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Mother Cora with her young, three days after delivery. Transference from birth box to monitor of field zoologist
Photo by Jiří Vítek

Breeding of Polar Bears in the Brno Zoo (1)

The successful delivery of polar bears born on 23 November 2007 in the Brno Zoo was preceded by two deliveries, when the inexperienced female Cora was not able to take care of the young. Before the delivery we focused on the summary and evaluation of the present knowledge of our breed, the acquisition of information on the way of breeding in other (especially the Berlin Zoo) and coordination of works during modifications of the inside lodging room and the run-out of polar bears. All preparations also counted with the variant of artificial breeding, which we would start only if was absolutely necessary.

Unpleasant Reading of Breeder's Logs

The study of records in breeder's logs from 2004–2006, which show important events in the life of polar bears in the Brno Zoo is quite an unpleasant activity. Watchful waiting for the arrival of viable young bears ended in failures. Female Cora delivered the first young in 2005, when polar bears lived in the original, not very suitable run-out of smaller dimensions. Cora, as an inexperienced mother, did not know how to behave in the unknown situation. Unfortunately, she responded by killing both the young bears immediately after delivery. The only positive of the sad situation was the finding that Cora and its partner Umca are fertile. The following year, when animals were situated in a bigger natural exposition after brown bears,

One from two cameras, which transfer pictures and voices from birth box *Photo by Jiří Vítek*

Cora decided to give birth in the run-out. It carried one of the twins to the den and left the other at the place. We waited for twenty minutes but Cora did not come for the other offspring. Even if we brought the young to the artificial breeding, it was not successful. Both the young died by the third day after the birth of sepsis and overall exhaustion. The young which Cora carried to the den, did not get milk, which was proven by the camera recording and later also by section. In addition to the lack of experience of the mother, the reason for the death could also be insufficient creation of mother's milk. Therefore, we added application of a specimen supporting the creation of milk to the preparation for the third delivery.

We anticipated Cora has genetically encoded to become good mother. Despite this fact, we did not want to leave anything to chance and tried to find out, if had not made a mistake.

During Cora's third pregnancy in 2007 we paid maximum attention to the preparation for the birth and following breeding of young bears.

Modifications to the Den and Run-out

According to our watching Umca copulated with Cora from 4 to 29 March 2007. Pregnancy of polar bear females lasts for 245–262 days, the delivery could occur between 13 November and 12 December. However, with regard to the fact that nidation occurs at female bears – a later embedding of the ovum – we could postpone the latest possible term of delivery to the end of December.

We stated that works on modifications of the breeding facility must be finished by 5 November. We install the equipment for the transmission of pictures and sounds from the procedure of breeding to the delivery box which we bought in 2006 - two outside cameras with the night additional light, type AVC 6672, intercepting the infrared spectrum to the distance of 12m. The shooting angle of these cameras is 74°, resolution 480 TV lines. The sensitivity of 0 lx enables the cameras to take pictures even at night. A suitable place for the computer controlling recording and transmission was found in the breeding facility directly in the den. We connected the transmission both to the zoologist workplace, and to their private computers at home. The floor of the delivery box has been equipped with a heating board with the output 1600W since 2006 which maintains the room temperature at 10–20 °C. A digital humidity-meter records air humidity in the den and it is regulated by a vent with a remote control.

We painted white and disinfected all parts of the den, we lubricated the lowering doors and installed a stronger light. We rectified all technical shortcomings in the run-out; we repaired the drain in the pool and the crumbed away concrete around the overflow of the pool. We moved the male to the former exposition of Syrian bears on 19 November.

We decided that if the mother starts nursing after giving the birth, we would assign one permanent breeder to it. Three days after delivery are the most critical. It is necessary to have a sound record and consult it with a vet to find out whether the mother bear really feeds the young (e.g. load crying heard from the box in 2006 was wrongly interpreted as an expression of satisfaction of the young).

Preparation to Artificial Breeding

We also considered the limit situation when the not nursed young bears would have to be taken away from their mother and breed them artificially. We bought a quality incubator with

Incubator for bear nursling in one exhibit of bird pavilion placed *Photo by Jiří Vítek*

various accessories: nonwoven textile Perlan, cellulose wadding, baby bottles, dummies, a microwave oven, a boiling kettle, disinfection means, a record log, a scale, wiping cloths, children napkins as a base under the animal, a desk (situated in the sterile perimeter at the incubator), cover on the table made of Perlan, disinfection on the floor, a spare clothes for the breeder and masks. We also bought the feeding mixture consisting of the Tatra milk, cream, yolk, horse native serum and vitamins A, B, C and D 3. This alternative milk with the fat content of 30.5–35% is applied warmed to 36.5–37 °C.

