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Management and Breeding of the Larger Hairy Armadillo, *Chaetophractus villosus*, at Pozań Zoo.

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With 3 Figures and 3 Tables

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Introduction

Armadillos, like all other predominantly myrmecophagous, or insectivorous mammals pose a special problem in captive maintenance. Although armadillos are more generalised feeders, and substitute diet is well developed resulting in generally good survival rate and longevity, breeding through generations remains a rarity.

Out of 153 armadillos of 6 taxons registered as living by ISIS at 30. VI. 1996 only 12 were born within the last 12 months, and just 7 survived beyond 30 days mark. There were eight La Plata Three-banded Armadillo, *Tolypeutes matacus*, and four Hairy Armadillo, *Chaetophractus villosus*, bred during that period.

The results from previous sources (Int. Zoo Yearb. and ISIS reports) are similar. Out of 213 Hairy Armadillos registered individually as born in the International Zoo Yearbook from Vol. **1** to Vol. **31** at least 127 were not reared beyond 30 days of age what represent ca. 60%. In just two zoos – Katowice and Antwerp this species had been bred more or less regularly over a period of five years or more, partly in second generation. According to ISIS data this taxon show a negative trend over the last 15 years. The peak number had been registered in the 1988 with 35 (16.19) individuals. At the end of 1995 this population dropped to just 21 (13.8).

Although none of the taxa currently kept in captivity is of any conservation concern, other forms like Three-banded Armadillo, *Tolypeutes tricinctus*, and Giant Armadillo, *Priodontes maximus*, are under severe threat in the wild. For several other taxa like Naked-tailed Armadillos, *Cabassous unicinctus*, and *C. centralis*, as well as some smaller *Dasypus* sp. the data on the status, distribution and threats is lacking. Therefore it is of some importance to learn the husbandry requirements on some common and widespread species which can be subsequently applied to captive breeding for conservation of threatened species. For the La Plata Three-banded Armadillo the husbandry protocol in well developed, resulting in a permanent breeding colony in a number of USA zoos. The highly endangered Three-banded Armadillo may well benefit from this experience in the next future.

The widespread and in spite of heavy hunting presure still common Hairy Armadillo may serve as a model species for developing husbandry guidelines for larger species.

Here we would like to share our experience from maintaining a breeding group of this species over a period of 10 years in our zoo.

The genus *Chaetophractus* contains three species: *C. vellerosus*, *C. nationi* and *C. villosus*. All are adapted to live in open areas, even semideserts, also on high altitudes. They are active during the night in the summer, and diurnal through the winter. The Hairy Armadillo distribution is confined to northern Paraguay, southern Bolivia to central Argentina. In the wild this species seems to be rather catholic in food preferences taking insects, small mammals, reptiles, amphibians, supplementing its diet with vegetable matter during the winter. The breeding season is said to be restricted to September in Argentine Province of Santa Fe (WALKER 1991). The gestation period is 60–75 days, twins in a litter (mostly of opposite sex) are a norm, weaning at 50–60 days and sexual maturity is reached at 9 months (MERRETT 1983). An individual is known to live for over 20 years in captivity.

The History of Keeping Armadillos at Poznań Zoo

Due to good contacts between Polish zoos, and Poles living in Argentina different species of armadillos reached Poland in the sixties and seventies. Although breeding had been achieved with both Six-banded, *Euphractus sexcinctus*, and Hairy Armadillo at Wroclaw Zoo it didn't result in establishment of permanent breeding groups (GUCWINSKA 1971).

In the sixties and seventies not less than 5 species of armadillo, Pichi, *Zaedyus pichi*, Nine-banded, *Dasypus novemcinctus*, Six-banded, Hairy and La Plata Three-

Fig. 1. Larger hairy armadillos; mother with offspring aged two month.
Photo: MARIAN BATKIEWICZ

banded had been kept at our Zoo. Although the survival, and longevity was quite good, the breeding was only incidental. This was mostly due to the fact, that most were acquired as single individuals.

After a break of 12 years we acquired an adult pair of *Chaetophractus villosus* from La Plata Zoo, Argentina on 29. V. 1986. They were adult animals, most probably wild-caught. Both are still alive at the moment of writing. First breeding occurred on 18. VII. 1989 with twins (1.1) successfully reared. Since then 30 individuals had been born (9.5.16), 16 died (1.2.13), 13 (9.4) were transferred to other collections and one escaped.

