place the tortoises in the period between May and mid-September into an outdoor enclosure with an area of approximately 12 m², primarily designated for the keeping of Pygmy marmosets [*Callithrix pygmea*]. The marmosets use the branches of several trees here and they descend onto the ground only sporadically. The enclosure is separated from the visitors by glass, direct sun rays reach it in the morning and there is a heated hut by its brick wall. If the weather is cold and wet, the tortoises stay in the hut for as long as several days.

Birth of Seven Hatchlings

The incubation of two clutches, laid in the autumn of 2007 in the indoor enclosure, was as similarly unsuccessful as the ones in the previous years. This unfortunate situation was successfully changed in the year 2008. How did it happen? At the end of May and mainly during June, strong mating efforts took place in the outdoor run. The male was chasing the female all over the area. At first, it looked like the only hiding place from the sex-desiring male would be the narrow space of the hut. But even there, the female was discovered. At the beginning of August, the female limited her intake of food and crawled all around the whole area very actively. She dug an experimental hole on 15 August, but left it late in the afternoon without covering anything. Four days later, on 19 August in the afternoon, she laid



Female dug out a hole for egg-laying
Photo by Michal Balcar

seven eggs which she covered up in the wetter part of the run, at a depth of approximately 15 cm. The eggs resembled table tennis balls in their colour and size; they were almost round, with a diameter of 38-42 mm and a weight of 35-38 g.

After digging up the eggs, which were all covered with an extremely slippery secretion, I washed them all in lukewarm water and placed them in an incubator. I used Vermiculite as an incubation substrate. The temperature in the hatchery was set to 30 °C. The relative humidity of the air reached up to 90 %. The happy moment occurred on 27 December 2008, when the first newborn Leopard tortoise in the history of Brno Zoo hatched after 128 days. Immediately before hatching, a soft crack was clearly visible on the surface of the egg, and liquid was leaking from it. It meant that the embryo has completed its development and the hatchling was trying to open the shell. Leopard tortoise hatchlings, similarly as with the young of all other tortoises, have a hard, horn-like protuberance on the top of their "snouts", i.e. above the premaxillary bone of the upper jaw. It is located exactly in the place where other reptiles have a sharp (egg) tooth. This protuberance helps the young tortoises to break through the shell. Two more young hatched on 29 December 2008. After the New Year, on 2 January 2009, four more tortoises saw the light of day. Seven young had hatched from seven eggs after incubation periods of 128, 130 and 134 days. It is commonplace that the eggs do not develop at the same speed and that the hatching will stretch over several days. After breaking the shell, the young firstly rest and sleep in their partially open egg and stick out only their head or leg. And finally, our little Leopard tortoises opened the rest of their shells with strong movements and biting and left their eggs forever. After hatching, the tortoises are slightly deformed. Gradually and slowly, the soft shell stretches to a normal size. Through the reduction of its curvature, the shell can be enlarged by 10 to 28 %. This irreversible stretching of the backbone ends the shaping of the shell. The average carapace length of our hatchlings was 42 mm and the average width was 34 mm. The weight ranged from 25-30 grams.

I transferred the newly hatched young from the incubation container into a clean, disinfected plastic container, onto a layer of moist foam rubber. Until the yolk sac had been absorbed and the umbilical opening had closed, they remained in the hatchery. This is the only way to eliminate the entry of infection into the fragile organism of a newly born tortoise. Afterwards,



The egg-laying before transport into incubator
Photo by Michal Balcar

I gradually moved the young into a prepared nursery terrarium with the dimensions 220x100x30 cm (length x width x height). Its bottom is divided into three sectors which are equipped with various substrates. In the first sector, there is a layer of always damp wood shavings, in the second one a layer of damp forest litter covered with leaves and the third part, filled with fine grit, can be called a "fitness centre". The young tortoises look for the two wet sectors before sleeping and enjoy burrowing into their substrates. Sleeping in a moist environment and the fluctuation of temperatures during the day is one of the decisive factors which influence the correct formation of the shell. The third part is a kind of exercise ground which forces the small tortoise to expend a large part of its energy. The nursery is lit by two Osram Biolux 36 W fluorescent tubes. I used the well-proven Osram Vitalux (300 W) lamp as a heating source which also provides the UV component of radiation - in its light beam, the temperature reaches up to 35 °C. This lamp is placed above the substrate at a height of approximately 40 cm and it is in operation for 5 hours a day. In the remaining areas, the temperatures range from 22-25 °C. At night, the temperature drops to 18-20 °C.

The little tortoises accepted their first food, which approximated the food of the adults in its composition, three days after hatching. They also enjoy eating small pieces of larvae of various kinds of insects, slugs or snails. They always have a bowl of water at their disposal.