After placing a young to the incubator, we proposed several variants. The first of them was the lodging at the Tiger Rock exposition. But it would be suitable only later after a partial independence of the young adequate to its level of somatic maturity. The lodging is separated from the areas of tigers and leopards only by a wooden wall, which does not reach the ground and it would be a high risk of a transfer of contagion. The room cannot be disinfected and it is accessed through a "dirty" corridor. The room temperature in unstable and the incubator could easy break down. It would not manage the temperature gradient between the required temperature and the ambient temperature.

A lower level of risk was offered at the internal box of Celebes crested apes with fully washable surfaces which could be easily disinfected. However, the access also led through a "dirty" corridor. Temperature and humidity would be stable there, the incubator would work in a small temperature gradient and the box offered the use also after a partial independence of the young. The location of the incubator would unfortunately mean to create an alternative area for Celebes crested apes.

The third variant was a clubroom of the Station of Young Scientists with a minimum presence of pathogens. Surfaces of the room can be partly disinfected; the access would lead through common areas at optimum temperature regime. These areas would be used for the stay of the young only with difficulties after the twelfth week of age. Compared to the previous variants, the disadvantage would be a longer distance for visitors. The incubator could be viewed through a big window at a given time but its location there would restrict the activity of the station.

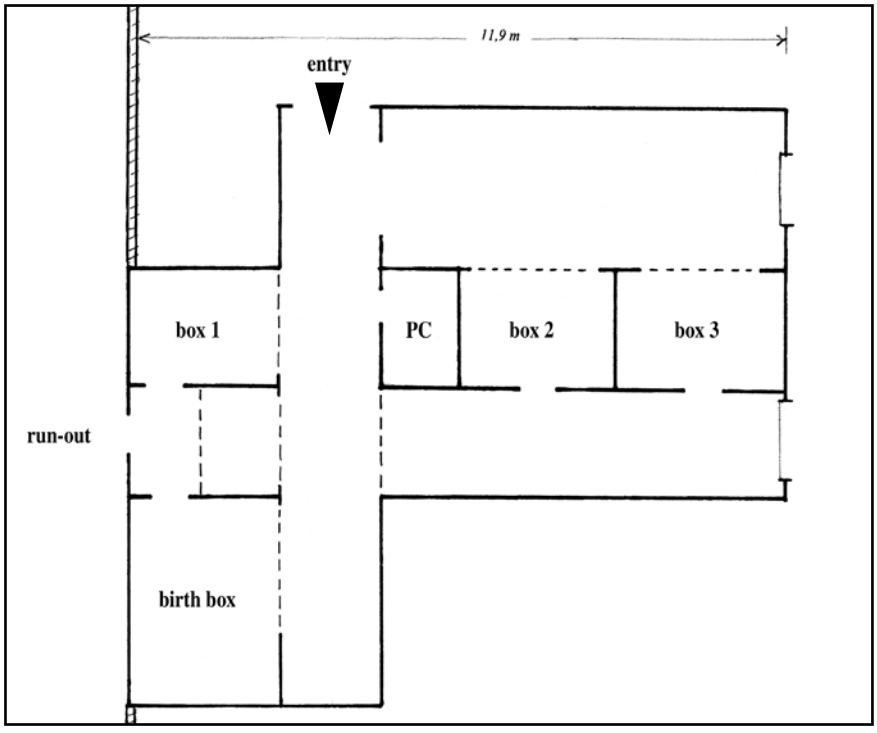
Finally, the fourth variant won: we installed the incubator in an exposition of exotic birds separated from the visiting route by a glass wall. Temperature and hygiene conditions were satisfactory there. We only needed to find an alternative space for a group of budgerigars.

Procedure of Artificial Breeding

Birth weight of polar bears ranges from 454 to 680g. Female bears give birth from the half of November to the beginning of January usually to two, sometimes three young bears. When bred in captivity, the mortality on the zero days is as high as 53.4%. Artificially bred young bears are immediately after being taken away from their mothers given frozen blood plasma to add immunoglobulin.

