An overview on the development of veterinary animal care in Bucharest Zoo over the past 40 years, and further possible development

DIPLOMA THESIS
for the graduation to
MAGISTRA MEDICINAЕ VETERINARIAE

by

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1. Introduction

1.1 Why this topic?

Over the past 40 years the Zoological Garden of Bucharest has continuously changed from multiple points of view: animal numbers and variety, enclosure design, administration or therapeutical methods. Different aspects such as political background, restricted access to external knowledge and limited medical equipment have influenced the shaping of the Zoo as it is today. To know the background of the Zoo is of historical interest, but it also serves as a starting point of further locally applicable solutions that could positively influence welfare status, health and disease control of the animals, as well as improving staff safety and input.

To have a better understanding of the data gathered for the present study it is important to take note of the historical background on which the Bucharest Zoo was formed. During the periods between and after the world wars, animals were kept sporadically in small private collections, menageries and circuses. However, on the dawn of the newly instated communist regime, during the 1950’s, it became almost a fashion that every township to have its own small zoo.

This is how Romania was quite soon scattered with hundreds of small zoos that were nothing more than a compound of a few, minuscule iron cages, where single individuals from (generally endemic) species were housed and displayed for the local public. Unfortunately these animal collections survived the passing of political regimes and today remain untouched after more than 50 years. The Bucharest Zoo was born during the same time, under the same auspices, but being the country’s Capital, it had to be build on a larger scale.

1.2 History of the zoo through the eyes of its devoted veterinarian, Dr. N. Micu

Dr. Nicolae Micu was considered to be the “soul” and the promoter of the Bucharest Zoo, with more than 30 years of experience as the main veterinarian and researcher of the institution. The following paragraphs are an account of his words following an interview taken in July 2009 at the “Clinic for Exotic Animals” in the University of Veterinary Medicine in Bucharest. He founded this clinic as a part of the small animal internal medicine department, after his retirement from the Zoo in 2007. Sadly, Dr. Micu passed away just months after making this last recorded dialogue. The “Clinic for Exotic Animals” was left unattended ever since, yet another symptom of the absence of specialized professionals in this field of veterinary medicine.

<<In 1957 various animal collections from different menageries across Bucharest (from “Carol” park, “Cișmigiu” garden, “Balta Albă”) were gathered in the location of the present day zoo, on the outskirts of Bucharest, amidst the Băneasa Forest. At its beginnings the animals on display were mostly native species, such as bears, foxes, waterfowl (mainly from Cișmigiu garden), the only exotic presence being a lioness.>>
During the next two to three years, between 1958 and 1959 the municipality planned to move the zoo to Pantelimon area, under the supervision of Prof. Dathe from Berlin, but the plan was soon abandoned. Still to this day the streets in the surrounding area bare animal related names (Squirrel Street, Dolphin's Square, Reindeer Street, Lark Street, etc.)

In 1961 Dr. Micu had his first contact with the newly founded Zoo. He was still attending the veterinary technical school, and was hired as a vet technician to assist the treatments performed by Professor Constantinescu, with whom he later co-authored many of his papers. Together they performed radial neurectomy in pelicans as a measure of flight restriction. However, the method did not have optimal results, since neural contact was restored through collateral nerve branches. They abandoned the method and resumed to only clipping the wing feathers (primary remiges) twice a year, a method that due to ease of technique and safety is still used today.

Even though he was not fully accredited as a veterinarian, he worked as the only member of the staff with medical training until 1963. During this time he translated the German periodical from Leipzig “Der Zoologische Garten”, into Romanian language.

It was not until 1963 that he became a fully competent veterinarian by defending his diploma thesis on parasitology of the carnivores of the zoo. He noted that phenothiazine compounds and piperazine were used as antiheminthic drugs at the time. He thus began his scientific carrier, collaborating with other veterinarians and different institutions (Veterinary University of Bucharest and laboratories both in Romania and abroad). Among other scientific activities, he published 2 papers (on testicular tumors and ehrlichiosis in rats) that were accepted for presentation at a veterinary congress in Milano. However the communist censorship did not allow him to attend the conference, only the posters were sent.

In the 1974, Dr. Micu was hired as the official zoo veterinarian and he remained the only veterinarian on staff for the next 30 years. At the time the zoo had a total of 236 animals on display, housed on approximately 5.3 ha, a surface that changed very little over the years.

Starting in 1964 and continuing throughout the later 1960’s the Zoological Garden started a massive ostrich reproduction program. The animals were housed on auxiliary terrains, in free-ranging conditions, outside the zoo perimeter. Through this intensive breeding program they were able to obtain the highest reproduction rate in ostriches at the time. As a consequence of their breeding success they sent 89 Nandus (Rhea americana) to Holland. The animal exchange was organized through an animal dealer, van der Brink, a long time partner of the zoo. In return, Dr. Micu received Gnu antelopes (wildebeests), Nilgai antelopes, tigers, the first tranquilizing gun and other items.

During almost a decade between 1968 and 1976, the Zoological Garden has gone through a true “facelift”. Keeping up with modern standards regarding enclosure design, massive renovation works were performed on most of the cages. Waterfowl that were constantly being brought in from Cişmigiu garden and the Danube Delta received new, spacious water pools. Before this transformation, all the enclosures were plain concrete/metal bar cages with no enrichment
whatsoever. Even if the materials used for enclosure construction were maintained over the later years for most of the animals, the style changed, making them seem more attractive for the public and slightly more suitable for the animals.

Along the years the Zoo housed many species of animals, both indigenous and exotic ones, most species not being a part of the collection today. Here are some examples:

Reptiles:
- Pythons, boa, colubridae (Natrix tessellata)
- Nile crocodiles, Cuban alligators
- Black vipers brought form Armenia in 1964-1965. (In the present days, in Romania it is interdicted by law to keep poisonous snakes in captivity.)
- scorpions, kept in the reptile section

Birds
- Ratites: Cassowary, African ostriches, Emu, Rhea.
- Jabiru storks, flamingos (never reproduced, possibly because of the small enclosure and group numbers)
- Great Bustard (birds that are now virtually extinct in Romania). The eggs were collected from the wild steppes in Hungary and incubated in the zoo. The breeding program was successful.
- Parrots: African Grey, Macaws, different budgerigar species.
- Doves: common and exotic dove species
- Pheasants: many species.
- Waterfowl: crowned crane, Sarus crane, black and white swans, wild geese and ducks.

Almost all of the bird species reproduced successfully in captivity. In the past the collections had to be limited to small groups, because no special bird enclosures were available. The present day “Exotarium” was built in 2000 and is the indoor complex where most of the exotic bird species are housed. Some reptiles are also displayed in the same building.

Ungulates
- Nilgai antelopes
- Gnu/ Wildebeest
- Blackbuck antelopes
- Saiga antelopes (now critically endangered, with former habitat range spreading throughout the sub-Carpathian steppes)
- Yaks
- Zebu
- European Bison
- Mouflons
- Fallow Deer, Red deer
- Camels, dromedaries

Apes
- Old World primates: baboons, mandrills
- Orangutan (one individual, did not survive alone)
- Chimpanzees: Max (brought in 1975) and Suzi (brought in 1976). They bred and gave birth to Felicia and Felix in Bucharest Zoo. They were the only chimpanzees ever to be brought in, and over the years only Felix still remains today in the exhibit. Anecdotally, the zoo staff remembers the heart-breaking story of how Felix, trying to play with rocks, accidentally killed his sister Felicia.
- Rhesus macaques.

Carnivores
- Indian (Bengal) tigers
- Siberian tigers were a present from Mao Zedong for Ion Gheorghe Maurer (head of state and President of the Great National Assembly of Romania), who used to come weekly to visit them.
- Red, polar, and silver foxes
- Jackals
- Raccoon dog
- European wolves
- Ferrets
- Raccoons
- Coati
- Minks
- Spotted hyenas
- Lynxes

Pachyderms:
- Rajah, a male Asian elephant was brought to Bucharest as a gift from Indira Ghandi for Gheorghe Gheorghiu Dej (the communist leader of Romania from 1948 until his death in 1965) in 1963. He was 2 years old when he was shipped from India. While still a young cub he was walked all the way to Herastrau (a public park about 8 km away) to bathe. However, he became very aggressive and uncooperative once he became an adult. An Italian tamer was hired to tame him, but she did not obtain significant results. Rajah died at 28, the cause of death being an ossification of the cardiac valves.
- Gaya, a female Asian elephant was brought in 1974 from Leipzig. She was 14 years old at the time. She did not get along with Rajah and they refused to mate. Her death at 48 years in 1996 was caused by a massive echinococcosis infestation and the case received a special attention from the media at the time.
Brief account of medical procedures performed in the past (before 2007):

- One of the Siberian tigers (given to president Maurer) suffered from “maladaptation syndrome” after its arrival at the zoo (presented with vomiting, extreme sensibility to the environment). He was treated with gastric medication, antibiotics, general support.

- In 1974 a generalized adenopathy was observed in one of these tigers. Together with Professor Manolescu, he performed biopsies of lymph nodes and bone marrow and diagnosed leukemia.

- Another case of neoplasial disease was found in a Sumatra tigress with pronounced weakness and weight loss, in which epitheliosarcoma was diagnosed.

- The same type of tumor (epitheliosarcoma of the serosae) was discovered in a female zebu, around 1978-1980.

- A spotted hyena was diagnosed with Hodgkin’s lymphoma.

- All the clinical files and test records were sent to Pasteur Institute and to the Institute of Sanitary Veterinary Research, both in Bucharest, for rechecking and specialty expertise.

- Lynxes reproduced for a period of time, around 1976-1978, but they suddenly stopped reproduction (the high inbreeding percentage was thought to be the reason).

- The first cesarean section carried out in the zoo on a carnivorous animal was performed on a lioness, together with Professor Seiciu. For anesthesia they used a combination of Stresnil® (azaperone) and metomidate. At the time Combelen, a phenothiazine derivate was used, but did not work satisfactory on lions; therefore an alternative combination had to be found. Immobilon and other drugs generally used today in practice were not available in Romania at the time of the procedure. The operation was nevertheless successful and the cubs were removed uneventfully. However, the fetuses were already dead.

- In 2002 the second cesarean section was performed, together with Professor Alin Birtoiu. For this surgery the anesthetic protocol was switched to ketamine and xylazine and the procedure was finished without complications.

- Herbivores were mostly susceptible to enteropathies caused by parasites: protozoa, coccidia, trichostrongylus, dictyocaulus. Therefore, one of the most important procedures with great medical significance was the fecal examination. For example, in 2006, more than 100 of such exams were performed in all animals in the zoo. As prophylaxis or treatment were used fenbendazole, thiabendazole, levamisole and miclosamide.

- Human influenza virus in bears (see Annex 1) was diagnosed for the first time in Romania in 1970. The virus isolation was performed at Canatcuzino Institute and confirmed in a laboratory in Philadelphia, USA. At the time the zoo had European bears, two Canadian Kodiak bears, one polar bear and two Asian bears. They all received antibiotics (tetracyclines, rifampicin, sulfonamides), vitamins, anti-inflammatory medication (metamizole) for up to 10 days. They all recovered.
Medicine and biological products used before 2007

- Generally, physical restraint was used, mostly because lack of anesthetics but also because lack of “hands-on experience”.

- Most of the drugs historically used in Zoo Bucharest were imported from Germany, Austria, France, USA. The most difficult to acquire were anesthetics and tranquilizers; during the communist regime it took more than one month to obtain authorization for purchasing such drugs. Therefore, planning a procedure was very difficult and emergency treatments and captures were almost impossible to perform.

- Tranquilizers and anesthetics used:
  - Combelen, precursor of acepromazine;
  - Pentothal (in small monkeys) in combination with hyaluronidase, enzyme given as an additive, so that the drug could be injected intramuscularly instead of intravenously;
  - Plegomazin® (in cercopitecs, pavians);
  - Hypnodil® 5% (metomidate);
  - Stresnil® (azaperone) used successfully in lions, horses;
  - Diazepam;
  - In earlier years there was no access to ketamine or phencyclidines (PCP), however later, ketamine became one of the most used anesthetics.

- Vaccines were used especially in ungulates against catarrhal fever and anthrax.

- Antibiotics:
  - For infections with classic germs sulfonamides were used, first injectable, then given in food for at least 7 days. (sulfadimidine, sulfadiazine, Borgal, Biseptol)
  - Pfizer products came into use in 1964-1965: penicillin, tetracycline (oxytetracycline), streptomycin, terramycin.

- Multivitamin complexes: Vitamin B complex, AD₃E.

The zoo collaborated with the veterinary faculty in Bucharest, with the Sanitary and Veterinary Control Laboratory in Bucharest, also with institutes in Austria, Germany, Belgium, Holland.

