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ZOO report
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BRNO

Pair of Madagascan iguanian lizards

Breeding of Madagascan iguanian lizard

Presence of iguanas *(Iguanidae)*, a typical American animal, inside the immense area of agamas *(Agamidae)* on Madagascar and Comoros is one of the greatest geographical peculiarities. In the island isolation, Madagascan iguanian lizards formed their own subfamily, *Oplurinae*, which further divides into two tribes. The first one is a monotypic tribe *Chalarodon* and the second *Oplurus*. Six kinds of tribe *Oplurus* can be found in almost whole the Madagascar and Comoros Islands.

It would be naive to suppose that quickly proceeding devastation of the last remains of the original nature would not affect in some way also the fate of Madagascan iguanian lizards. They also participate in an unusually high representation of endemites in local animal kingdom, which with amphibians and reptiles reaches 99 percent. Extinction of each Madagascan tribe is an irreplaceable loss. That is why I welcomed the opportunity to study life manifestations of iguana *Oplurus cuvieri* (Gray, 1831), that enriched herpetologic collection of Brno zoo in 2005.

This iguana inhibits mainly west and northwest of Madagascar; it is very common in the surrounding area of administration centre Mahajanga. Towards south its territory continues along west shore up to Morondava town, it lives also in the centre of island up to the frontier of eastern rain forest. It is an inhabitant of dry forest, where it climbs on tree branches. It is also possible to meet the lizard in open country, on the rocks and on the ground. Contrary to most other iguanas, information about biology of iguanas from Madagascar is very scarce. From most more detailed information we learn that Madagascan iguanian lizards live in a sympatric way with other kinds of geckos and besides usual insect they eat various fruits and leaves.

Head of Madagascan iguanian lizard

Iguana *Oplurus* cuvieri usually grows to length of 25–29 cm, exceptionally up to 38 cm – in such size 23 cm falls on tail. Together with iguana *Oplurus* quadrimaculatus, which grows to length of up to 39 cm, *Oplurus cuvieri* belongs to the biggest members of its tribe. It differs from related tribe *Oplurus cyclurus* by ordering of tail articles. Oplurus cuvieri has got an articulate tale and between individual big rings of tail thorns narrow raw of small interrings is seen. Brown colour in many shades prevails on the back, both sexes have several dark or almost black cross strips, between them appear both white and dark taints.

The prerequisite of successful breeding is the stimulation of iguanas during several-month period of cold when daily temperatures do not exceed 20–24 °C. This is at least approximate imitation of annual climatic cycle in nature. Madagascan winter, or the period of draught, lasts approximately since April till November. During the time not only Madagascan iguanas but also many local kinds of lizards and amphibians are in inactive state to survive the colder period of year. We decided to breed *Oplurus cuvieri* in 2004, when Zoo Rotterdam offered us the young born there in October 2003. Three iguanas (two males and one female) arrived to zoo in Brno on 27th April 2005. We appropriated them a specious exposition in pavilion Tropical kingdom. Terrarium is 2 m high, 2.20 m long and 1 m wide. Back part is shaped into the form of artificial rock with many rest terraces with built-in power resistance cables for warming. Two high-intensity discharge lamps (HQI 250 W) secure artificial lighting. Several dry branches fill the space, at the bottom there is a layer of sand substrate. Temperature gradients enable lizards a considerable behavioural thermoregulation. On heated-up rocky ledges the temperature reaches temperature 35–40 °C, in remaining space 25–30 °C. Data are valid for period since March till the end of November. Since December till the end of February, that is for the time being of three months, we successfully simulate cold phase when in exposition occur the decrease of temperatures to 22–24 °C in the daytime and 18–20 °C in the night. Daily photoperiod simultaneously also shortens to approximately 10 hours and lizards significantly reduce both movement and food intake.