It is necessary to decide on the taking away of the young individually – on the basis of visual watching and listening to the sound recording – within 12 hours after birth so that hypoglycaemia and hyperthermia cannot develop. Therefore, we technically assured monitoring of records from the delivery even out of the working hours from the apartments of selected zoo workers. Before taking the young bears away, the female must be anesthetized, her blood is taken for the production of an auto-vaccination. We prepared a sterile box and a car for the transfer of the young.

The publication called Hand-rearing Wild and Domestic Mammals published in Detroit in 1997 recommend an optimum temperature of the incubator from 36.2 to 37.2°C at the air humidity of 58–61 %; the minimum given temperature is 32.5°C. The recommended frequency of feeding is 2.5 hours/24 hours with the quantity of



Ground plan of ice bears den

individual lots ad libitum. The used bottles must meet the standards for children. Feeding mixture shall be freshly prepared to sterile bottles. After feeding, mouth shall be cleaned and tummy and rectum shall be given a light massage. Feeding is carried out in the incubator. The base cover under the young shall be replaced each time (a nonwoven textile or a single use child napkin). With regard to no immunity of the young, partial sterility must be adhered to also around the incubator.

There are many items in the working regime at artificial breeding of polar bears: the young must be weighed twice a day, the scale must be daily disinfected and a new clean base cloth from cellular wadding must be used. Further, photographs must be taken every day, times of drinking and the volume of the drunk up milk must be recorded as well as times of defecation and the procedure of the body evolution (opening of eyes, cutting of teeth, etc.). All veterinary performances must be recorded – kind, concentration, and scope of disinfections, temperature in the incubator, humidity and temperature in the room. Records must be kept since the birth.

In relation to the expected birth, our incubator was in the testing operation from 28 October 2007, always during the working hours, since 5 November continuously. We switched it off only in the middle of February. Fortunately, it did not need to be used in "real operation". We will bring a detail description of the breeding of polar gears in the next publication.

Jiří Vítek,
Operation Zoologist

Effect of Borrow Pits on Population of the Dyje Lower Course Fish

Pikeperch, one of the predatory species living in the gravel-pit lakes *Photo by Pavel Jurajda*

Knowledge of the character of fish communities can be used for evaluation or the level of erosion of the water environment. Fish is striking and relatively easily identifiable and especially small fish sensitively responds to all changes in the ecosystem. The occurrence and quantities of small fish in the given location is a very important indicator of natural reproduction. The terrain research I participated in from 2001 to 2002 in the Soutok preserve had two main goals: to evaluate fish communities of several small artificial pools (so called borrow pits) and to compare several aspects of the fish ecology of these non-flooded locations almost isolated from the river with locations regularly flooded. The mentioned preserve administered by Lesní závod Židlochovice of Lesy České republiky, the state company, is situated near Lanžhot at the Břeclav region, where the Dyje flows to the Morava.

During natural floods, which regularly recurred in the south-Moravian flood plains at the times before the regulation of rivers, biotopes of flood plains (alluvia) connected to the river and water organisms – especially fish – could settle places which are most of the year separated from the channel of the main rive for most of the year. The Dyje used to belong among typical alluvial rivers, where the production of fish directly depends on the connection of the main channel with side branches and regular floods. The then diversity of water biotopes and hydrological regime of the alluvium was conditioned by the fluvial (erosive and depositing) activity of the river. It also ensured substitution of gradually disappearing water biotopes by new biotopes. This landscaping activity of rivers ended with their regulation and construction of protective dykes and dams, which enable to regulate flow through the river channel. Water biotopes which remained behind these dykes (at the territory of so called "passive alluvium") were slowly losing their importance by the deposition of ground washed off from fields. Renewal of the original state is, in fact, non-implementable due to the urban development of the landscape. To preserve the diversity of water biotopes – and the biodiversity of the present cultural landscape – there seems to be the only possible measure, i.e. to protect original biotopes and build artificial wetlands – borrow pits, gravel plants or canals. Artificially created reservoirs can be used and maintain as an environment especially suitable for endangered fish species.

Borrow pits are artificial biotopes which appeared at Soutok in 1983–1985 during mining of materials for the construction of an anti-flood dyke – the mined out places were later flooded with water. Borrow pits are of a regular shape, a steep bank, a gravel-sand bottom covered with a thin layer of mud and they have nearly no hiding places for fish. Water vegetation is represented very rarely. At some places, grass, roots or branches of willows growing on the bank reach the water. Possible hiding places for fish are formed by stubs and poles and stems fallen to water. These borrow pits, if regularly flooded, almost fully substitute natural biotopes for fish communities. If the flood comes in a suitable season and lasts for sufficiently long time, the flooded edges of borrow pits play an important role in reproduction of some fish species. The monitored borrow pits included three borrow pits regularly flooded at draining of water from the Novomlýnská Dam and other three borrow pits flooded only rarely at extreme flows in the Dyje.