The biggest issue in the Zoo was the constant supervision from communist party delegates and liability in case of death of an animal. In such a case, the veterinarian was held directly responsible, and he had to pay for the “damage” or he was legally charged. A great pressure was forced on the vet staff for many years. A similar pressure can be felt even today, but the communist delegates are replaced by media representatives (see chapter on Capacity Building). At the moment, the zoo veterinarian is still restricted by legislation, and most of the procedures, especially those involving anesthesia require special approval from the ethics committee and from the Zoo direction. >>
After the “December Revolution” in 1989 funding was extremely limited as the country went through a massive restructuring process caused by the “December Revolution”. Therefore improvements (in enrichment, cages, and husbandry) were carried out only later on, after 2000 especially in the primates’ and carnivores’ enclosures. During the same period connections with EAZA were made, and it is hoped that in the near future the Bucharest Zoo will become a member.

1.3 Research activity conducted in Romania and in the Zoo Bucharest in particular

Romania’s overall presence at conferences, professional meetings, workshops, was only scarce during the communist regime, mainly due to the harsh regulations concerning Romanian citizens travelling abroad. Participation at the “International Symposium on Diseases in Zoo Animals”, for example, as depicted graphically in Fig.1, shows that during the years prior to 1970 there is little if any Romanian sourced papers. In 1970, the symposium took place in Budapest, Hungary, a country close both geographically and culturally to Socialist Romania. Therefore it may be presumed that attending the event was accepted, if not even to some extent encouraged by the Communist Party. Annex 1 lists all the Romanian sourced scientific publications presented at the “International Symposium on Diseases in Zoo Animals” and published in “Verhandlungsberichte über die Erkrankungen der Zoo- und Wildtiere (Verh.ber. Erkrg. Zootiere)”. 

After 1970, the number of publications gradually decreases, and after 1977 there is no report of any Romanian sourced scientific presentation at the symposium. Although Romanian veterinary research is present in small animal international events, in the field of wild and exotic animals the contributions remain very scarce, mainly presented on local level events.

Fig. 1. Number of Romanian sourced articles presented at the “International Symposium on Diseases in Zoo Animals” (1960-1980).


1.4 Animal species on display

In Annex 2 the official animal list of the Zoological Garden of Bucharest for February 2009 is presented, grouped by class and order (Tables 1, 2 and 3). For each of the species the common English name is given, the Latin name according to the binomial nomenclature and the number of individuals according to gender (number of males, females and young individuals or of unknown gender).

The species marked with red and an asterisk are present on the IUCN “red list” with conservation statuses of “Near threatened”, “Vulnerable” and “Endangered”. It is important to make this distinction to establish this zoo’s potential for conservation programmes, because today, zoo animals throughout the world are traded less for money, than according to a gene weighted index of “rarity value’ (Tudge 1991), and it is also essential to determine the zoo’s role within the conservation agenda.

To exemplify, the zoo is well known for its success in breeding different bird species, especially pelicans. The Dalmatian pelican population in Romania is known to be still one of the largest in Europe, but on a descending slope. Future collaborations between the Zoo and external wildlife protection programs would attract funding and would benefit both the zoo reputation and the bird status in the wild. Also breeding programs for tigers and jaguars have been successful in the past.

As a legislative measure, the U.S. Fish and Wildlife Service has emphasized its expectation that institutions seeking permits to own endangered species should demonstrate that they will enhance the survival of the species in the wild (MILLER et al., 2004).
## Annex 2

### Table 1. List of bird species in the Zoological Garden of Bucharest (last updated: Feb. 2009):

<table>
<thead>
<tr>
<th>Common name</th>
<th>Species</th>
<th>Males</th>
<th>Females</th>
<th>Unknown/ youngs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Raptors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tawny Eagle</td>
<td><em>Aquila rapax</em></td>
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<tr>
<td><em>Andean Condor</em></td>
<td><em>Vultur gryphus</em></td>
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<td>Eurasian Tawny Owl</td>
<td>Strix aluco</td>
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<tr>
<td>Common Buzzard</td>
<td><em>Buteo buteo</em></td>
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<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Eurasian Griffon Vulture</td>
<td>Gyps fulvus</td>
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<tr>
<td><strong>Waterfowl</strong></td>
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<td></td>
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<tr>
<td>Greater Flamingo</td>
<td><em>Phoenicopterus ruber</em></td>
<td>7</td>
<td>3</td>
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<tr>
<td>Egyptian Goose</td>
<td><em>Alopochen aegyptiacus</em></td>
<td>2</td>
<td>3</td>
<td>2</td>
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<tr>
<td>Canada Goose</td>
<td><em>Branta canadensis</em></td>
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<tr>
<td>Common Moorhen</td>
<td><em>Gallinula chloropus</em></td>
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<tr>
<td>Mute Swan</td>
<td><em>Cygnus color</em></td>
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<td>Black Swan</td>
<td><em>Cygnus atratus</em></td>
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<tr>
<td>The Eurasian Coot</td>
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<td>White Pelican</td>
<td><em>Pelicanus onocrotalus</em></td>
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<td><em>Dalmatian pelican</em></td>
<td><em>Pelicanus crispus</em></td>
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<td>Wood duck</td>
<td><em>Aix spons</em></td>
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<tr>
<td>Mallard</td>
<td><em>Anas platyrhynchos</em></td>
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<td>Mandarin Duck</td>
<td><em>Aix galericulata</em></td>
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<td><strong>Pheasants</strong></td>
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<tr>
<td>Order</td>
<td>Common name</td>
<td>Species</td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>---------</td>
<td>-------</td>
<td>---------</td>
</tr>
<tr>
<td>Columbiforme</td>
<td>Red-rumped Parrot</td>
<td>Psephotus haematonotus</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Budgerigar</td>
<td>Melopsittacus undulatus</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Galliforme</td>
<td>Diamond Dove</td>
<td>Geopelia cuneata</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Ringed turtle dove</td>
<td>Streptopelia risoria</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Vulturine Guineafowl</td>
<td>Acryllium vulturinum</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Indian Peafowl</td>
<td>Pavo cristatus</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>California Valley Quail</td>
<td>Lophortyx californica</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Piciforme</td>
<td>Cuvier's Toucan</td>
<td>Ramphastos cuvieri</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cuculiformes</td>
<td>Livingstone's Turaco</td>
<td>Turaco livingstonii</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 2. List of mammal species in the Zoological Garden of Bucharest (last updated: Feb. 2009):

<table>
<thead>
<tr>
<th>Order</th>
<th>Common name</th>
<th>Species</th>
<th>Males</th>
<th>Females</th>
<th>Unknown/youngs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carnivores</td>
<td>*Jaguar</td>
<td>Panthera onca</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>*African lion</td>
<td>Panthera leo</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mountain Lion</td>
<td>Puma concolor</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Lynx</td>
<td>Lynx lynx</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>*Tiger</td>
<td>Panthera tigris</td>
<td>5</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Brown bear</td>
<td>Ursus arctos</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Alaska Tundra Wolf</td>
<td>Canis lupus tundrorum</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Primates</td>
<td>Vervet monkey</td>
<td>Chlorocebus aethiops</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>*Common Chimpanzee</td>
<td>Pan troglodytes</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Long-tailed/crab eating macaque</td>
<td>Macaca fascicularis</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>*The Mandrill</td>
<td>Mandrillus sphinx</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Hamadryas Baboon</td>
<td>Papio hamadryas</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mammals</td>
<td>*Barbary Sheep</td>
<td>Ammotragus lervia</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>*Asian water buffalo</td>
<td>Bubalus bubalis</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>European Roe Deer</td>
<td>Capreolus capreolus</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Fallow Deer</td>
<td>Dama dama</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Common eland</td>
<td>Tragelaphus oryx</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Red Deer</td>
<td>Cervus elaphus</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Llama</td>
<td>Lama glama</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Moufflon</td>
<td>Ovis musimon</td>
<td>7</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Domestic sheep</td>
<td>Ovis aries</td>
<td>2</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Domestic goat</td>
<td>Ovis spp</td>
<td>4</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Bovis spp</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Equidae</td>
<td>Domestic donkey &amp; mule</td>
<td>Equus spp</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Shetland pony</td>
<td>Equus caballus Shetland</td>
<td>4</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Domestic horse</td>
<td>Equus caballus</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mustelidae</td>
<td>Ring-tailed Coati</td>
<td>Nasua nasua</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Common Raccoon</td>
<td>Procyon lotor</td>
<td>4</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Marten</td>
<td>Martes spp</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rodents</td>
<td>North African crested porcupine</td>
<td>Hystrix cristata</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Nutria</td>
<td>Myocastor coypus</td>
<td>5</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Eastern gray squirrel</td>
<td>Sciurus carolinensis</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Marsupialia</td>
<td>Tammar Wallaby</td>
<td>Macropus eugenii</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 3. List of reptiles and amphibians in the Zoological Garden of Bucharest (last updated: Feb. 2009)

<table>
<thead>
<tr>
<th>Common name</th>
<th>Species</th>
<th>Males</th>
<th>Females</th>
<th>Unknown/youngs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Snakes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reptiles &amp; Amphibians</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Turtles</strong></td>
<td>Red-eared slider</td>
<td></td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td><strong>Crocodiles</strong></td>
<td>Nile crocodile</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>Lizards</strong></td>
<td>Green iguana</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td><strong>Tortoise</strong></td>
<td>Leopard tortoise</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td><strong>Amphibians</strong></td>
<td>Green and black poison dart frog</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Yellow-banded poison dart frog</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>*Golden Poison Frog</td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

| Green anaconda                     | *Eunectes murinus*            | 0     | 0       | 2              |
| Green anaconda                     | *Eunectes murinus*            | 0     | 0       | 4              |
| Burmese Python                     | *Pithon molurus bivittatus*   | 0     | 0       | 1              |
| Indian Python                      | *Pithon molurus molurus*      | 0     | 0       | 6              |
| Albino python                      | *Pithon molurus*              | 0     | 0       | 5              |
| African Rock Python                | *Pithon sebae*                | 0     | 0       | 2              |
| Python, other species              | *Pithon spp.*                 | 0     | 0       | 5              |
| Ball python                        | *Python regius*               | 0     | 0       | 1              |
| Boa                                | *Boa constrictor*             | 0     | 0       | 17             |
| *Japanese Forest Ratsnake*         | *Elaphe conspicillata*        | 0     | 0       | 1              |
| Aesculapian Snake                  | *Elaphe longissima*           | 0     | 0       | 4              |
| Common Kingsnake                   | *Lampropeltis getulus*        | 0     | 0       | 3              |
| Corn Snake                         | *Elaphe gutatta*              | 0     | 0       | 1              |
| Kingsnakes                         | *Lampropeltis spp*            | 2     | 5       | 7              |
| **Turtles**                        | Trachemys scripta elegans     | 0     | 26      |                |
| **Crocodiles**                     | Crocodylus niloticus          | 0     | 3       | 0              |
| **Lizards**                        | Iguana iguana                 | 1     | 4       | 0              |
| **Tortoise**                       | Geochelone pardalis           |       |         | 4              |
| **Amphibians**                     | Dendrobates auratus           | 0     |         | 3              |
|                                    | Dendrobates leucomelas        | 0     |         | 3              |
|                                   | Phyllobates terribilis        | 0     |         | 3              |
1.5 Geographical location and Zoo Plan - Annex 3

Fig. 2 Location of the Zoological Garden of Bucharest within the city

Fig. 3 Surroundings of the Zoological Garden of Bucharest
Fig. 4 Plan of the Zoological Garden of Bucharest
1.6. Aims of this study

The aim of this diploma thesis was to develop a constructive critique of the management of the Zoological Garden of Bucharest (Băneasa Zoo) with emphasis on veterinary staff, animal behavior and animal health. The method used to gather data consists of a process of:

- Identifying points where there is room for progress;
- Studying relevant literature concerning similar cases and situations;
- Developing an improvement strategy formulated as a suggestion to the Zoo staff;
- Observing the possible effects, if the particular suggestion is implemented.

In some of the case studies presented, the last two steps will be missing.

Based on more than two years of observations (2008-2010) and considering available equipment, medication, funding and other resources, conclusions will be drawn and several suggestions will be made regarding enclosure design, enrichment, medical treatments and protocols. Evolution in time is recorded, and the effects of some modifications will be highlighted. It is not meant to be comprehensive, and, while trying to capture an overview of the complex task of managing a zoo and the health of its animals, it is emphasized mainly on carnivore mammals. It is not the purpose of this study to bring criticism to the staff itself, which was kind enough to cooperate and assist all the way through making this study.
2. Capacity building

During the planning of this master thesis ‘capacity building’ was identified as being a major issue for further development of Bucharest Zoo. The social, economic and political environment contributes substantially to the way the Zoo works and understanding the need for building capacity may help troubleshoot its current setbacks.