The basic component of food of iguanas *Oplurus cuvieri* living in human care are crickets *Gryllus assimilis* and *Gryllus bimaculatus*. In Zoo Brno they get, though irregularly, also larvae of darkling beetles *(Zophobas morio)*, larvae of Goliath beetle *(Pachnoda marginata)* and smaller imagos of locusts *(Locusta migratoria)*. The most popular food of our Madagascan iguanas are all development stages of cockroach *(Nauphoeta cinerea)* and also – but only sporadically offered – caterpillars of silkworm *(Bombyx mori)*, with whom iguanas can literally overfeed themselves. I was very surprised by their active intake of shredded pieces of carrot and sliced apple, added twice a month to food. We always sprinkle their food with some of vitamin-mineral preparations (Vitamix, Roboran, Plastin). We dose vitamin D_3 once a month (except three winter months) in quantity 500 units / kg of live weight.

We recorded the first sexual activity two months after the arrival of iguanas to our zoo. The copulation, which took approximately one minute, took place on rocky ledge. Dominant male watched over the female and drove away the smaller male. The smaller male almost did not get to privileged heated up positions on the rock and occupied upper corners of exposition where he was less noticeable. During the second year of breeding the aggressiveness of dominant male grew and that is why we caught the weaker male and placed him to terrarium in backing.

On 15th June 2005 female oviposited the first three unfertilised eggs on rocky sparing, filled with clay/sand substrate. Overview of all other oviposotions are declared in the table. During the first year I recorded three ovipositions. Although fertilized eggs from second and third oviposition developed well, sucklings in the eggs (one from oviposition 2 and two in oviposition 3) died just before emergence. I chose Vermikulit as incubation substrate for egg lodgement and I kept incubation temperature at 27–28 °C. In 2006, the second year of breeding, I observed repeated mating already at the beginning of April. The fourth and fifth oviposition we found again in the upper rocky sparing, eggs from the sixth and seventh lay freely at the bottom of terrarium. Four eggs of sixth oviposition we found already bitten through by insect, two eggs from seventh

Overview of ovipositions of iguana *Oplurus* cuvieri in Zoo Brno in years 2005–2006

Oviposition No.	Oviposition date	Number of eggs	Date of hatching	Incubation time	Body length	Total length	Sibling number	Note
1.	15th Jun 05	3	–	–	–	–	–	unfertilised
2.	2nd Jul 05	3	–	–	–	–	–	2 unfertilised eggs, 1 dead embryo, 42nd day of incubation
3.	20th Aug 05	3	–	–	–	–	–	1 unfertilised egg, 2 dead siblings, just before hatching
4.	1st May 06	3	13th Jul 06	74	4.5 cm	11.0 cm	1.	1 dead sibling just before hatching
			13th Jul 06	74	4.6 cm	11.5 cm	2.	
5.	10th Jun 06	4	21st Aug 06	72	4.3 cm	10.8 cm	3.	2 dead siblings just before hatching
6.	22nd Jul 06	4	–	–	–	–	–	destroyed oviposition
7.	21st Aug 06	2	–	–	–	–	–	unfertilised

oviposition were obviously not fertilized. Compared to the first year of breeding, the number of ovipositions and eggs increased. Average size of fertilized eggs was 26 × 16 mm. For incubation I placed three eggs from the fourth and four eggs from the fifth oviposition, this time I increased the temperature to 29–30 °C. During incubation I displaced (20th June) one unfertilised egg from the fifth oviposition. Two healthy siblings appeared on 13th July 2006, after 74 days of incubation. Born siblings had their navel stud still visible, that is why I placed them to hygienically adjusted box with moist foam rubber at the bottom, where they remained for three days, until the rest of vitelline sac was absorbed entirely and navel scar shrank. After opening the third egg from fourth oviposition I discovered an already dead developed sibling inside, with big unabsorbed vitelline sac. From the fifth oviposition one young appeared after 72 days, this successful fosterling came to the world on 21st August 2006. Incubation conditions were identical with oviposition No. 4. In the remaining two eggs dead nubbins with unabsorbed vitelline sacs were found again.