Housing

Armadillos in our zoo had been kept in a variety of cages. All of them were inside cages, with no access to outside enclosures. At present we hold two groups. One is placed in the Nocturnal House on the exhibit. The enclosure is 20,2 sq.m. large. The concrete floor is covered with a deep litter of shredded bark. There is a number of rotten logs, two nest-boxes and a small pool provided. Hay is given as a bedding. The exhibit is centrally heated to app. 25 °C throughout the year, with little seasonal variation. The exhibit is separated from visitors by a glass, sound-proof panel. This cage is shared with a breeding pair and a youngster of Grey-legged Douroucouli, *Aotus trivirgatus griseimembra*. There is an adult, breeding pair, a female born 5. VI. 1996 and a pair born 23. VIII. 1996 housed in this cage.

The back-up pair is kept in an off-show facility. This is a room 3,5 sq.m. with a concrete floor covered with shredded bark and peat moss. Logs and a variety of nest-boxes are provided. This room is heated in the winter, and during the cold sum-

Fig. 2. Armadillos often use fallen and hollow logs as natural dens. Photo: MARIAN BATKIEWICZ

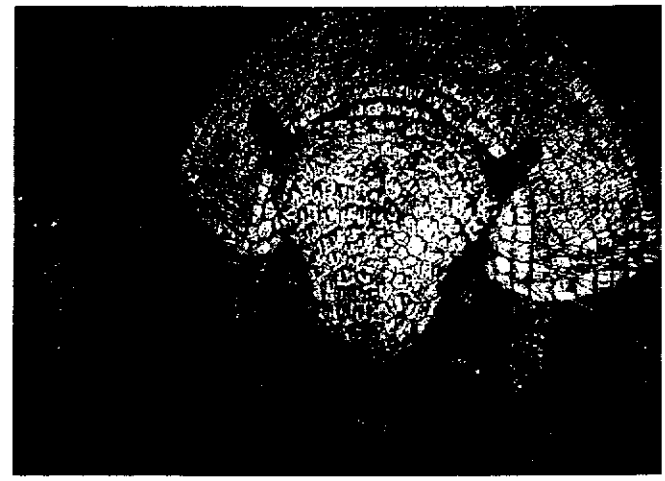

Fig. 3. Armadillos seem to enjoy access to open water for drinking and bathing.
Photo: MARIAN BATKIEWICZ

mer spells the heat is provided through infra-red heat lamps. Successful breeding occurred also in this place.

Formerly, the original breeding pair had been kept in a glass-fronted exhibit with a floor dimension of 2,3×4,4 m shared with a group of Indian Flying Foxes, *Pteropus gigantaeus*. This exhibit was provided with a stone-made cave filled with hay. Some logs were also provided, and the floor was covered with a mixture of sand and peat-moss. The initial breeding took place in this exhibit.

Food composition

In the wild the diet of armadillos consists mostly of insects, plants, tubers, small rodents, lizards, fruits, vegetables and carrion (WALKER 1991, MACDONALD 1984, MERITT 1976). Some species are specialised in ants and termites. The armadillos of the genus *Chaetophractus* seems to be most generalised feeders.

In captivity several species adapt readily to a meat mixture composed of horsemeat, hard-boiled eggs, fruits supplemented with minerals and vitamins (MERITT 1976).

Initially we offered a wide selection of food items to record preferences. Minced beef, horsemeat, fruits and vegetables (raw, grated, or cooked), quark, raw or boiled eggs, baby cereals, milk, boiled rice, insects, pinky mice, day-old chicks had all been given. After recording definitive food preferences the following mixture and schedule had been developed:

basic food: 1/2 raw, or cooked minced beef, or horsemeat; 1/3 mixed chopped fruits (bananas, grapes, peaches, cherries, sweet cherries, plums, apples) and raw, grated or cooked vegetables (carrots, beetroots, lettuce, cucumbers, cauliflower, tomatoes); 1/4 baby cereal, or boiled rice with milk, or quark and boiled eggs, or raw yolk. Twice a week armadillos are offered insects (locusts, crickets, mealworms, or giant mealworms). Giant mealworms are the preferred food-item. When the live insects are offered the standard mixture is reduced to half or the normal dosage.

Because the armadillos show a tendency to obesity there is a fasting day once a week. This is not implemented during later stages of suspected pregnancies and lactation.

Breeding

First confirmed breeding had been recorded only after three years of keeping the original pair. It can't be excluded that the unrecorded births occurred previously, but the youngsters had been destroyed immediately. The table I summarised the breeding of Hairy Armadillo at Poznań Zoo.