2.1 What is capacity building (CB)?

Capacity building entered the mainstream of management terminology in the recent years referring mainly to aid given to developing countries. It quickly spread to other areas, where it is applied to any means of producing skills and competences in places where these are needed.

The United Nations Development Programme (UNDP) defined ‘capacity building’ as creation of an enabling environment with

- Appropriate policy and legal frameworks
- Institutional development
- Community participation (of women in particular)
- Human resources development
- Strengthening of managerial systems.

UNDP adds that capacity building is a “long-term, continuing process, in which all stakeholders participate (ministries, local authorities, non-governmental organizations and groups, professional associations, academics and others)” (UNDP Briefing Paper, 1991)

2.2 How is it done? Following the example of capacity building in conservation projects

2.2.1 CB in zoos

Zoos are generally economic-oriented institutions, organized towards efficiency and profitability and it is implied that they do not need capacity building on large scale. It is understandable why there are no studies to the author’s knowledge that address the need for and the effects of capacity building in zoos. Therefore we use the conservationists’ approach to capacity building as a model, since both zoos and conservation projects deal with safeguarding wild animals in captivity or in the wild. Even if the purpose itself of handling wild animals is different, both face similar problems: medical issues, animal-human interaction and environmental enrichment. To conclude, an attempt will be made to apply conservationists’ example in the case of Zoological Garden of Bucharest.

2.2.2 CB: the feedback system

When designing a capacity building project it is important to keep in mind that this is a self-regulating process.
It starts by pinpointing the sensible issues that need to be addressed → it continues with performing the “diagnosis” of the context → training the appropriate persons → selecting the action to be implemented → maintaining and enforcing the chosen course of action → verifying if the chosen action is effective, and the initial situation has improved → the entire cycle is repeated until it becomes a fine tuned instrument of aid (Fig. 5).

Fig. 5 Feedback scheme applied to capacity building (taken from HORTON et al., 1998)

2.2.3 Tools
SALAFSKY (2001) considers adaptive management to be the perfect solution for building capacity in complex systems. He describes it as a combination between research and action, between biological sciences and social sciences. This applied research brings on common grounds both theory and real applicability.

It is also essential that participants to a project, may it be a conservation project or otherwise, have all the necessary skills to perform the tasks needed to complete the goal (Table 4). These skills themselves represent a target of a capacity building project. They need to be identified as present or absent, and according to their urgency they can be taught, trained, and acquired.
Table 4 Critical functional roles within a project (taken from SALAFSKY et al., 2002)

<table>
<thead>
<tr>
<th>Skill type</th>
<th>Functional role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge and general aptitudes</td>
<td>Conceptualization, systems thinking, model development, problem setting, Strategic thinking, visioning, weighing, alternatives, Assumption testing, experimental design, cause-and-effect thinking, Analytical thinking, statistics, computer skills, Strategic communications, strategic thinking, writing and design skills, conflict resolution skills</td>
</tr>
<tr>
<td>Programmatic skills</td>
<td>Situation analysis, site assessment, capacity assessments, Project design, planning, scenario evaluation, Strategic planning, setting targets, goals, objectives, activities, Project implementation, developing, workplans, setting budgets, Develop monitoring, plan, monitoring strategy, indicators and methods, Assess methods, effectiveness, cost-effectiveness and practicality, Information management, data processing and storage, data cleaning, Data analysis, qualitative data, quantitative data, Product planning, audience and media identification, needs assessment, Product development, pilot testing techniques, production skills</td>
</tr>
<tr>
<td>Administrative skills</td>
<td>Coordination, facilitation, partnership development, proposal development, Organizational management, personnel management, financial management, organizational development, Evaluation, performance evaluations, financial evaluations, process tracking, Information systems, develop and run systems, database management, cost-benefit analysis, Routine communications, internal systems, external reporting, public relations</td>
</tr>
</tbody>
</table>

2.2.4 Importance of CB in conservation

A survey among the members of the “Austral and Neotropical America” section of the Society for Conservation Biology indicates that lack of capacity building for conservation is among the most urgent problems that need to be addressed to improve conservation in the region (CEBALLOS et al., 2009)

2.2.5 Lessons learned by conservationists

HORTON (1998) in his discussion paper “Building Capacity in Planning, Monitoring and Evaluation: Lessons from the Field”, notes that “capacity building is more a process of social experimentation than of social engineering. Management systems cannot be imported but need to be developed within organizations.”

He draws nine conclusions from his practical experiences as manager of a capacity-building project in Latin America; these conclusions were very useful guidelines in conducting the present study at the Bucharest Zoo:

1. Project design is much more than a technical process; it is essentially one of negotiation.
2. In capacity-building projects, design activities cannot end when implementation begins.
3. A priority for capacity-building efforts is to prepare managers to deal with complexity, uncertainty and change.
4. In capacity building efforts, don’t patronize managers, but seek to collaborate as equals.
5. Organizational assessment is a complex social process, intertwined with organizational politics.

6. In designing capacity-building projects, it is essential to involve managers and staff members in assessing needs and opportunities.

7. Action-learning strategies offer great potential for capacity building.

8. In the context of strategic management and organizational learning, planning, monitoring and evaluation take on new meanings.

9. Training is most effective when it is designed to serve a purpose within an organizational change process.

2.2.6 Example

The ‘Knowledge Exchange Train’ is worth mentioning as an example of successful capacity building implementation. An international team of scientists and practitioners from conservation and development organizations traveled across a tri-national area of the southwestern Amazon, quickly increasing public awareness and participation of the native populations in planning and governance. This model supports planning for sustainable development and can be adapted to other geographic contexts and topics (MENDOZA and AGUILAR, 2007)

2.3 The context of CB

2.3.1 Why is it important?

Deborah Eade writes in her book “Capacity-Building: an Approach to People-Centered Development”, “capacity building cannot be seen or undertaken in isolation. It is deeply embedded in the social, economic, and political environment. Understanding this environment is critical in order to understand who lacks what capacities in any given point; why; and why this matters.”

Exploring the socio-political context in which the Bucharest Zoo stands is vital for understanding its issues, its present state, the rate of its development, and the possible steps to improvement.

2.3.2 Potential

As one of the largest zoos in Romania and located in the economic and social heart of the country, the Zoological Garden of Bucharest possesses a great and yet barely exploited potential. Bucharest is a city with more than 2.5 million inhabitants with an increasing demographic trend. According to the United Nations Population Fund, “the world is undergoing the largest wave of urban growth in history”: in 2008 more than half of the population will be urban dwelling, making prospects of city zoos easy to predict. They are able to access a wider public, therefore access larger economic resources, but they could also have a higher social impact, reaching and educating a wider range of people.
2.3.3 Location

The value of real estate in Bucharest is booming, even during the economic crisis. The prices of land, especially inside city limits, are higher than similarly positioned land tracts in other European capitals. The Zoo is “inconveniently” located in one of the green outskirts areas that present high interest for real estate developers. On the map shown in Annex 3 it can be seen that the Zoo is tightly surrounded by private buildings. Real estate investors have put a tremendous pressure on the Zoo management for several years, and it was even planned to move the zoo to a new location. As result all improvements to the zoo were cancelled.

2.3.4 Public attitude

The attitude of the media towards the zoo limited many of its activities. As an example, a great scandal arose in 1996 when the elephant Gaya died. The media presented the animal’s death as being due to mishandling and inappropriate use of force, even if the true cause of death was a massive echinococcosis infestation. It was a widely covered issue by almost all local and national newspapers and television broadcasters. A similar case that received impressive but biased media coverage took place in 2007, when a panther tried to escape from its enclosure and was killed by the zoo’s staff in an attempt to tranquilize it. As a consequence of this aggressive position from the media and public, the staff is reluctant to perform major medical or management maneuvers on many of the zoo’s animals.

2.4 Targeting the issues (implementation of CB in Zoo Bucharest)

1. One of the most obvious differences from other zoos is the vast amount of paperwork and administrative tasks the veterinarians have to perform. If we look at Table 4 we notice that administrative skills play an important part; however, they are not necessarily to be met by the same person who is in charge of other aspects of the project. Changing the legal framework and the organization scheme and general responsibilities might help relieve the veterinarians of burdensome tasks and unnecessary responsibilities.

2. The veterinarians bare a large responsibility within the zoo. They are held liable and face negative public feedback in case of death of an animal, even if the procedures are performed lege artis. For example the darting equipment is seldom used because of the risks implied. An improvement of the zoo’s image and a changing the legal framework can solve this issue.

3. The lack of trained animal keepers and vet assistants lowers animal life quality and sometimes interferes with the medical act itself, due to low compliance. There is only one veterinary technician on staff, who performed medical treatments for many years, but is close to retirement. The faculty of veterinary medicine in Bucharest cancelled the “veterinary technician degree” 5 years ago. Reinstalling this degree, hiring trained personnel, adjusting the wages (keepers are currently severely underpaid) could increase the motivation within the staff and improve the situation.
4. There are very few interns present in the zoo (biologists, vet students). They could be used, for example, to study the type and intensity of animal stereotypes, or quantify the effects of enrichment programs. There is generally little professional contact between the Zoo and the University of Veterinary Medicine of Bucharest. There are known sporadic collaborations with surgeons and pathologists, however there is little exchange of professional knowledge.

Challenges to capacity building in conservation can include: lack of university programs, little access to information, lack of capacity to publish and publicize scientific research, and dependence on foreign institutions. Also the universities themselves can suffer from an acute lack of infrastructure, educational resources, and professional development opportunities for educators (CEBALLOS et al., 2009).

However MILLER et al. (2004) bring a solution to the lack of cooperation between collection based institutions and the academia, giving the example of Denver Zoo and the Missouri Botanical Garden, where biologists on staff teach in universities and mentor graduate students. Zoos can access research funds, and the students’ projects could benefit the collections. On the other hand, universities themselves can organize teaching modules, training courses, lectures and workshops to train future professionals. For example, the international training programs organized by the Conservation and Research Center of the Smithsonian National Zoological Park have produced over 3000 alumni, many of which now hold prominent positions in their home countries (MILLER et al., 2004).

5. Access to information is one of the most powerful tools of capacity building. The Bucharest Zoo has unfortunately limited resources; databases and networks as for example Veterinary Information Network, Scopus or relevant journals, are still inaccessible. However, a major improvement has taken place in the last years, since a younger veterinarian was brought on staff. After purchasing specialty books and gaining access to free online libraries, the sphere of knowledge has expanded and it reflected in the quality of the medical act, as it will be discussed in a later section.

6. The veterinarians need further “hands on” training; however restricted funding prevents them from attending international conferences and workshops. As a possible future alternative, a short internship in a modern, geographically close zoo, such as the one in Budapest, could offer sufficient extra practice.

7. Data recording has also been deficient and obsolete: all data, including medical data have been recorded in physical logbooks (hardcopy); almost all logbooks older than 2007 have been lost due to faulty storage. Since the beginning of 2009, however, all data is recorded in a FOX Pro searchable database.

8. A general problem is the lack of funds. To encourage additional income, the model of the veterinary clinic of the Viennese Schönbrunn Zoo could be adopted: the clinic, with its equipment and staff could work part time as an open clinic, targeted on exotic animal patients. Bucharest Zoo is relatively small, with a daily caseload that would permit such a time investment. There is
however the question of safety concerning biohazards (foreign animals can introduce infectious diseases and parasites), since the clinic is located deep inside the zoo premises, far from the main entrance.

2.4.1 The first international Symposium on Wildlife and Exotics Medicine (1st ISWEM) was organized together with the help of the Bucharest Zoo in March 2010. Taking part in the lectures and workshops, and the mere fact of organizing the event has changed many of the practices in the Zoo and especially in the veterinary department. It provided access to information, created connections with peers, opened the path to gaining practical skills. It was with this occasion that many pieces of equipment have been used for the first time (darting equipment, anesthesia machine, oxygen chamber). They have all been previously available, but never utilized due to lack of “know-how”.