Keeping in an Outdoor Run is the Condition for Success

The euphoria from the first breeding of the tortoise was somewhat suppressed by the death of the breeding female. The obstruction of egg-laying by an abnormally big egg which got stuck in a Fallopien tube became fatal for her. The female died on 23 December 2008, which is four days before the birth of her first offspring. All the little tortoises - survivors are doing well without any serious problems.

I consider the fact that the tortoises were given the chance to stay in an outdoor run from May till September as the main reason why we finally managed to breed the Leopard tortoise after many years. The advantages of such an approach are obvious. The tortoises will enjoy enough sunshine, fresh air, fresh food as well as the large area. The quality of life of tortoises (their welfare) is created, apart from by the temperature of the environment and other factors, also by the length of day and the intensity and composition of light. All these values also influence the breeding process and the viability of the embryos. Our seven successfully-bred Leopard turtles are the proof of it.

Michal Balcar,
Breeder at the Tropical Kingdom pavilion



Young ones with rests of shells on their carapace
Photo by Michal Balcar



Releasing a beaded lizard into an exposition



Mexican beaded lizards

First Appearance of Venomous Beaded Lizards

The family of beaded lizards [*Helodermatidae*] is made up of two species – the Gila monster [*Heloderma suspectum*] with the sub-species *H. s. suspectum* and *H. s. cinctum*, and Mexican beaded lizard [*Heloderma horridum*] with the sub-species *H. h. horridum*, *H. h. exasperatum* and *H. h. alvarezii*. Their original biotope are the arid areas of western Mexico from its southern up to its northern part where the range of Mexican beaded lizards also partially extends into the adjacent area of the Sonora Desert in the south of the USA.

They are the only venomous lizards – the extremely rare Earless monitor lizard [*Lanthanotus borneensis*], which is also sometimes grouped with venomous lizards, do have developed venom glands but are missing an outlet from them to the mouth. The venom apparatus of beaded lizards differs from the same organ in venomous snakes. Venomous snakes have the openings of their venom glands connected to venom fangs, while the venom glands of beaded lizards open into the back third of the lower jaw. The toxin is thus transported onto the whole area of the arch of the lower jaw and can be conveyed into a wound by more than one tooth; beaded lizards have 36 to 42 teeth. The toxin of beaded lizards is usually substantially diluted with saliva during a bite,

which lowers its effectiveness. The toxin of beaded lizards is a type of neurotoxin; in composition it is close to the neurotoxins of cobras. The venom apparatus of beaded lizards is probably used for defence.

The keeping of the Mexican beaded lizard in Europe is controlled by the European Endangered Species Programme (EEP), its reproduction in captivity is recorded in the International Stud Book (ISB), and the Red List of Threatened Species lists it in the “vulnerable species” category.

Our beaded lizards belong to the nominate subspecies *Heloderma h. horridum*. They live up to 20 years of age, and in adulthood can weigh up to several kilograms for a body length of 80–90 cm. The female lays 3–5 eggs with an incubation period of 120–135 days (all subspecies of the Mexican beaded lizard have been reproduced during breeding in the Czech Republic). The young hatch with a size of approximately 15 mm and are more distinctively coloured than their parents. They begin to accept their first food at about 14 days of age.

The demands for the breeding facilities for beaded lizards are not hard. A tank with minimum base dimensions of 100 x 50 cm is sufficient, with a height of 50 cm. Washed river sand will serve as the base substrate and a part of the standard equipment of the terrarium is a water container and a hollow log. In the summer, it is necessary to maintain the temperature at around 30 °C, falling at night to 22–24 °C.

In the wild, the food of beaded lizards consists of bird eggs and newborn chicks (mainly of ground-nesting species), reptiles and small rodents. They hunt the rodents, which are the dominant part of their food, in their burrows. Beaded lizards check the presence of the prey using their sense of smell. The odour molecules caught on the tip of their tongue are transferred for analysis to the Jacobson's organ which is located on the upper palate (that's why beaded lizards, similarly to snakes, stick out their tongue and move it back into the mouth cavity frequently). Mexican beaded lizards practically do not eat insects or other reptiles – they don't attack them even when sharing an enclosure.

In captivity, beaded lizards are offered a spectrum of food similar to which they eat in the wild; in emergency, they can also be served minced meat. The eating of eggs is a ritual for them – the lizard licks the egg white with the yolk out of a broken egg, then bends its head backwards and lets the content flow into its stomach. In captivity, beaded lizards are served quail eggs as

well as hen eggs. Beaded lizards first examine the shell to find out what is inside. Then, they try to grasp the egg in their jaws and lean it on a firm object, e.g. a stone or a wall of the terrarium. If they succeed, they push the egg against the obstacle while increasing the compression of their jaws simultaneously. After several minutes, they will break the whole circumference of the shell and start biting out an opening in a weaker spot from which they will lick up the content.