In April 2001 the ground water caused that non-flooded locations overflew and the flood (overflow) took only to the beginning of May. In the spring 2001 (April to July) conditions for spawning of fish were created in three levelling borrow pits and growing up of the small fish was improved by a controlled flooding. The flood occurred at the time when the temperature for spawning of most fish species was sufficiently high and lasted for a long time, which showed at the species diversity and the numbers of small fish in these locations. The total of 15 small fish species were caught at the flooded locations in 2001, 12 species at three non-flooded locations. The proportion of the number of fish per unit of the fishing effort at non-flooded locations to the flooded locations was 1:8 in May and nearly 1:75 in October. Only small fish of predacious fish (common perch, ruff and pikeperch) was caught at the non-flooded locations in October, the disappearance of small fish of cyprinids was probably caused by the lack of hiding places.

In the spring of 2002 natural overflow of the flooded locations occurred only in March, when fish was not prepared for spawning. A controlled flooding was not carried out. The proportion of the

Adult fish catching with dragnet *Photo by Pavel Jurajda*

number of fish per unit of the fishing effort at the non-flooded locations to the flooded locations was 1:1 in June as well as October. In August 2002 an unusual flooding of five of six locations by the Dyje River occurred. Fish species such as Prussian carp or silver bream were the only ones which used it, as they reproduce by batch spawning coming in several waves with a certain time delay. After the July flood in 1997 silver bream was a dominant species at two normally non-flooded locations, silverfish dominated at the flooded locations, which means both these species with batch spawning are able to use even delayed floods for reproduction. At a flooding in the following year borrow pits may serve as a source for enrichment and strengthening of populations in the river. Red eye was a dominant species of adult fish in the non-flooded borrow pits. This phytolithofilous species able to spawn both on plants and a rocky substrate is not demanding and finds suitable conditions for reproduction in borrow pits.

Waters of alluvium act as an incubator and a source of plankton and benthos, thus assuring rich offer of food for fish. The flooded area also protects fish from water flow and predators and gives them suitable conditions for spawning and growing of small fish of phytolhitophilous and phytophilous species (spawning on plants). Vegetation flooded with water with a higher temperature provides small fish with enough hiding places and rich food. Most juvenile fish remains near the spawning area for several months and uses these places for growing. The highest mortality of small fish shows in the first month after birth and it declines in the following two months. A relative stabilisation of the number of the population comes during late summers and early autumns. When the water level declines, there is a higher risk of predation by mammals, birds and predacious fish. A successful reproduction of phytolhitophilous and phytophilous fish species does not depend only on the possibility of individuals to migrate to an alluvium, but it is strongly influenced by many factors, including temperature and water cleanliness, a character of the territory and food offer. It results in a bigger variability of numbers and species diversity of small fish compared to adult fish determined in individual years.

Spawn cowered by fungus on the flooded shoreline vegetation *Photo by Pavel Jurajda*

After the evaluation of results of our research and their comparison to the known literature data we can state that borrow pits as types of water biotopes of human origin successfully substituted natural biotopes (pools, branches and lakes in alluvium) and created suitable environment for fish communities. The function of borrow pits as places for growing up of small fish seems to be limited by the length of the bank line, the volume of the borrow pit and the depth variability. The absence of connection with a river causes small fish to return to borrow fish after the river's decline, where it spends the winter. A lack of vegetation and other hiding places leads to a higher predation pressure and consequent decline of the small fish quality. When creating new artificial wetlands, it would be suitable to think of as big environmental diversity as possible and sufficient length of the bank line. A gentle slope of banks is also important, where smaller increase of the water level is sufficient for flooding a bigger area of the bank vegetation than in case of steep banks.

The research confirmed that flooding of the bank vegetation of small artificial pools has a significant importance for natural reproduction of phytophylous species and also for the reproduction of phytolhitophilous species. As for the characteristics of flooding, its duration (at least for two months) and its right timing (April, May) are important. In the following year, if the biotope is flooded by the river, small fish from borrow pits can enrich and strengthen populations of phytolhitophilous and phytophilous fish species in the river. Original fish species living in the river after its channelling can find refuge in new habitats created by humans in alluvia.

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