Table 5 orders all the above-mentioned issues into a table organized according to the CB feedback scheme. It presents the targeted problem within the system, its context or causes, possible actions that could address it, and, if the actions have been applied, what are its effects on the system so far.
Table 5. Summary of capacity building related issues in the Zoo of Bucharest:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause(s) of the problem</th>
<th>Possible solution(s)</th>
<th>Implemented?</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Vast amount of paperwork and administrative tasks the veterinarians have to perform</td>
<td>&gt; Outdated regulations</td>
<td>&gt; Re-thinking veterinarians’ attributions and responsibilities</td>
<td>No</td>
<td>—</td>
</tr>
</tbody>
</table>
| 2 Veterinarians’ liability in case of failure, even if procedure was performed *lege artis* => risky procedures are | > Outdated regulations  
> Negative media publicity | > Changing the legal framework  
> Changing media/public attitude  
> Re-thinking veterinarians’ attributions and responsibilities | No           | —       |
| 3 Lack of trained animal keepers and assistants                        | > Low wages  
> Lack of specialized training (cancelling of the Veterinary Technician degree) | > Higher salaries  
> Specialized courses/trainings  
> Reinstalling the Veterinary Technician degree | No           | —       |
| 4 Few interns, practicants (biology, vet students)                     | > Little contact with the local academia  
> Lack of academic infrastructure (programmes, traineeships) | > Accessing research funds  
> Mentoring programmes between zoo staff and students  
> Organisation of teaching modules, lectures, workshops | Partially: taking part in the 1st ISWEM | Publication of scientific papers  
> Student training |
| 5 Restricted access to information                                      | > Lack of funds => some books and databases are unaccessible  
> Lack of peer contacts | > Accessing free online databases (IVIS), open access journals (PLoS ONE)  
> Participating in workshops and trainings (in and outside Romania) | Partially:  
> Some books have been purchased  
> Some databases are being used  
> Staff took part in the 1st ISWEM | > New professional connections have been created  
> New procedures/treatments will be implemented (Eg.: contraception in carnivores) |
| 6 Insufficient hands on training for the vet staff                     | > Lack of funding  
> Lack of learning programmes oriented on wild/exotic animals in Romania | > Internship in a modern, geographically close zoo (Budapest)  
> Participating in workshops and trainings (in and outside Romania) | Partially:  
> Taking part in the 1st ISWEM | > Staff learned to use the already existent anesthesia machine and darting equipment |
| 7 Obsolete record keeping                                               | > Data recording only on hardcopy logbooks  
> Logbooks prior to 2007 are lost due to faulty depositing | > Installing and using a computer based recording program | Yes: a FOX Pro searchable database is now in use | > Ease of record keeping  
> Ease of information sharing |
| 8 Lack of funds                                                        | > Use of the zoo's hospital as a part time open clinic | | No | |
3. Behavior and Environmental Enrichment

The construction of the enclosure is one of the most important aspects relevant for captive animal wellbeing. It can influence the animal's stress level, behavior, reproductive success and health. In the following chapter environmental enrichment is discussed in close relation to animal behavior, summarizing relevant literature and applying it directly to the case of Băneasa Zoological Garden.

3.1 Sources of stress

Although there are many definitions of "stress", it was basically defined as the experience of having intrinsic or extrinsic demands that exceed an individual’s resources for responding to those demands (DANTZER, 1991). The tendency of systems to maintain a steady state is referred to as homeostasis, and a “stressor” is anything that challenges homeostasis (SELYE, 1976). Stressors result in a cascade of physiological events (activation of catecholamines and the hypothalamic pituitary-adrenal axis, tachycardia, increased respiration rate, increased glucose metabolism, reduction of immune function, etc.) designed to prepare the body for homeostatic challenge that results in the “fight or flight” response (MORGAN and TROMBORG, 2007).

In captive animals, perhaps the greatest stressors are those over which the animal has no control and from which they cannot escape. MORGAN and TROMBORG (2007) considered several factors to influence stress in wild animals kept in captivity. They included abiotic environmental stressors (sound, light condition, odors, thermal and tactile experiences, substrate) and confinement specific stressors (restricted movement; absence of retreat space; forced proximity to humans; routine husbandry; restricted feeding and foraging; abnormal social groups). In the following paragraphs these stressors will be discussed in relation to the carnivores on display at Zoo Bucharest.

3.1.1 Sound

In the wild noise levels can rise above 20 dB but rarely exceed 40 dB. Recordings of the sound pressure levels in zoos averaged 70 dB, and were influenced by the number of visitors, the intensity of their conversations, the presence of maintenance machinery or exhibit water features, and the amplitude of sounds of surrounding urban transportation systems (TROMBORG and COSS, 1995).

It is obvious that reactions will be observed from the part of the animals. It has been noticed that, in the wild, caribou respond to the sound produced by aircraft flyovers with increased activity (MAIER et al., 1998) and similar effects of aircraft noise have been found in captive desert mules (BLEICH et al., 1990). The Bucharest Zoo is located in between the two airports that serve Bucharest, the closest being located at 3 km (see map, Annex 3). The flight path of the airplanes, especially after take off intersects the location of the Zoo.
It is also known that a number of animals, including tigers, elephants, and dolphins can detect infrasound (VON MUGGENTHALER, 2000). Because many devices (such as trucks, pumps, filters, and other engines) used in captive environments generate seismic vibration and other infrasonic sound, there is a possibility that they can distress some animals (MORGAN and TROMBORG, 2007). Bucharest Zoo, even if located in the heart of a forest on city outskirts, is surrounded by an area with heavy construction activity (see “Context” of Chapter 2.). Furthermore, there are several construction projects at the moment inside the Zoo itself. Even though the number of visitors is not as high as in other European zoos of similar size, the noise levels in general and possibly infrasound are most probably exceeding comfort levels.

3.1.2 Light

Artificial light conditions apply mainly to nocturnal mammals and to some reptile species, whose circadian cycle is reversed. Carnivores in Bucharest Zoo are mainly being housed in outdoor enclosures. They receive natural light throughout the year, however, in the case of the tigers and in the past of the lions, a rotation schedule was applied for access to the outdoor space. For example, when two tigers housed in the same enclosure, each day, only one of them is allowed to go in the outside paddock, while the second is locked in the inside cage. The next day the two animals swap places. Therefore, at each given moment one of the tigers will have less access to natural light.

3.1.3 Odors

Virtually all mammals other than primates are considered macroosmatic, meaning that they orientate themselves using smell as a cue. In captivity, routine cage cleaning may interfere with these cues. Many animals use scent marks to delineate territory or to indicate reproductive status, and for these species the constant removal of these scent cues may be stressful. In response to cleaning, such species usually attempt to re-anoint their surroundings (HEDIGER, 1964).

Many of the cages in zoo Bucharest are cleaned daily with pressurized water, despite the vet recommendations. It has been observed that after cage cleaning the animals become restless, they refuse to eat, manifest aggression towards staff and vocalize. Even though the veterinarians are aware of the fact that scent markings of the cages are an important factor for the animals’ wellbeing, imposing a new cleaning schedule seems to be more difficult than expected.

There is data that suggests that a variety of animals may be able to detect distress in conspecifics based on odor cues and that these may be stressful to individuals perceiving them (MORGAN and TROMBORG, 2007). Almost all tigers in the Bucharest Zoo display some degree of stereotypy and therefore it is to be expected that the urine will contain scent-coded information about the individual’s stress. In the case of the tigers housed in “swapping” pairs, the scent of a stressed partner can echo the same state of negative arousal and therefore leading to a vicious circle.
3.1.4 Temperature

Most animal welfare legislation explicitly dictates allowable temperature ranges for different species (BESCH, 1990). In case of animals housed in open-air enclosures it can be rather difficult to control the environment’s temperature. Romania has a typical continental climate, which can generate temperatures of over 30°C during the summer and -15°C during winter. Some of the carnivores on display are endemic, and are adapted to this temperature range (wolves, brown bears, lynx), others are exotic species acclimatized with warmer surroundings (lions, coati). However, all the animals have access to indoor shelters.

3.1.5 Substrate

There has been a major improvement over the years from the point of view of substrate materials. All cages and enclosures used to have plain concrete floors (some containing a water pool). Now the outdoor enclosures have been redesigned to offer a combination of earth bedding, grass, rocks, and tiles, with hills and viewpoints. The indoor enclosures remain plain concrete and tiles, for ease of cleaning (see Fig. 6). When animals are given a choice, they appear to select substrates that vary by thermal qualities and their softness (MORGAN and TROMBORG, 2007).

Fig. 6 Indoor view of the jaguar’s cage.
3.1.6 Restricted movement

In one study on the impact of captivity on different carnivores, stereotypic pacing was found to correlate positively with species home range size in the wild (CLUBB and MASON, 2003, 2007), suggesting that the impact of enclosure size on captive animals is a matter of life history (MORGAN and TROMBORG, 2007).

In simple terms, the enclosures should offer more space to the animals. When comparing the ranges brown bears use in the wild and the size of their enclosures in captivity, no matter how suitable or enriched they are, it is obvious they are severely confined. In the past, Băneasa Zoological Garden kept 3 bears in small (ca. 150 m²), separate cages. Recently a new enclosure unifying these smaller cages has been built and this is now used for housing only two animals (see Fig. 7).

Not movement itself is missing in the enclosures, since many animals can cover by pacing the equivalent distance covered in the wild (CLUBB and MASON 2007). Instead, regular or substantial variations in the visual, olfactory, auditory and tactile signals coming from the surroundings are missing (MEEHAN and MENCH, 2007).

Fig. 7. The bear enclosure before (top) and after (bottom) reconstruction.
3.1.7 Absence of retreat space and forced proximity to humans

One of the behavioral opportunities that are limited for animals in captivity is their ability to move away from one another or from human passers-by. The lack of sufficient retreat space is a significant potential stressor for captive animals (MORGAN and TROMBORG, 2007). In a study of zoo-housed leopards, overall activity was suppressed when visitors were present and large increases in visitor numbers resulted in increased pacing (MALLAPUR and CHELLAM, 2002), indicating agitation or stress.

One of the best features of the carnivore enclosures in Bucharest Zoo is the fact that they are designed in such a manner that vegetation and cage furniture offer enough space for the animals to retreat from visitors and keepers. Some enclosures offer more protection from disturbance than others, and the best example is the jaguar’s pen (Fig. 8). It has such abundant vegetation and a complex structure of tunnels and passages, that most of the times the animals are concealed from the public. Some of the tiger enclosures, however, lack a proper amount of furnishing. It was observed that tigers in these enclosures spent more time pacing than jaguars.

Fig. 8 Visitors’ view of the jaguars’ enclosure.

3.1.8 Restricted feeding and foraging

Food for carnivores in the Bucharest Zoo is given according to a schedule, and is offered most of the times as raw meat. There is invariably the same food given at same times, normally once a day. There is a so-called “expectancy” behavior observed prior to feeding times, when an
increase in pacing and agitation is displayed. This type of behavior has been noted in many captive species, not only in zoo animals throughout the world (POPESCU and ROSU, 2007). After feeding, the animals resume to their inactivity or to their stereotypes.

Many studies have shown that animals will perform work to obtain food (COULTON et al., 1997), even when the same food is freely available. This type of behavior is named “contrafreeloading,” and animals in barren environments are particularly likely to display it (MORGAN and TROMBORG, 2007).

One possibility to improve the quality of life in these animals is to either scatter the food in their enclosure, so that foraging time is increased (POPESCU and ROSU, 2007), giving food puzzles, offering food at different times of the day, and using entire carcasses for the large carnivores. Easy-to-eat diets have also been found to have harmful effects on carnivore dentition (WENKER et al., 1999); feeding whole-prey items in contrast improves dental condition (LINDBURG, 1998). In addition, one study of large cats in zoos showed that whole-carcass feeding reduced stereotypic behavior in off-exhibit areas, but increased hiding behavior on exhibit (MCPHEE, 2002). The net benefit from intact carcass feeding to carnivores in captivity has yet to be determined (MORGAN and TROMBORG, 2007).

These measures however would require more work and compliance from the side of the keepers (see “Targeting the issues”, Chapter 2.).

3.1.9 Abnormal social groups

Although the vast majority of carnivores are solitary, approximately 15% have evolved to live in social groups (VUCETICH et al., 2004). Different factors (such as territorial defense, communal rearing of young, cooperative hunting and defending prey from scavengers) contributed to this evolution (CARBONE et al., 1997).

In captivity, however, there is no competition with other species over food, no predation and no danger of scavengers. In the same time, the groups are limited in their possibility to regulate social tensions or to find partners. Thus, the population sizes in captivity need to be carefully adjusted. To give an example of how closed captive populations can react when alterations are made, it is interesting to analyze the case of the wolf pack in Zoo Bucharest. Over the years it had the same leading alpha male. After moving the pack to another enclosure, while the old one was being refurbished, and after transporting some of the low ranking males to another zoo, the former omega male became the dominant wolf in the newly formed pack.

Many felid species, the majority of which are solitary in the wild, are often housed in pairs or trios in zoos. Although this arguably provides a source of social enrichment, it can also be a source of chronic stress (MELLEN et al., 1998). One solution is to alternate pairs on exhibit or house solitary cats with visual and/or olfactory access to conspecifics. This is also the case for most of the felid housing conditions in Bucharest. Some pairs are kept together (lions, lynxes), while others
are kept separately, alternating the access to the enclosures, but mainly to prevent reproduction. More investigations are needed to identify the best method for keeping such animals and the ideal number or individuals in a group.