The involved individuals are as follows:

MS0089 – adult female imported from La Plata Zoo on 29. V. 1986
MS0090 – adult male imported from La Plata Zoo on 29. V. 1986
MS0091 – female born to MS0089 and MS0090 on 18. VII. 1989
MS0163 – male imported from La Plata Zoo on 29. V. 1986 on loan from Warsaw Zoo
MS0162 – female imported from La Plata Zoo on 29. V. 1986 on loan from Warsaw Zoo

The female MS0089 seems to had reached the end of her reproductive activity. She gave birth to 8 documented (observed) youngsters, of which 5 were fully reared. All were sired by the same male (table 1).

The female MS0091 had 21 recorded youngsters, of which 10 were reared. Last five offspring was sired by another male. Died 2. XII. 1996 (table 2).

The female MS0162 died unexpectedly on 20. X. 1994, leaving her son at the age of 24 days. This animal was well able to survive, and was placed in another collection subsequently. This female had given birth to at least 9 offspring prior to arrival to our zoo. None of them had been reared beyond the age of 8 days.

Reproductively active Hairy Armadillo females may have a very short interbirth intervals. The shortest recorded was 72 days and 74 days. This doesn't seem to correspond with the loss, or separation of previous offspring. In fact both shortest intervals occurred ofter successful rearing. Female MS0091 had given birth three times

Table 1.

FEMALE MS0089

MALE	DATE OF BIRTH	NO. AND SEX OF YOUNG	REARED/NOT REARED	REMARKS
MS0090	18. VII. 89	1.1	reared	
MS0090	23. III. 90	0.0.1	died 23. III. 90	destroyed
MS0090	25. IV. 91	1.0	reared	
MS0090	8. VII. 91	0.1	reared	
MS0090	1. VI. 92	0.0.1	died 4. VI. 92	destroyed, reserve accommodation
MS0090	8. XI. 92	0.0.1	died 8. XII. 92	reserve accommodation
MS0090	1. VI. 94	0.1	reared	

Table 2.

FEMALE MS0091

MALE	DATE OF BIRTH	NO. AND SEX OF YOUNG	REARED/NOT REARED	REMARKS
MS0090	24. VII. 91	1.0.1.	reared	0.0.1 escaped aged 1M24D
MS0090	10. VII. 92	0.0.2	both died 27. VII. 92	reserve accommodation
MS0090	8. XI. 92	0.0.2	died 8. XII. 92	found missing, reserve accommodation
MS0090	5. II. 93	1.1	reared	
MS0090	28. III. 94	1.0	reared	
MS0090	18. VIII. 94	2.0	reared	
MS0090	24. X. 94	0.0.1	died 21. XI. 94	
MS0090	3. IV. 95	0.0.2	both died 10. IV. 95	
MS0090	5. IX. 95	1.0.1	0.0.1 died 17. IX. 95	
MS0163	25. III. 96	0.0.2	both died 31. III. 96	reserve accommodation
MS0163	5. VI. 96	0.1	reared	
MS0163	23. IX. 96	1.1	reared	

Table 3.

FEMALE MS0162

MALE	DATE OF BIRTH	NO. AND SEX OF YOUNG	REARED/NOT REARED	REMARKS
MS0163	26. IX. 94	1.0	reared	

during 1994 with 3 out of 4 born youngsters reared and 1996 with 3 out of 5 born reared. The extremely short inter-birth intervals doesn't seem to have any negative influence on rearing performance, and physical condition of the female, and were therefore not prevented through separation of the male.

Mating is easy to observe. The male follows the female closely, sniffing urogenital region and attempting to mate several times a day.

Pregnancy at later stages is becoming rather obvious. The female imported from La Plata Zoo when observed during later stages of pregnancy showed a visible flattening of the carapace, which was barely covering flanks. The armour after the birth replaced itself back to normal position.

All births took place in the night (or "artificial night" in the nocturnal exhibit). Only one birth was actually observed. The female prepared a shallow depression in the litter through pushing bark with her nose and fore-legs. The actual birth took a very short time, with two pinkish youngsters expelled within ca. 10 min. The other, juvenile female showed some interest in the new-born youngsters and sniffed them several times, without any aggressive reaction from the mother. The Douroucoulis, especially juvenile descended several times very close to young armadillos, without any visible disturbance of the female. Immediately after birth female left offspring and started gathering hay provided in the vicinity of the nest. After ca. 10 minutes the nest was completely covered, and the female entered it and remained with

youngsters. By the next morning both had been moved by the female to a nest box, where the further successful rearing took place.