We kept three small iguanas together in terrarium, which had dimensions 60 × 50 × 50 cm (length, height, width) with clay/sand substrate at the bottom and many dry branches and several pieces of bark. Two fluorescent tubes (Osram Biolux 36W) secured illumination. Lightbulb (60W) provided heat, the siblings spent most of their time below it – temperature reached 35–40 °C there. Small iguanas accepted their first food, an early stage of locusts, already on the third day after birth, while they were still in plastic box. Since the third month the biggest small iguana controlled the whole space of terrarium and his territorial behaviour became so intensive that I decided to place each sibling into a separate terrarium.

So much brief data from the first breeding of iguana *Oplurus cuvieri* in Union of Czech and Slovak Zoos, but obviously also in the Czech Republic. After Zoo Rotterdam, Zoo Brno therefore became the second European zoo that can boast about successful reproduction of the rarely kept lizard. This was also one of the reasons why Zoo Brno sent the first two young of Madagascan iguanian lizard up the contest of the most significant nursling of the year. Our double victory in category of lizards, amphibians and fish of contest organized by association of persons Czech Zoo proves that we have something to build on. For breeding the Egyptian turtle *(Testudo kleinmanni)* we gained the first prize in 1996, for breeding Jackson's Chameleon *(Chamaeleo jacksoni)* we gained the same in 2000.

May the success of breeders from pavilion of Tropical kingdom of zoo in Brno be the contribution not only to understanding but also preserving biodiversity of beautiful and mysterious island, that is sometimes described as another continent for its specific features. Reproduction of rare lizard is the first and probably the most important step with which Zoo Brno ally to the campaign for Madagascar nature protection, announced this September by European Association of Zoos and Aquaria.

Michal Balcar

Artificial nursing of brown hare

Hares that we clarify to the family Leporidae and tribe Lagomorpha are generally considered to be a difficult group to breed. Long-term successful keeping in captivity is made more difficult by several interesting aspects of their biology. For example, for breeding in captivity it is important that hares – contrary to rabbits – do not build permanent hiding places and self-infection by endoparasites presents a great danger them, the risk is even increased by so called cecotrophy, i.e. eating one's own feces. Eaten vegetable food is not digested in the first phase and from the appendix, which takes almost 30% of digestive system it quickly goes out in the shape of mashy pellets that the animal immediately eats. Excreta (cecotrophies) contain – contrary to other hard pellets - next to partially digested food also vitamins and bacteria from appendix that are necessary for decomposition of cellulose. Thus most of the food passes through the alimentary tract twice, which secures maximum usage of nourishing elements. This process is called defecation.

Feeding of brown hare sibling *Photo by Miroslava Piškulová*

Even more difficult than breeding of healthy animals is their reproduction in captivity. Especially demanding is the artificial nursing of siblings deserted by their mother. Milk of *Leporidae* is specific. They have one of the most concentrated milks

among ground mammals, which is characteristic by high content of fats and proteins and on the other hand also very low content of milk sugars (lactose). Significantly higher content of fats in breast milk have pinnipedians (in low content of proteins and trace amount of sugar) and cetaceans. It is not easy to keep good digesting of young hares, because it is not possible to supplement excreta of female that even very young siblings lick from vent of their mother.

Workers of Rescue centre for handicapped animals of Zoo Brno made an attempt to breed artificially two brown hares *(Lepus europaeus)* by the end of this June. Municipal police brought to zoo two very small about two days old healthy siblings handed over by people from Brno-Líšeň residential area. It was a typical example of likable human endeavour to save an animal life combined with absolute unfamiliarity with species biology. Mother with 100% certainty did not leave her children but she only hid them for the time between individual breast feedings. Unfortunately, siblings held in hands of people cannot be returned because human smell would discourage the female and she would not take care of her offspring.

In the first place we had to prepare an appropriate accommodation for young hares in zoo and a supplement of natural milk. For the first day of breeding we placed little hares to middle, easily cleanable and desinfectable transport plastic box, later we placed them to a big cage and finally to spacious hutches.