3.2 Coping with stress – natural behavior vs. stereotypic behavior

Stereotypies are relatively invariant, repetitive behaviors that seem to have no immediate function (MASON, 1991). Since there are some recognized stereotypic behaviors that are perfectly normal and unproblematic (a cat kneading a pillow, a fetus or baby sucking its thumb, a dog chasing a stick), MASON et al. (2007) suggest the use of the term “abnormal repetitive behavior” (ARB), since it pinpoints only the pathologic conduct.

In a general overview of stereotypes and their basis, MASON et al. (2007) punctuates several reasons why captive animals perform stereotypic behavior:

- Cues external to the animal, persistently trigger or motivate a specific behavioral response;
- The environment creates a state of sustained stress;
- Faulty nervous system development; nervous system disabilities.

As an example on the widespread occurrence of stereotypic behavior/ARB in captive environments, an excerpt of a table listing the prevalence of ARB in different bear species is presented in Table 6. For brown bears, a concerning proportion of 48% display some type of abnormal behavior. Even more concerning is that among the bear species investigated, this is the lowest prevalence, with the highest being of up to 100% in polar bears. In the case of the Băneasa Zoological Garden, all carnivores on display show some type of stereotypic behavior.

Table 6. Prevalence of abnormal repetitive behaviors in bears in zoos and breeding centers. (MASON et al., 2007):

<table>
<thead>
<tr>
<th>Species</th>
<th>Prevalence expressed as a % (and as a fraction of the individuals sampled)</th>
<th>Number of institutions sampled</th>
<th>Worldwide population: estimated worldwide zoo total, if 50% zoos report to ISIS; see text</th>
<th>Estimated worldwide number of zoo animals affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown bears (Ursus arctos)</td>
<td>40% (89/225)*</td>
<td>49</td>
<td>459,000</td>
<td>432</td>
</tr>
<tr>
<td>Antartic bears (Ursus thibetana)</td>
<td>54% (139/259)</td>
<td>28</td>
<td>131 (262)</td>
<td>141</td>
</tr>
<tr>
<td>American black bear</td>
<td>43% (6/14)*</td>
<td>7</td>
<td>501 (601)</td>
<td>258</td>
</tr>
<tr>
<td>Sun bears (Ursus ursinus)</td>
<td>74% (12/22)*</td>
<td>14</td>
<td>138 (276)</td>
<td>204</td>
</tr>
<tr>
<td>Spectacled bears (Tremarctos ornatus)</td>
<td>60% (9/15)*</td>
<td>10</td>
<td>140 (280)</td>
<td>168</td>
</tr>
<tr>
<td>Sloth bear (Melursus ursinus)</td>
<td>55% (60/24)*</td>
<td>39</td>
<td>70 (140)</td>
<td>84</td>
</tr>
<tr>
<td>Polar bear (Ursus maritimus)</td>
<td>100% (12/12)*</td>
<td>8</td>
<td>199 (398)</td>
<td>227</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>18</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

In the same paper, Mason et al. (2007) consider five potential means by which repetitive abnormal behaviors could be approached: genetic selection; pharmacological treatment; the
reinforcement of alternative behaviors; punishment; environmental enrichment. Even though all measures (except punishment) are potentially useful, enrichment is the preferred approach.

3.2.1 Genetic selection

There are very few attempts to eliminate stereotypies in zoo animals through breeding, and it has been done indirectly by avoiding to breed highly stereotypic individuals. Experimentally, stereotypic behavior was successfully selected against in poultry (MILLS et al., 1985); while on a practical level, there is a national policy in the Netherlands for mink ranchers to breed this behavior out of their farmed populations (EC, 2001). There would be, however, very few potential to successfully use this method, especially in Zoo Bucharest, without addressing the underlying issues first.

3.2.2 Pharmacological treatment

The second approach to ARB reduction is the use of pharmacological agents such as serotonin-reuptake inhibitors. POULSEN et al. (1998) described the successful use of oral serotonin reuptake inhibitors in a polar bear that had been displaying ARB’s for two decades, considerably improving its behavior. Previous tactics (enrichment-based ones) had failed to achieve this. However, while fluoxetine reduced this animal's ARBs, a similar course of treatment had some exacerbating effects on the pacing of her similarly aged companion. Therefore the effect remains difficult to predict and understand.

3.2.3 Reinforcement of alternative behaviors

A third way to deal with ARBs is to actively reinforce non-stereotypic behaviors with reward, as done in companion animals. Offering intellectual stimulation to intelligent zoo animals can prevent them from conducting stereotypic behavior, and it is a widely spread practice in zoos to train their animals. Training can be used for interrupting ARB’s, but can also be used for creating a closer bond with the keeper, to habituate them with human contact, to prepare them for visitor shows or to facilitate clinical examinations or non invasive veterinary maneuvers. Animal training requires a specialized and dedicated staff, and more commitment and involvement of the keepers. At the Bucharest Zoo, animals most prone to successful training would be the two lions and the wolves, since these animals are well conditioned with human presence.

As an example, other than training, HARE (1995) achieved an overall reduction in stereotypic behavior using remote-controlled feeders to reinforce only ‘desirable’ behaviors (e.g. active investigative behaviors) in two brown bears (Ursus arctos).

3.2.4 Punishment

Punishment is rarely used in zoo animals, and refers mainly to methods that prevent ARBs (bitter-tasting paste used to prevent over grooming in rodents, or licking in ungulates, blocking the
path used by a mammal for pacing, etc.). When this method is used, generally the animal finds an alternate fixation.

3.2.5 Environmental enrichment

Obviously enrichment is the best course of action for dealing with stereotypy. Fig. 9 demonstrates the effects of enrichment on different types of stereotypic behaviors. The numbers above the columns refer to the percent of cases in which enrichment significantly decreased stereotypy performance. Interesting to note is that, even if reduction of stereotypy is observed in almost all cases, it was not completely eliminated.

Fig. 9 Effects of enrichment applied to captive animals (farm, laboratory and zoo animals) (SWAISGOOD and SHEPHERDSON, 2005)

3.3 Enrichment – how, where and when

3.3.1 Definition

NEWBERRY (1995) defined enrichment as an improvement in the biologic health of the animal resulting from modifications to the enclosure. CHAMOVE (1989) defined enrichment as methods that alter the captive animal’s behavior so that the behaviors observed are similar to the behaviors expressed by the animal’s wild conspecifics. Lastly, the definition used by MELLEN and MCPHEE (2001) combined both biologic and behavioral measures. CHAMOVE (1989) states that the frequency with which animals engage in stereotypic behavior is a sensitive measure of the effectiveness of an enrichment condition.

Whatever the definition may be, over the past years an increasing interest in the field of enrichment has been observed, and the field is influenced by developments in animal welfare and pushed forward by needs of animal conservation.
3.3.2 Goals

MELLEN and MACPHEE (2001) defined the five main goals of enrichment:

1. Animal welfare is the primary goal. Although it is difficult to define and measure scientifically, it is accepted that an enriched captive environment enhances the psychological and physiological well-being of animals;
2. Successfully reproducing animals that exhibit adequate parental care;
3. Identify and reduce potential sources of chronic stress and enhance an animal’s ability to cope successfully with acute stress;
4. Reduce or eliminate aberrant behaviors and concurrently provide opportunities for species-appropriate behaviors and activity patterns; such animals are also more informative and interesting to our visitors;
5. Re-introduction of captive-born animals appears to be more successful when developing animals are reared under conditions that allow the performance and maintenance of species-appropriate behaviors.

3.3.3 Assessment

How are the effects of enrichment assessed?
- Changes in animal behavior (e.g., time budget) or behavioral tests (e.g., open-field);
- Neurological assessment (e.g., dendrite density);
- Physiological measures (e.g., measurement of glucocorticoids);
- A mixture of behavior and physiology (DE AZEVEDO et al., 2007).

In zoos the experiments are carried out with more limited experimental control. Not only are zoo studies using smaller sample sizes (33.33% of studies used less than six animals) but are conducted in less scientifically rigorous experiments due to the inability to control sources of experimental variation, for example temperature, number of visitors (DE AZEVEDO et al., 2007).

3.3.4 How is it done

Historically, “the wild” was considered the ultimate guide to assessing the adequacy of a captive environment (HEDIGER, 1969), however it could be argued that the captive environment is simply another environment to which animals have adapted (SHEPHERDSON, 1998).

MELLEN and MACPHEE (2001) suggests that an enrichment plan should be developed based on an animal’s natural history, individual history, and its specific exhibit constraints (see Annex 4), and it should be based on a simple algorithm similar to the one presented in Chapter 1 “Capacity building”:

Goal setting → Planning/approval → Implementation → Documentation → Evaluation → Readjustment
There is a tendency for food-related enrichment to be greatly used in zoos; this probably reflects the powerful reinforcing properties of food-related enrichment and the greater availability of staff for implementation (Table 7; DE AZEVEDO et al., 2007).

Table 7. Success of enrichment by its type (DE AZEVEDO et al., 2007):

<table>
<thead>
<tr>
<th>Type</th>
<th>Yes (%)</th>
<th>No (%)</th>
<th>Equivocal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive</td>
<td>73.08 (19)</td>
<td>15.38 (4)</td>
<td>11.54 (3)</td>
</tr>
<tr>
<td>Food</td>
<td>70.73 (29)</td>
<td>9.76 (4)</td>
<td>19.51 (8)</td>
</tr>
<tr>
<td>Sensory</td>
<td>64.71 (33)</td>
<td>19.61 (10+)</td>
<td>15.69 (8)</td>
</tr>
<tr>
<td>Social</td>
<td>65.22 (30)</td>
<td>6.52 (3)</td>
<td>28.26 (13)</td>
</tr>
<tr>
<td>Structural</td>
<td>78.67 (118)</td>
<td>10.00 (15)</td>
<td>11.33 (17−)</td>
</tr>
<tr>
<td>Unknown</td>
<td>57.07 (210)</td>
<td>5.98 (22)</td>
<td>36.96 (136+)</td>
</tr>
<tr>
<td>Various</td>
<td>69.35 (43)</td>
<td>4.84 (3)</td>
<td>25.81 (16)</td>
</tr>
</tbody>
</table>

3.3.5 Influencing factors

TAROU and BASHAW (2007) explain in detail the factors that influence enrichment effectiveness:
- Intrinsic reinforcement
  - Exploration and novelty-seeking, hunting behavior, play, nest-building, performance of stereotypic behaviors;
  - Can be used by adding sensory stimuli to a familiar enclosure, rotating animals among exhibits.
- Extrinsic reinforcement
  - Has a longer lasting effect. The performance of behavior results in an external outcome that increases the likelihood the behavior will be performed again;
  - Can be used by providing hidden food or scattering food items throughout an enclosure.
- Habituation
  - Is defined as “response decrement as a result of repeated stimulation” (HARRIS, 1943);
  - Influenced by: frequency with which the stimulus is presented; intensity of the stimulus (the weaker the stimulus, the faster and more pronounced the habituation); characteristics of the stimulus.
- Extinction
  - When reinforcement is no longer provided for a behavior;
  - An animal may continue its search for food even after all of it has been obtained but will eventually stop if its efforts continue to go unreinforced.

3.3.6 Implications for Zoo Bucharest

There are only very few case reports in the literature that deal with the evolvement of a zoo in time, and which follow its progresses over the years. One of these papers focuses on Adelaide Zoo (ANDERSON, 1995). According to this monograph, the Adelaide Zoo underwent significant design
modification during the 1960s and 1970s under the influence of postwar, modernist, planning philosophies. Some years later, Adelaide’s menagerie-style cages were refurbished or replaced during the 1980s and early 1990s, consistent with the shift to a more ‘story-driven’ exhibition approach. Interestingly, this evolution very much coincides with what Bâneasa Zoological Garden has gone through. According to Dr. Micu, basic principles of environmental enrichment were first adopted between 1968 and 1976. A second wave of improvements took place some years later than in Adelaide, indisputably due to the particular historical frame of Bucharest zoo.

It is to be expected that yet a third wave of major changes to the Zoo’s enclosures will occur in the near future. Mostly due to pressure from the public, for economical and political reasons and also the hope that Zoo Bucharest will soon adhere to EAZA, the present zoo authorities will need to invest in new designs, new materials, and not least in research on enrichment and its effects. An extensive checklist for defining an animal’s captive environment is presented in MELLEN and MACPHEE (2001).
4. Medical Management

4.1 Generalities

The Zoological Garden of Bucharest has a total number of 32 large carnivores (jaguar, African lion, mountain lion, lynx, tiger, brown bear, Alaska tundra wolf), and 9 small carnivores (coati and raccoon). Keepers that are designated to the animals are generally grouped in pairs: 2 keepers for raccoons and lynxes, 2 for large cats (tigers, lions, pumas, and jaguars), 2 for bears and wolves and 2 for coatis (they have however other animals in care). They are responsible for feeding, cleaning the cages, reporting signs of illness to the veterinary department and helping with animal contention.