As the disturbance of the nest was felt to cause destroying of offspring no attempts had been made to record development of the youngsters, and their bodyweights. No attempts had been made to hand-rear any of new-born youngsters. In fact the youngsters were either completely reared, or completely destroyed, sometimes without the slightest trace left. In no case a weak, young armadillo was spotted outside the nest. The observations made during rearing were restricted to quick checks when the female was leaving the nest, without even touching youngsters.

From our limited observations it comes out that young armadillos open eyes around 20–28 days of age. They start moving outside the nest at the age of 30 days and take solid food from the day 35 onwards. The successful rearing of an armadillo left alone at the age of just 24 days suggests a possibility of much earlier weaning, but this is probably just a case story, and is certainly not recommended as a guideline. This juvenile was left with its father. The food was supplemented with a larger percentage of milk-based products, including baby food (Humana).

Veterinary problems

There were very few veterinary problems. Only three animals aged beyond 30 days died. Two were adult females. The third was a juvenile male. In this case autopsy revealed prolonged ileitis of unknown aetiology. This animal apparently didn't switch to solid food properly. It showed considerable troubles in digesting food, having in turns exhibiting diarrhoea and obstipation for a period of almost two weeks before its death.

One of the females died due to degenerative changes in the kidneys and urinary tract, second due to bleeding in the brain of unknown aetiology.

All other deaths were of neonates, or juveniles less than 30 days old. As most of them were devoured by adult armadillos there was no chance to perform autopsies.

No parasitic problems had been detected. As a prophylactic measure our armadillos are dewormed twice a year. The agent is either Fenbendasole at a doses of 50 mg/kg, or Pyrantel at a doses of 5 mg/kg.

The only other veterinary problem occurred in the 1988. One male sustained an injury in the rear part of carapace (ca. 5 cm wide) with resulting infection. Similar problems occurred in a number of other collections: Washington (ROBERTS et al. 1982) and Warsaw (ZIELIŃSKI pers. comm). This condition was cured with antibiotics and ointments applied directly.

Other observations

According to our observations the Larger Hairy Armadillo is not entirely nocturnal under captive conditions. It shows a rather accidental pattern of activity. The armadillos are always pretty active after being provided with food. During the day they move around over short periods of time. In the nocturnal house the activity is more visible, but there are still long periods of inactivity. Especially females rearing young are rather reluctant to stay outside of the nest-box for a prolonged period of time.

One of our males, which was kept in a rather small cage prior to arrival in our zoo shows after almost two years a stereotypic behaviour circling in one spot, before resuming normal locomotory patterns.

The first breeding occurred at our zoo after an escape of the original female. She managed to dig a hole of ca. 2 m length and 1,5 m depth through the night expressing her unusual abilities. She had been recovered after 6 hours of digging by four people, with the use of two hunting dogs. Three months later she had given birth to first offspring.

Armadillos are becoming rather tame. This is difficult to talk about close contact between them and keepers, but they seem to enjoy petting and scratching.

We had never observed any infra-specific aggression. At a certain time we kept together 8 armadillos – two adult males, two adult females and four offspring from both females. It happened even that two females gave birth simultaneously and both fed youngsters without differentiating between their own and the other females.

Suckling armadillos make a noise very similar to cats murmur. Females often feed babies lying on the back.

Conclusions and recommendations

Larger Hairy Armadillo, provided with a right accommodation and diet can be a very long-lived zoo exhibit. Being a member of rather aberrant and primitive mammal group it carries a good education potential, especially in European collections. This species can be safely accommodated with a range of other species – bats, South-American Primates, perhaps also Tree Porcupines, *Coendu* sp. and Squirrels. These animals are almost ideally suited for nocturnal exhibits.
The following recommendations can be drawn:

- The size of the cage seems to be one of the most crucial factors in successful rearing of offspring. In small cages the animals are prone to destroying youngsters as well as in developing stereotypic behaviour. The cage for a pair (or small group) should be no less than 10 sq.m. Out of 13 not reared youngsters in 9 litters, 11 in 8 litters were born in temporary, quite small cages. It seems that they need a considerable time to settle-down and accept new environment, even when this means a change to a better accommodation.
- The balanced diet with a large amount of live insects should be given.
- Any disturbance to the mother should be avoided.
- A deep litter should be provided. Shredded bark, eventually mixed with peat and sand proved to be an ideal choice.
- A variety of nest-boxes allowing pregnant female to separate herself for birth is essential.
- A lot of hay should be provided in the nest-box.
- We had never separated a male prior to expected birth, and we feel it unnecessary. Females are being separated in Łodź Zoo (Maik-Siembida 1996), but rearing results are poor.
- A small water-pool provides a constant source of activity. Armadillos very often wade throught it.

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