Milk of *Leporidae* contains 15.75 % (12.0–20.0 %) of fat, 12.25 % (7.5–18.0 %) of proteins and 2.62 % (1.5– 4.0 %) of milk sugar (lactose). Some authors define with some species little different values of fat (rabbit up to 10.45 % and hare up to 24 %). Condensed unsweetened milk Tatra (fats 9.0 %, proteins 8.0 %, sugars 11.6 %) was used, in spite of a significantly higher percentage of sugars as the base of alternate milk, mildly diluted by natural juice from grated carrot, and egg yolk (for increase of fatness). The portion of alternate milk therefore consisted of 130 ml of condensed milk Tatra, 15 ml of carrot juice and one egg yolk. *Roman Kučera*

Process of artificial nursing of brown hare

Day of life	Date	Note
1.	20th June	Probable date of birth
3.	22nd June	Hares brought to Zoo Brno
4.–11. (8 days)	23rd–30th June	Feeding by alternate milk from syrette in 2-hour intervals since 7 a.m. to 11 p.m. At the beginning they were licking the syrette, later slightly sucking it. From the very beginning a green food was offered (dandelions, trefoil, soft grass) and carrot cut to thin slices. Cage was cleaned once in 4 days. Presence of excreta was important, after several days they also ate it. They put their excrements to one place, the one where food was placed. They slept at the other side of box.
12.–21. (10 days)	1st–10th July	Feeding by milk from syrette in 3-hour intervals since 7 a.m. to 9 p.m. The portion of milk was ad libidum. They started to eat a lot. Green food and carrot were supplied in excess. They started to bite a bit during feeding.
22.–26. (5 days)	11th –15th July	Feeding by milk from syrette in 3-5 hour intervals since 7 a.m. to 9 p.m. Green food was supplied in excess. Hares grew considerably and had to be relocated into a bigger cage.
27.	16th July	They refused milk, they started to eat only green food – they were weaned.
28.–42. (15 days)	17th–31st July	Feeding with greed food and carrot. Daily allowed to go free on grass and regularly dewed. They use bowl with water only for wetting fur and washing.
43.	1st August	Weight approximately 300 g. Transferred to rabbit hutch.
44.–98. (55 days)	2nd August – 25th September	Feeding by green food, carrot, snail-clover granules and they have a hay bed in the corner of hutches. They became wild and shy in the big hutch.
99.	26th September	After 96 days after the beginning of artificial breeding, with weight of approximately 1.5 kg, they were let out to open nature in locality Mniší hora.

Protection and breeding of fishing cat

Like most small cats also fishing cat is often introduced under Latin family name *Felis*. But already in 1858 Severtzov separated a group of cat tribes to a separate branch Prionailurus. At present time, next to fishing cat *(P. viverrinus)* also leopard cat *(P. bengalensis)*, rusty-spotted cat *(P. rubiginosus)* and forest cat *(P. euptilurus)*, that is by some authors considered to be a subspecies of leopard cat belong to this tribe. Peculiarity of the group was confirmed also by study of caryotypes. Flat-headed cat *(Ictailurus planiceps)* is close relative to family Prionailurus and iriomote cat *(Mayailurus iriomotensis)*.

Family name *Prionailurus* comes from Greek language. Prion means "to file" and ailur is a cat. Generic name *viverrinus* refers to civet cats *(Viverridae)*, probably for certain similarity.

Fishing cat is scattered in tropical Asia where it divides into two branches. Main tribe *Prionilurus viverrinus viverrinus* lives in Pakistan, India - as far as Himalayas foreland, Ceylon, the whole southeast Asia up to Vietnamese-Chinese border and on Indonesian island Sumatra. Tribe *P. v. risophores* lives on Indonesian islands Java and Bali and on a few islands in the area.

Threats and protection

Fishing cat is threatened most by destruction of natural environment, especially wetlands that under the pressure of modern civilisation are changing into agricultural area. Other dangers consist in fact that fishing cat is considered a predatory animal; people also hunt her for meat or fur and source for preparations of traditional east medicine.