There is only one official veterinarian on staff; however a second, freshly graduated veterinarian was hired 2 years ago on a veterinary technician position. Also on staff, helping with treatments is a graduated vet technician, with more than 25 years experience, who will retire this year.

The veterinary department uses rooms and facilities in two of the Zoo’s buildings, and makes use of offices, kitchen / meeting room, locked pharmacy and supplement storage, necropsy room, operating room, treatment room and equipment depositing rooms.

4.2 Problem sources

The Zoo’s veterinary department was fully furnished during the past years with new tools, medical equipment and medical machinery, however, few of this equipment has actually been used. In the following summary some of the available equipment as well as associated probable causes of interference with the medical act are described:

- Operating room with isoflurane gas anesthesia
  - issues:
    - It was never used because the connection piece between the isoflurane bottle and the vaporizer was missing; as a result, the vaporizer could not be filled;
    - There is also no exhaust system / outlet for residual gas;
    - Oxygen supply is made through pressurized bottles; it is apparently a great deal of bureaucracy to legally fill the containers (it is an expensive, lengthy process);
    - Manometers / pressure valves are not functioning correctly;
- Surgery tables with variable height and inclination angles
  - issues:
    - Is not used at full capacity because the telescopic tilting mechanism is broken, and cannot be repaired;
- Portable blood gas analyzer (seldom used);
- Automated hematology analyzer
  - issues:
    - Needs reagents (expensive investment);
    - Machine used rarely, therefore it often malfunctions, the system’s pipelines being clogged;
- Oxygen chamber for small animals / birds;
- Dan Inject CO₂ darting rifle and associated equipment (darts, needles, filling accessories)
  - Issues:
    - Never used because of lack of training, high risk of injury;
- Some of the carnivore cages are outfitted with a squeeze cage, frequently used for treatments, immunizations, clinical examinations;
- X-Ray machine (rarely used)
- Missing items:
  - Anesthesia monitoring equipment (puls – oxymeter, capnograph, blood pressure measuring instruments, EKG);
  - Scaling / weighting devices (especially for large animals);
  - Designated separate stalls or cages for recovery and treatments;
  - Ultrasound machine.

4.3 Case load and medical procedures

Normally all the procedures are performed in the animal’s enclosure and only in few cases the animals are taken out and separated from its mates.

Most of the procedures performed at Zoo Bucharest are preventive and prophylactic in nature, with supplements being the most used drugs in the Zoo’s veterinary practice. The following paragraphs present an overview of most often encountered cases, diagnostics and treatments for carnivore species, since 2007 until present date (July 2010).

JAGUARS (PANTHERA ONCA):
- Arthritis / arthrosis (lameness): carprofen, vitamins, plant products;
- Nephritis / Urinary tract infections (painful urination): sulphonamides and trimetoprim, vitamin B, vitamin C, vitaminic complex;
- Traumatic wounds (bite wounds): amoxicillin and clavulanic acid, tetracycline, general wound care and management.
- Digestive tract disorders (enteritis): loperamide, metoclopramid, omeprazol, plant extracts;
- Supplements: reproduction stimulation, hepatoprotector, coat enhancing;
- Vaccines: viral rhinotracheitis, caliciivirosis, panleucopenia, rabies;
- Antiparasitics: fenbendazole.
**LIONS (**Panthera leo)**:
-Respiratory distress (diagnosed as viral): ampicilin, ibuprofen, amoxicillin and clavulanic acid;
-Dyspepsia: enzymatic products (amylase, lipase, tripsine);
-Renal and hepatic disorders: mainly vitaminic and plant supplements;
-Dental abscess: amoxicillin and clavulanic acid;
-Constipation: amoxicillin and clavulanic acid, laxatives, acidum asparticum, supplements.
-Supplements: vitamin combinations and plant products for coat enhancing, minimizing stress, bezoars elimination, protecting the liver, reducing obesity;
-Vaccines: viral rhinotracheitis, calicivirosis, panleucopenia, rabies;
-Antiparasitics: fenbendazole.

**WOLVES (**Canis lupus)**:
-Dermatitis: dexamethasone, supplements
-Bite wounds: general wound management, cefadroxil (second generation cephalosporin), piroxicam, dexamethasone, omeprazole;
-Lameness, rheumatic symptoms: dexamethasone, amoxicillin and clavulanic acid;
-Otitis externa: dexamethasone, enilconazole, trimetoprim sulphonamides;
-Gingivitis, pyorrhea: metronidazole.
-Supplements: for improving general body condition, stimulating hair growth, antistress, improving immunity;
-Antiparasitics: imidacloprid and permethrin (K9 Advantix®)

**MOUNTAIN LIONS (**Puma concolor)**:
-Dyspepsia: enzymatic products (amylase, lipase, tripsine);
-Arthritis: carprofen;
-Supplements: bezoars elimination, improving general condition, protecting the hepatic tissue, preventing urolithiasis;
-Antiparasitics: fenbendazole, praziquantel and pyrantel.

**LYNXES (**Lynx lynx)**:
-Stomatitis: metronidazole, spirulina extracts, vitamin E;
-Limb inflammation (unknown origin): trimethoprim and sulfadoxin, vitamins B and C, dexamethasone;
-Supplements: preventing coprostasis, stimulating reproduction, improving general condition, improving hepatic function, improving digestion;
-Vaccines: viral rhinotracheitis, calicivirosis, panleucopenia, rabies;
-Antiparasitics: fenbendazole.
Raccoons (*Procyon lotor*):
- Traumatic / bite wounds: the male had to be isolated; trimethoprim and sulfadoxin, lincomycin and spectinomycin, vitamin supplements, fluid therapy (glucose), oxytetracycline spray;
- Dermatitis: dexamethasone, acidum asparticum, amoxicillin and clavulanic acid, oxacillin, ampicillin, lincomycin and spectinomycin, vitaminic supplements;
- Traumatic conjunctivitis: enrofloxacin, locally injected lidocain, locally applied cyclosporine A;
- Supplements: coat improvement, bezoars elimination, general condition boosters;
- Vaccines: distemper, adenovirus 2, parainfluenza, parvovirus, leptospirosis, rabies (Lacrimed, Defensor, Vanguard, Nobivac RL si DHPPi);
- Antiparasitics: fenbendazole, ivermectine, enilconazole, praziquantel and pyrantel.

Bears (*Ursus arctos*):
- Joint pain (lameness): meloxicam;
- Recurrent respiratory symptoms (nasal discharge, coughing): ibuprofen, erythromycin, amoxicillin and clavulanic acid, bromhexine, omeprazole, cefuroxime, vitamin supplements;
- Digestive tract disorders (enteritis): loperaminde, oral spectinomycin, activated charcoal, ranitidine, oral enrofloxacin, oral fluid therapy;
- Periscapular abscess: enrofloxacin, piroxicam, Theranekron (Tarantula cubensis extract);
- Supplements: general condition boosters, metabolism stimulation, hepatic protection, coprostasis prevention, antistress (before and after moving to new enclosures);
- Vaccines: distemper, adenovirus 2, parainfluenza, parvovirosis, leptospirosis, rabies (Defensor, Vanguard plus);
- Antiparasitics: mebendazole, fenbendazole, levamisole;
- Surgical procedures: the male bear (Vasile) has undergone orchiectomy and a canine tooth extraction.

Tigers (*Panthera tigris*):
- Recurrent respiratory symptoms (present in almost all tigers: mucopurulent nasal discharge, dispnœa, coughing): erythromycin, amoxicillin and clavulanic acid, loratadine, doxycicline, enrofloxacin;
- Lameness: amoxicillin and clavulanic acid, piroxicam, meloxicam, ranitidine, supplements;
- Dyspepsia: enzymatic products (amylase, lipase, tripsine);
- Enteritis (vomitus, abdominal cramps): amoxicillin and clavulanic acid, ranitidine, metoclopramid, loperamide (Imodium), drotaveride (No Spa), vitamin supplements, activated charcoal;
- Artrosis: carprofen, Arthromed (chondroitin, glucosamine sulphate, methylsulfonylmethane, vitamins);
- Dermatitis: dexamethasone, loratadine, vitamins, local nistatine, neomocine, triamcinolon;
- Submandibular abscesses, skin necrosis: local wound care, systemic therapy: amoxicillin and clavulanic acid, diphenhydramine (antihistaminic), vitamin B and C, ranitidine, dexamethasone, metronidazole, trimethoprim and sulfadoxin, tetracycline;
- Supplements: prevention of urinary tract infections, urolythiasis, antistress, preventing constipation, hepatic protection, coat enhancing, obesity prevention and treatment, cardio-tonic, immunostimulant, general condition booster;
- Vaccinations against viral rhinotracheitis, calicivirus, panleucopenia, rabies (Nobivac rabies, Nobivac tricat);
- Antiparasitics: fenbendazole, praziquantel and pyrantel;
- Surgical procedures: one male tiger (Gorun) has undergone orchiectomy in 2007;
- Short lasting tranquilizing for moving to a new enclosure (two tigers: Luna, Otto): Acepromazine, Ketamine, Xylazine (dosages unknown).

4.3.1 Case study: successfully resolved dermatological problems in two tigers

“Pussy” developed an abscess of approximately 5 cm in diameter under the right arch of the mandible. Her treatment commenced on the 08.01.2010, and was performed daily in the contention squeeze cage. The abscess was opened, drained, and the wound was treated as an open, contaminated flesh wound, without sutures, and aiming for second intention healing. The following medication was used: dexametasone, metronidazole (Stomorgyl), trimethoprim and sulfadoxin (Borgal 24%), amoxicillin and clavulanic acid (Amoxiklav tb 625, Amoxikel), vitamin B complex (Multiject B), vitamin C. The wound was cleaned daily and protective antibiotic and Zinc Sprays were applied for about 40 days. (Fig. 10, Fig. 11, Fig. 12)
The second clinical case was observed in the male “Gorun”, who developed for the first time pruritic dermatitis. His treatment was initiated on 04.01.2010 and closed on 13.01.2007 and consisted of oral loratadine (Claritin®), oral dexamethasone (Eczekan) and topical ointment with nistatine, neomocine, triamcinolon (Nidoflor). Gorun’s skin lesions were presumed autoimmune in nature and never developed to abscess. The symptoms disappeared and did not relapse.

4.4 Anesthesia

4.4.1 Female *Panthera onca* – tranquilizing for capture

The female jaguar Betty (born in 2005) has escaped her enclosure on 27.11.2007, causing panic among the zoo visitors and the staff. It has been tried to physically immobilize the animal
using a net and a sling pole, but after the efforts have brought no result, a ketamine dart was used. Unfortunately the veterinary records do not mention the dosage or the volume of ketamine used.

The darting was fatal for the female jaguar. Necropsy revealed neurogenic shock, generalized hyperemia of brain, lung and liver tissues, settling the cause of death to shock, circulatory collapse and disseminated intravascular coagulation (DIC).

There have been cases mentioned in literature of using ketamine alone for immobilizing free ranging jaguars (see Table 8) in dosages varying from 7 to 40 mg/kg body weight. HOPE and DEEM (2004) have noted that anesthesia related mortality in jaguars is up to 3%, and death caused by immobilization or transport up to 2%. It might be the case that Betty’s death was produced by extreme anxiety, over dosage, drug intolerance, or a combination thereof.