Beaded lizards have developed an ability to store excess fat in their tail which helps them overcome long periods of drought. The volume of accepted food is small compared to the size of their body. Because these calm animals usually accept food well in captivity, it is necessary to mind the danger of overfeeding and fattening; obesity reduces reproduction. The circumference of the tail, measured above its root, is used as a test for the assessment of their condition. It shouldn't be larger than the circumference of their body in the area of the coxal bulge.

Beaded lizards are active late in the evening and at night. In their calm phase they go stiff and become lethargic. They are, however, easily disturbed by even insubstantial stimuli and changes. In January their environment should have a constant temperature of 13–16 °C, in February even with a fall to 10–12 °C. In March we raise the temperature to 14 °C at night and 20–24 °C in the day, while in April it is 22–24 °C at night and 26–30 °C during the day, with the lizards given the opportunity to warm themselves in a localised area heated up to 37 °C. In the geographical latitudes where the Sonora Desert is found, the photoperiod (length ratio of night to day) is 14:10 in the winter, while in the summer it's the opposite. The relative humidity of the air doesn't seem to be a decisive factor for beaded lizards. In Arizona and northern Mexico the air humidity in the spring and summer varies within the range of 0–5 %, from July to September it can reach up to 50–90 %. Given the fact that they also live underground, beaded lizards aren't going to have a problem with a departure from these values.

For successful breeding of these lizards in captivity it is necessary to simulate the conditions in their area of origin. Breeder's experience has shown that special equipment, hatcheries and other gadgets are not needed more than a climate atlas and detailed knowledge of the place the animal comes from.

Jiří Vitek,
Operating zoologist



Sand cat – male

New Exposition of Sand Cats

The Brno Zoo has still had enough free space for establishing new expositions. Many of them are built for example along the new backbone road. A place for a new exposition was also found inside a pavilion, namely in the atrium of the Tropical Kingdom pavilion. At the end of the previous year Okno – komplet, Ltd. built a breeding facility for Sand cats [*Felis margarita harrisoni*] there. This species thus returns to the pavilion where its successful breeding was carried out in 2000 and 2001.

The exposition consists of glazed aluminium sections which close the space 5,5 m long and 2,5 m wide and high. It is heated by two radiators masked by branches and dry grass and two heating boards situated in the floor. The exposition is lit by a HQIT 250W discharge tube and also gets daylight. Sand serves as the base. The illusion of a desert is induced by dry bushes, tree stumps and branches. There are two small boxes available for the cats.

We did not have to go far for the animals we got in. They come from the so called "Alley of Beasts of Prey", which used to be a line of cages with small beasts of prey which was cancelled in the lower part of our zoo. Osiris, a five years old tomcat born in the British Bristol Zoo, forms a couple with Eva, a two years old cat from the Polish Krakow Zoo. Cats got used to the new environment very quickly and we believe they will soon deliver young ones.

Breeding Sand cats started in our zoo in 1998 by importing two males from the Wuppertal Zoo. Approximately two years later we managed to gain two females from the Berlin Zoo. One couple is situated in a lower part of the zoo in an outside exposition



New exposition of the Sand cats



Sand cat – female

and the other settled in the inside exposition in the building of vivaria neighbouring with the Tropical Kingdom. The female delivered and bred four kittens there in 2000. Later the breeding of Sand cats concentrated only in the lower part of the zoo and more kittens have not been born.

Sand cats are one of the smallest wild cat beasts of prey. They live in the arid zones of Northern Africa (they also occur in Chad and Niger on this continent), the Near East and the Central Asia up to Pakistan, where they are considered extinct. There are six subspecies, and two of them, *Felis m. margarita* from Northern Africa and *Felis m. harrisoni* from the Arab Peninsula are the subject of the European Conservation Programme. The Sand cat has a strikingly wide head with huge ears. The fur can be any colour from sandy to grey with the black tail tip. It has excellent hearing and is able to hear the prey through a layer of sand and dig it out. It does not bog into sand because it has a dense black fur between finger pads. It avoids places with a hard surface. Its main diet is sand rats and it also hunts

for desert jerboas, lizards and birds. It is able to catch a poisonous snake which it stuns with a paw. The Sand cat is best of all cats adapted to the life in a dry environment. Its kill is the only source of water for it; it need not drink at all. It spends hot periods during the day in its burrow, which it has dug. One cat can have more burrows. It is active at nights. Its natural enemies include jackals, big birds of prey and big owls.

According to a legend a sand cat was a guide of Mohamed, therefore local people do not kill it, even if it is sometimes harmful to their chickens. It is the only cat beast which is not endangered by a loss of its natural environment. Nowadays it is endangered by catching for private breeders. IUCN estimates its numbers to 5,000 adult individuals. To count them, however, is very difficult because they do not leave any tracks in sand, its fur colour makes it almost invisible and when illuminated by a torch light, it closes its eyes.

Lenka Vejpustková and Josef Kolesa,
Breeders at the Tropical Kingdom