We do not have sufficient data regarding the number of animals. The cat is at the point of extinction in Pakistan, where she was scarce already before that and people still pursue her – shoot and trap her. Fishing cat is critically endangered on overpopulated and highly cultivated Indonesian island Java, where pesticides pollute local nature. State legislatures in Bhutan, Malaysia and Vietnam do not protect fishing cat at all, we also have no information about her protection from Cambodia. Hunting is regulated in Laos and in neighbouring states laws of various level protect her. In spite of that the International Union for the Conservation of Nature and Natural Resources (IUCN) sees her future in an optimistic way and since 1996 fishing cat has in Red Book status "Lower Risk/Near Threatened". On the basis of geographical distribution and estimation of population density the number of cats was set at less than 10,000 individuals living in wild nature, however, with decreasing tendency. Local subpopulations do not have more than 1,000 individuals.

The environment and way of living

Fishing cats inhibit especially wide range of biotypes connected to water and moist environment – swamps, marshes, mangrove bushes and banks of rivers and brooks. They were seen in tidal gulfs and we also meet them deep in tropical forests. In bushy vegetation near water flows they ascend also

to higher areas. For example in Himalayas forelands they live even in the altitude of 1,500 metres above see level and in mountains of Ceylon even 2,100 metres above see level.

The area of home territory ranges from 4 to 8 km^2 with females and up to 22 km^2 with males. Fishing cats share part of their area with bigger jungle cat *(Felis chaus)*.

The environment in which fishing cats live affects and determines their way of life. The most concisely they can be described as fisheaters. We see them mostly fishing along the banks of water flows and water areas. They draw out fish from deep water and often play with it in shoal water. They were seen to dive and catch fish right to jaws or to simulate fall of insect by gentle movements of paw on water surface and thus allure fish to the surface where they hunt them. It is not known if they prefer certain kinds of fish and whether they affect the size of fish population.

Studies that focused on composition of food confirmed that fishing cats feed in preference on fish. Analysis of 144 samples of excrements showed that 109 of them contained bits and pieces of fish. Pieces of birds were in 39 samples, of insect in 18, of small rodents in thirteen, mix of molluscoids, lizards, snakes and meat of mammals in eleven and in thirty-one samples were pieces of grass. Although the main component of food in most of the area is fish, there are populations of fishing cat that prefer other animals. Hunting of palmipeds was recorded in Pakistan: fishing cats swam under water to the birds and drew them down under water. Also small Indian civet *(Viverricula malaccensis)* is recorded as prey, as well as sambur *(Rusa unicolor)*. Reports that wild pigs or other big wild or domesticated animals became prey refer probably to eating carcasses, which is quite frequent. In 1987 fishing cat was seen at carcass of caw and a case is recorded the cat sponged upon prey of tiger. Earlier reports of fishing cats eating dogs, sheep, calves and even children probably refer to these cases of necrophagy.

Reproduction and nursing in captivity

Fishing cats mate mostly once a year, usually in January or February but it is known that they can mate also in June. Kittens were seen in nature since April to June. In Zoo Philadelphia kitten were born in March and August. In private breeding in Ceylon the first two kittens were born on 21st October. In Zoo Brno one birth occurred at the beginning of May and two in the middle of June. Gravidity lasts 63–65 days. The number of offspring ranges from one to four; on average two siblings are born. Young cats weigh 100–173 g after birth and put on weight about 11 g a day. Their eyes are open on the sixteenth day. They eat meat since the fiftieth day and are weaned at the age of four to six months. At the age of nine months they reach the size of adult animals and achieve independence at the age of 12–18 months. They reach sexual maturity probably right afterwards. In captivity, males were seen helping a female with taking care of siblings. It is not clear if the same behaviour is typical for wildly living fishing cats.

According to ISIS data, by the end of August 2006 in total 26 American zoos and 65 other institutions in the whole world bred 96 males, 85 females and 7 individuals without determined sex. Population in captivity urgently needs new founders and according to non-profit organisation EFBC´s Feline Conservation Center a pair of siblings was imported from Vietnam to the U.S. in June 2003 and pair of siblings from Singapore in July 2003. Both pairs are from parents caught in nature. Newly completed unrelated pair went to Zoo Cincinnati and EFBC kept the second in California. There are 10 other individuals in the institution. European population was enriched by import of pair from Zoo Colombo to Zoo Brno in 2005. Both animals were born in captivity to parents whose origin was nature.