Table 8. Literature review of anesthesia dosages reported for the chemical immobilization of free-ranging jaguars, Panthera onca (modified after DEEM, 2004):

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage (mg/kg)</th>
<th>Sample Size</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine</td>
<td>10 - 12</td>
<td>Not available</td>
<td>[1]</td>
</tr>
<tr>
<td>Ketamine</td>
<td>7 - 40</td>
<td>9</td>
<td>[3]</td>
</tr>
<tr>
<td>Ketamine</td>
<td>22</td>
<td>7</td>
<td>[2]</td>
</tr>
<tr>
<td>Ketamine + Diazepam</td>
<td>11.8 / 0.25</td>
<td>2</td>
<td>[1]</td>
</tr>
<tr>
<td>Ketamine + Xylazine</td>
<td>3 / 0.6</td>
<td>1</td>
<td>[1]</td>
</tr>
<tr>
<td>Ketamine + Atropine</td>
<td>0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketamine + Xylazine</td>
<td>7 / 0.5</td>
<td>1</td>
<td>[1]</td>
</tr>
<tr>
<td>Ketamine + Diazepam</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketamine + Xylazine</td>
<td>10.6 – 11.5</td>
<td>2</td>
<td>[4]</td>
</tr>
<tr>
<td>Ketamine + Xylazine</td>
<td>1.3 – 1.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketamine + Xylazine</td>
<td>11</td>
<td>8</td>
<td>[5]</td>
</tr>
<tr>
<td>Ketamine + Xylazine</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketamine + Xylazine</td>
<td>6.6 / 0.66</td>
<td>Not available</td>
<td>[6]</td>
</tr>
<tr>
<td>Ketamine + Medetomidine</td>
<td>1.46 – 3.48</td>
<td>2</td>
<td>[7]</td>
</tr>
<tr>
<td>Ketamine + Atipamezol</td>
<td>0.36 – 0.087</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telazol</td>
<td>6.6 – 16.4</td>
<td>11</td>
<td>[8]</td>
</tr>
<tr>
<td>Telazol</td>
<td>10</td>
<td>Not available</td>
<td>[9]</td>
</tr>
<tr>
<td>Telazol</td>
<td>3.9</td>
<td>11</td>
<td>[1]</td>
</tr>
<tr>
<td>Telazol</td>
<td>3.5 – 9.1</td>
<td>6</td>
<td>[3]</td>
</tr>
</tbody>
</table>

References as used in DEEM, 2004:

4.4.2 Female Panthera leo – anesthesia for ovariohysterectomy

On 18.10.2007, an 80 kg, 1.5 year old female lion, Laura, was brought to Bucharest Zoo for ovariohysterectomy from Braila Zoo. Her general body condition was suboptimal, the bodyweight being under the average of 126 kg (according to the Cat Specialist Group, 1996). During the transport Laura had vomited in her crate, although she has not been previously sedated. All the relevant data from the anesthesia protocol are presented below, in Table 9:

Table 9 Anesthesia and surgery protocol for lion "Laura”:

<table>
<thead>
<tr>
<th>Time</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:00</td>
<td>1 ml xylazine and 3 ml ketamine injected intramuscularly;</td>
</tr>
<tr>
<td>16:05</td>
<td>Light sedation (instable, but still awake);</td>
</tr>
<tr>
<td>16:15</td>
<td>Metoclopramid injected intramuscularly (dosage unknown);</td>
</tr>
<tr>
<td>16:25</td>
<td>A top up of 4 ml ketamine was given intramuscularly;</td>
</tr>
<tr>
<td>16:30</td>
<td>Moved to the surgery room;</td>
</tr>
<tr>
<td>16:40</td>
<td>Shaved, washed, disinfected; First incision on the linea alba; No intravenous access could be obtained;</td>
</tr>
<tr>
<td>16:50</td>
<td>Manipulation of the uterus horns was followed by vomiting, convulsions, partial evisceration;</td>
</tr>
<tr>
<td>17:10</td>
<td>Ovariohysterectomy started;</td>
</tr>
<tr>
<td>17:40</td>
<td>Peritoneal lavage with normal saline and penicillin; Suture of abdominal wall layers;</td>
</tr>
<tr>
<td>17:50</td>
<td>Skin closure;</td>
</tr>
<tr>
<td>18:00</td>
<td>Patient started reacting to stimuli, 2 more ml of ketamine are given;</td>
</tr>
<tr>
<td>18:05</td>
<td>Fluid therapy: glucose 5% subcutaneous;</td>
</tr>
<tr>
<td>18:10</td>
<td>Patient was placed in its transport crate, and immediately transported back to Braila Zoo.</td>
</tr>
</tbody>
</table>
There are several issues that need to be addressed in relation to the case. To begin with, the anesthetic drug combination could have been improved, considering the poor general condition of the animal. Either replacing xylazine with medetomidine (medetomidine: 47.6-58.4 micrograms/kg and ketamine: 1.9-5.7 mg/kg, according to TOMIZAWA et al., 1997), or adding another drug to the mixture (Diazepam 10 mg bolus, HERBST et al., 1985) could have prevented convulsions. Propofol (EPSTEIN et al., 2002) was also successfully used in African lions for induction, however in this case no venous access could be obtained.

Second, it can be deduced from the surgery records that a dosage of 1.25 mg/kg xylazine and 3.75 mg/kg ketamine was initially given. HERBST et al. (1985) report a successful use of 0.46 to 1.17 mg/kg xylazine and 3.8 to 16.7 mg/kg ketamine in free ranging African lions. Therefore, even if there was adequate alpha 2-agonist coverage, the ketamine volume was too small for Laura’s weight. Even if a top up of 5 mg/kg ketamine was given 25 minutes after the initial injection and considering the maximum 30 minutes therapeutic time window of ketamine, it can be inferred that the patient was under dosed for the remaining 1.5 hours of surgery (fact confirmed by the active reflexes and convulsions displayed on the operating table).

4.4.3 *Canis lupus*: immobilization for treatment of a male; sedation for transport of a pack

Generally all procedures (medical or for management reasons) on wolves have been done by physically immobilizing the individuals, and only on rare occasions by making use of chemical immobilization. To exemplify, the case of the pack’s omega male is presented. On 01.09.2008 this animal was attacked by its mates resulting in multiple lacerations and deep bite wounds with subsequent bleeding. The animal was separated from the pack by pushing it into a corner by 5-6 helpers. The large number of people around (at least 10: helpers, keepers, veterinarians, security guards) created panic among all the wolves, not only the wounded one. After separation, the wolf was caught with the use of a net, the wound was briefly examined and the treatment was administered, after which the animal was released back into the enclosure. (See Fig. 13, 14) Severe tachypnea and tachycardia could be observed. As follow up, the wolf’s wounds eventually healed, but he remained under constant stress from its cage mates, who continued to exhibit aggressive behavior.

Interestingly, the same individual was transferred to another Romanian zoo one year later on the 6. 04. 2009, where he became the pack’s alpha male. A combination of ketamine (Ketaminol 10%) and xylazine (Narcoxil) injected intramuscularly was used. Unfortunately there is no exact record of dosages or effect.

At the end of the year 2008, the zoo management planned a general renovation of the wolves’ enclosure. Therefore, the entire pack had to be moved to another zoo. The procedure was similar to catching of the wounded male in the first example. No anesthetics were used and the animals were exposed to a high stress load due to the large number of people present, noises, and the transport crates that were new to them. Usually such an action assumes previous
accommodation of the animals with their new cages, and sometimes a long acting neuroleptic is used during the transport (haloperidol, perphenazine).

Fig. 13
Catching of a grey wolf using nets.

Fig. 14
Treatment of a grey wolf using physical immobilization.
Table 10 Literature review of anesthesia dosages reported for the chemical immobilization of wolves (Canis lupus):

<table>
<thead>
<tr>
<th>Drugs</th>
<th>Dosages</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiletamine and zolazepam (Zoletil®)</td>
<td>2.0-7.1 mg/kg: unexcited wolves</td>
<td>VILA and CASTROvieJO, 1994</td>
</tr>
<tr>
<td></td>
<td>5.2-12.9 mg/kg excited wolves</td>
<td>CONSTABLE et. al., 1998</td>
</tr>
<tr>
<td>Medetomidine</td>
<td>55.3 ± 10.7 μg/kg</td>
<td>HOLZ et. al., 1994</td>
</tr>
<tr>
<td>Ketamine</td>
<td>2.76 ± 0.53 mg/kg</td>
<td>KREEGER et. al., 1996</td>
</tr>
<tr>
<td>Medetomidine</td>
<td>50 μg/kg</td>
<td>KREEGER et. al., 1996</td>
</tr>
<tr>
<td>Xylazine with either:</td>
<td>0.5 mg/kg</td>
<td>KREEGER and SEAL, 1990</td>
</tr>
<tr>
<td>Sufentanil</td>
<td>7.5 μg/kg</td>
<td>KREEGER and SEAL, 1990</td>
</tr>
<tr>
<td>Etorphine</td>
<td>7.5 μg/kg</td>
<td>KREEGER and SEAL, 1990</td>
</tr>
<tr>
<td>Carphentanil</td>
<td>7.5 μg/kg</td>
<td>KREEGER and SEAL, 1990</td>
</tr>
<tr>
<td>Medetomidine and</td>
<td>0.04 mg/kg IM</td>
<td>LARSEN et. al., 2002 (Canis lupus rufus)</td>
</tr>
<tr>
<td>Butorphanol</td>
<td>0.4 mg/kg IM</td>
<td></td>
</tr>
<tr>
<td>Medetomidine and</td>
<td>0.04 mg/kg IM</td>
<td></td>
</tr>
<tr>
<td>Butorphanol and</td>
<td>0.4 mg/kg IM</td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td>1 mg/kg IV</td>
<td></td>
</tr>
<tr>
<td>Medetomidine and</td>
<td>0.04 mg/kg IM</td>
<td></td>
</tr>
<tr>
<td>Butorphanol and</td>
<td>0.4 mg/kg IM</td>
<td></td>
</tr>
<tr>
<td>Diazepam</td>
<td>0.2 mg/kg IV</td>
<td></td>
</tr>
<tr>
<td>Acepromazine</td>
<td>20 μg/kg</td>
<td>VALERIO et. al., 2005</td>
</tr>
<tr>
<td>Butorphanol</td>
<td>0.2 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td>2 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Medetomidine</td>
<td>30 μg/kg</td>
<td></td>
</tr>
</tbody>
</table>

4.4.4 Male Ursus arctos — sedation for limb radiography

In January 2008 an adult, male Ursus arctos, “Stelica”, was brought from Braila zoo for radiographic investigations, having dislocated one of his limb joints. On the 5.01.2008 the vet team made the first attempt to sedate the animal. The anesthetic drugs chosen were 1ml xylazine and 2.5ml ketamine; however the application had no effect and after 15 minutes a second injection was given, identical in composition and volume, again to no avail.

It was decided to wait 3 days, to allow the bear to rest, and on the 08.01.2008 a second attempt was carried out. This time the veterinarians used 2 ml medetomidine (Domitor) and 2 ml ketamine (Vetased). After 10 minutes the same combination was given again. Only after another 25 minutes “Stelica” fell into a sedation deep enough to allow safe manipulation. For added safety, another bolus of 0.75ml medetomidine and 0.75 ml ketamine was administered. After 25 minutes the investigations were complete, and the patient was antagonized with 3 ml atipamezole (Antisedan). 10 minutes later he was fully awake.
Ketamine, xylazine, and to a lesser extent, medetomidine were until a few years ago the most frequently used anesthetics in the Romanian veterinary practice. Their value as every day, readily available drugs cannot be denied. However, in the case of brown bears, opinions are divided regarding using the classic protocol of ketamine – xylazine or ketamine – medetomidine. Even if it was and is still used widely on free ranging bears with reported success (BERECZCKY, personal communication, 2010), some authors consider it obsolete and do not recommend it (Table 11, WEST et. al., 2007). Instead, other combinations are proposed.

Table 11. Mean recommended dosages of immobilizing agents used to facilitate capture of bears (WEST et. al., 2007).

<table>
<thead>
<tr>
<th>Drug Combinations (Mean Dosage in mg/kg)</th>
<th>Black Bear</th>
<th>Brown Bear</th>
<th>Polar Bear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xylazine/ketamine</td>
<td>2/4</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Medetomidine/ketamine</td>
<td>0.04/1.5</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Medetomidine/tiletamine-zolazepam</td>
<td>0.05/2</td>
<td>0.025/4.5</td>
<td>0.06/2.2</td>
</tr>
<tr>
<td>Xylazine/tiletamine-zolazepam</td>
<td>2/3</td>
<td>2.5/3.8</td>
<td>2/3</td>
</tr>
<tr>
<td>Tiletamine-zolazepam</td>
<td>7</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

NR, not recommended in this species.

There are also reports of using oral carfentanil in doses of 6.0 to 15.2 μg/kg in captive brown bears. This dose induced deep sedation sufficient for intubation (MORTENSON et. al., 2001). Normally, administration of 3.0 ml of "Hellabrunner mixture" (125 mg xylazine and 100 mg Ketamine in one ml) to adult Ursus arctos individuals should suffice (WIESNER, 1998). However, it is known that the combination has no reliable effect on bears.

4.5 Issues concerning sample collection

4.5.1 Blood

The zoo's veterinary department has no established protocol for routine blood sampling of its carnivores. The animals are sampled only when medical treatments have to be performed under sedation and these cases occur very rarely. For example, hematology and blood chemistry data are available for two brown bears: "Vasile" was sampled after his orchiectomy and tooth extraction, and "Stelica" during his x-ray examination. Similarly, the tiger "Gorun" was sampled while being sedated for orchiectomy. Consequently, there is no database for blood results for carnivores and no reference datasets.