Five zoos breed fishing cats in the Czech Republic at present time: Děčín (0, 1), Brno (1, 0), Olomouc (1, 0), Ostrava (1, 1), Praha (0, 1). Zoo Brno gained its first pair in June 1994 from British zoos. They were two-year old unrelated individuals. In the following year breeders saw one sibling, but

Artificially nursed sibling of fishing cat
Photo by Bohdana Bergmannová

it disappeared. In 1996 male was separated and on 16th June female gave birth to two siblings and began to nurse them. After 14 days one of them died and the second was apathetic. Young female had to be taken from her mother, she received two portions of antibiotics and after five days her condition improved. She was given alternate milk consisting of condensed unsweetened milk Tatra, egg yolks and water. At the age of three weeks she started to accept meat and in the age of two months when her weight was 1.6 kg she weaned herself. When she was two years old, zoo handed her over to Zoo Bojnice. Workers in private breeding in Ceylon experienced similar situation. Shortly after birth they found one of two siblings dead, dissection revealed the cause of death was pneumonia – perhaps it developed as a result of then monsoon rains. The second sibling was given terramycin and consequently nursed artificially. Female in Zoo Brno gave birth to another female in 1997 that later enriched the exposition of Zoo Ostrava. Another three kitten were bred in 2000, as adults they consequently got to Zoo Olomouc, Zoo Amnéville and Zoo Ostrava. Brno breeding female died in 2003 and her partner one year later, both at the age of twelve years. Zoo Brno gained another unrelated pair from Zoo Colombo in Ceylon in 2005. The original pair was self-confident, fleeing distance ranged between one and two metres. But the pair imported from Colombo was very shy, fleeing distance was more than 10 metres and when breeder approached them, the animals were fleeing in utter panic also on the walls of cage. Unfortunately, female had to be destroyed shortly after transfer from quarantine to exposition (one month after transport) because she suffered from complicated broken bones that she herself caused in temporary dormitory in exposition.

Some individuals living in captivity are tolerant to each other; males can participate in nursing of offspring. In Zoo Frankfurt in the years of 1960, 1961 and 1963, siblings were nursed in the presence of male who behaved very nicely to them. Also breeder in Ceylon does not think it necessary to separate male during nursing of siblings. However, male in Zoo Philadelphia killed the first kitten, so they routinely separated him. The experience in Zoo Brno is identical. We do not know if the siblings were eaten by male or female but the presence of male was disturbing. Male living in The Cat Survival Trust in Great Britain killed every female he was coupled with. On the other hand, breeding pair in Ceylon surprised by calm behaviour during feeding when partners did not quarrel or purred to each other.

Food of fishing cats in captivity conforms to possibilities of breeding institutions, however, as for feeding it seems cats are not demanding. Breeder in Ceylon fed them by beef heads and chickens with addition of mineral mix. In Zoo Philadelphia they were given row horsemeat, living rainbow smelts *(Osmerus mordax)* and addition of vitamins and minerals. In Zoo Brno the feeding portion is usually beef meat, chickens, rats and both frozen and living weed fish. Fishing cats avoid additions of roboran or plastin.

Like leopard cat also fishing cat poos most often into water, even when bowl with water is placed in the height and pooing is thus uncomfortable. This means fast contamination of pool with water and cats consequently use it only for pooing. They are persuaded to wash only by clean water with living fish. Cats quickly fish out all of the fish, even if there are more fish than they can eat.

Due to the fact that fishing cats come from tropics, they should have a heated dormitory at their disposal. However, they do not refuse staying on snow and freeze, because their fur with very dense base protects them efficiently against freeze. In captivity they can live up to fifteen years.

European Association of Zoos and Aquaria (EAZA) established Taxon Advisory Group (TAG) for managing breeding of fishing cat in zoos. In the U.S., breeding of fishing cat conforms to Species Survival Plan (SSP), whose goal is the securing of breeding of optimum number of 100 individuals. There is a pedigree book, administered by Lynda Roberts from Riverbangs Zoological Park in South Carolina, U.S. Coordinator of breeding in Czech and Slovak zoos is Mgr. Milada Petrů from Zoo Děčín.

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