Most of the carnivores in Zoo Bucharest could be trained to offer their paws for getting access to the cephalic vein. However, this requires time, trained staff, and compliance from the keepers. A routine, yearly check up could also be established, this procedure offering numerous advantages for the animal's health, ease of disease surveillance and reproduction management.
4.5.2 Urine

A different procedure is used for urine sampling. Occasionally, the veterinary technician collects urine samples from random animals, during cage cleaning or from easily accessible areas of the enclosures. The samples are then analyzed on spot using urine test strips or the automatic urine analyzer. Even if the number of samples would be high enough to follow the trend in the animal’s health status (2 to 3 collected samples each year per individual), the obtained values should be viewed with caution. Below are two examples, where urine samples were collected and analyzed twice for the same individual on the same day (Table 12). In each case, the values obtained differ significantly. The main reason is the sampling technique itself: the technician uses urine spots on the ground that can be hours old and contaminated from the environment. While this method can be used with questionable results, uncontaminated, fresh urine should be obtained using a sterile recipient during urination.

Table 12. Examples of urine sample analysis:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLU</td>
<td>+ - 50</td>
<td>+ - 50</td>
<td>mg/dl</td>
</tr>
<tr>
<td>PRO</td>
<td>++++ 1000</td>
<td>++++ 1000</td>
<td>mg/dl</td>
</tr>
<tr>
<td>BIL</td>
<td>+ 0.5</td>
<td>NEG</td>
<td>mg/dl</td>
</tr>
<tr>
<td>URO</td>
<td>++ 4</td>
<td>NORM</td>
<td>mg/dl</td>
</tr>
<tr>
<td>PH</td>
<td>7</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>SG</td>
<td>&gt;1.030</td>
<td>&gt;1.030</td>
<td></td>
</tr>
<tr>
<td>BLD</td>
<td>NEG</td>
<td>++ 0.2</td>
<td>mg/dl</td>
</tr>
<tr>
<td>KET</td>
<td>NEG</td>
<td>NEG</td>
<td>mg/dl</td>
</tr>
<tr>
<td>NIT</td>
<td>NEG</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>LEU</td>
<td>75</td>
<td>75</td>
<td>leu/μl</td>
</tr>
</tbody>
</table>

“Florentina” – Brown bear, 25.09.2007

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLU</td>
<td>+100</td>
<td>+200</td>
<td>mg/dl</td>
</tr>
<tr>
<td>PRO</td>
<td>NEG</td>
<td>NEG</td>
<td>mg/dl</td>
</tr>
<tr>
<td>BIL</td>
<td>NEG</td>
<td>NEG</td>
<td>mg/dl</td>
</tr>
<tr>
<td>URO</td>
<td>+2</td>
<td>NORM</td>
<td>mg/dl</td>
</tr>
<tr>
<td>PH</td>
<td>6.0</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>SG</td>
<td>1020</td>
<td>&gt;1.030</td>
<td></td>
</tr>
<tr>
<td>BLD</td>
<td>NEG</td>
<td>+0.06</td>
<td>mg/dl</td>
</tr>
<tr>
<td>KET</td>
<td>NEG</td>
<td>NEG</td>
<td>mg/dl</td>
</tr>
<tr>
<td>NIT</td>
<td>++</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>LEU</td>
<td>NEG</td>
<td>NEG</td>
<td>leu/μl</td>
</tr>
</tbody>
</table>

4.5.3 Feces

The parasitological surveillance of the Zoo’s carnivores is performed by collecting fecal samples, generally once a month from each enclosure, and analyzing them using both flotation and sedimentation methods for each sample. Usually there is no individual helminthological examination performed, and it is assumed that all inhabitants of one enclosure are equally free of, or bare the same parasitic loads. Some typical parasites encountered in Băneasa Zoological Garden are shown in Figs. 15, 16 and 17.
Fig. 15 *Baylisascaris transfuga* in brown bear feces

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Fig. 16 *Toxocara canis* in wolf feces

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Fig. 17 *Toxascaris leonina* in mountain lion feces

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Table 13 summarizes the findings of the fecal examinations since 2007, and the antiparasitic agents used in each species. After analyzing the medical records it has been observed that the antihelminthic drugs have rarely been alternated along the years. For example, in some species, only Fenbendazole (Panacur) has been used, and other species have been switched from fenbendazole to a treatment with praziquantel and pyrantel (Cesta®). While both products are theoretically effective against the observed pathogens, in some animals, even after administration of the treatment, the ova count remains high. Possible causes are that the animals have not ingested the full doses, the bolus was under dosed, or that the parasites developed resistance to the drug.

Table 13 Parasitological findings in carnivores of Zoo Bucharest, between 2007 and 2010.

<table>
<thead>
<tr>
<th>Species</th>
<th>Degree of infestation</th>
<th>Parasites detected</th>
<th>Antiparasitic treatment used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaguars</td>
<td>+</td>
<td>Toxascaris leonina, Strongyloides spp, Uncinaria spp.</td>
<td>Fenbendazole</td>
</tr>
<tr>
<td>Lions</td>
<td>+ → +++</td>
<td>Toxascaris leonine, Toxocara spp.</td>
<td>Fenbendazole, Praziquantel and pyrantel</td>
</tr>
<tr>
<td>Wolves</td>
<td>- → +</td>
<td>Toxocara canis</td>
<td>Selamectin</td>
</tr>
<tr>
<td>Mountain lions</td>
<td>+ → +++</td>
<td>Toxascaris leonina, Toxocara spp</td>
<td>Fenbendazole, Praziquantel and pyrantel</td>
</tr>
<tr>
<td>Lynxes</td>
<td>++ → +++</td>
<td>Toxocara spp, Toxascaris spp, Strongyloides spp, Ancylostoma tubaeforme, Taenia eggs</td>
<td>Fenbendazole, Praziquantel and pyrantel</td>
</tr>
<tr>
<td>Bears</td>
<td>++ → +++</td>
<td>Toxocara canis Baylisascaris transfuga</td>
<td>Fenbendazole</td>
</tr>
<tr>
<td>Coati</td>
<td>- (+)</td>
<td>One case of Enterobius (Oxyuris) spp.</td>
<td></td>
</tr>
<tr>
<td>Raccoons</td>
<td>+→++→+++</td>
<td>Toxocara spp, Baylisascaris procyonis</td>
<td>Fenbendazole, Ivermectin, Praziquantel and pyrantel</td>
</tr>
</tbody>
</table>

| +     | mild parasitic infestation |
| ++    | moderate parasitic infestation |
| +++   | severe parasitic infestation |

4.6 Reproduction and Contraception

4.6.1 Lioness “Ella”

The Bucharest Zoo houses at the moment two lions: one female, “Ella” and one male, “Marc”, both reproductively active. For several years they were separated, and had access to the outer enclosure on alternating days. On 29th of May 2009, however, following a sponsorship, Ella was implanted in the shoulder area with 3 deslorelin implant capsules (Suprelorin, 4.7mg per capsule, so a total of 14.1mg deslorelin). Since the implantation, both lions were allowed to share the outdoor enclosure at the same time. No mating and no offspring occurred to the present day. Dosages of 12 to 15 mg deslorelin have been used in female lions, successfully suppressing their
fertility for 12 to 18 months (BERTSCHINGER et. al., 2001). The zoo’s veterinarians are now planning to apply a new implant, hoping to be able to keep the two animals together on display.

4.6.2 Reproductive success – Jaguar “Pamela”

Some of the zoo’s species are nevertheless encouraged to reproduce. The two jaguars, Pamela and Amedeo, are kept in the same pen, and they receive special supplements meant to promote reproductive success. The pair reproduced twice: in 2004, Pamela gave birth to two male cubs, and in 2005 to two females, with both black and spotted coats. After weaning, they were transferred to other zoos, except one female, Betty, who was housed separately. It is presumed that the pair stopped reproducing due to Amedeo’s senescence (he was born in 1988), but no actual investigations have been performed.
5. Conclusions and implications

5.1 Generalities

- The historical context in which the Zoological Garden of Bucharest developed is essential to understand its present needs.
- There is little Romanian scientific contribution in the area of zoo, wild and exotic animals.
- The Zoological Garden of Bucharest possesses a good potential for Dalmatian pelican (*Pelecanus crispus*) reproduction. It gives a possibility for the zoo to improve its image, to bring scientific contributions and to aid existent conservation programmes.

5.2 Capacity Building

- The need for capacity building in zoos in general and in the Zoological Garden of Bucharest is severely underestimated. To the authors' knowledge, there is no literature available on capacity building in zoos.
- To study the case of the Zoological Garden of Bucharest, the model of capacity building projects in conservation was used.
- The substrate of the problems in Bucharest Zoo lay in its political status, geographical location, and public attitude.
- Main problems which the Zoo’s vet department confronts: lack of funding, vets’ lack of hands on training, lack of trained keepers, restricted access to information, limited connections with zoo vets from other countries and academia.
- Major improvement in the vet department has been noticed after the organization of the first international Symposium on Wildlife and Exotics Medicine in Bucharest, March 2010: it created contacts with peers, skill training, opened information channels between professionals, brought academia and zoo vets on common ground.

5.3 Behavioral Issues and Environmental Enrichment

- Sources of stress for the carnivores in the Zoological Garden of Bucharest:
  - Sound: the two airports in the vicinity; the construction sites outside and inside of the zoo.
  - Space: some tigers are kept in pairs that daily alternate access to the outside enclosure: this affects light exposure, contact with visitors, exposure to smell cues from the partner; improvement: the bear enclosure is now 3 times bigger and houses two instead of three bears.
  - Temperature: some of the exotic animals might have difficulties in adapting to the extreme continental climate of Bucharest.
  - Cage substrate: many of the cages used to have concrete floors; most have been drastically improved: they have been changed to earth bedding, rocks, grass with hills, viewpoints, water pools.
Every carnivore in the Zoological Garden of Bucharest displays some degree of stereotypical behavior.

Possible actions against stereotypies:
- Pharmacological treatment (serotonin-reuptake inhibitors, long acting neuroleptics): they have unpredictable effect and are difficult to dosage;
- Target, medical training: it requires keeper experience and compliance;
- Environmental enrichment: most feasible in the present case. It implies changes in the food routine (E.g. whole carcass feeding); enclosure design & furniture (most of the carnivore enclosure provide sufficient retreat space, sufficient furniture)

Major improvements in cage design and enrichment have been implemented over the past few years.

5.4 Medical Management
- Two veterinarians that have in care approximately 40 carnivores.
- The Zoo clinic is fully equipped; however most of the equipment has never been use due to insufficient training (E.g. anesthesia machine, darting gun).
- Missing items in the clinic: anesthesia monitoring equipment, weighing devices, hospital and quarantine pens/cages.
- The most often performed medical procedures are prophylactic treatments: immunizations, antihelmintics and supplements.
- In case of disease occurrence: treatments are merely symptomatic (seldom is evidence based medicine used).
- There are many problems and issues related to anesthesia and immobilization.
- There is no regular blood sampling and no blood bank.
- Urine samples are frequently collected only from the ground; this likely provides the vets with false results that lack uniformity.
- Flotation and sedimentation methods are used once a month to test the parasitic load of the carnivores in the Zoological Garden of Bucharest. *Toxascaris leonina* and *Toxocara spp.* are among the most often encountered parasites. The intensity of infection varies among species and season.
- Successful contraception was achieved in a lioness using deslorelin implant.
- Successful reproduction in a pair of jaguars was reached twice in 2004 and 2005. In total 2.2 cubs were born. However, ever since, no subsequent reproduction has been reported.
6. Summary

The aim of this diploma thesis was to develop a constructive critique of the management of the Zoological Garden of Bucharest (Băneasa Zoo) with emphasis on veterinary staff, animal behavior and animal health. To have a better understanding of the data gathered for the present study it is important to take note of the historical, social and economical backgrounds. Therefore the Zoo’s history, geographical location and structure are discussed in detail. Being an old institution founded in 1957, over the past years Băneasa Zoo had to improve the conditions in which its animals are housed.

The process used to gather data during more than 2 years (2008 – 2010) consisted of:
- Identifying points where there is room for progress;
- Studying relevant literature concerning similar cases and situations;
- Developing an improvement strategy formulated as a suggestion to the Zoo staff;
- Observing the possible effects, if the particular suggestions were, or will be implemented in the future.

Three main aspects were developed in this study; special focus was put on carnivores:

1. The need for capacity building in the veterinary department: it has been observed that the veterinarians have too many administrative duties, insufficient funding, limited international connections with zoo vets from other countries and academia and that the animal keepers lack proper training. However, outreaching events such as the first international Symposium on Wildlife and Exotics Medicine in Bucharest, March 2010 fundamentally contributed to capacity building within the staff.

2. Environmental enrichment and sources of stress were evaluated. Every carnivore in the Zoological Garden of Bucharest displays some degree of stereotypical behavior. However, major improvements in cage design and enrichment have been implemented over the past few years.

3. Medical procedures and medical management in Bucharest Zoo are influenced by all the factors discussed. Case studies were analyzed together with appropriate literature research to give a relevant image of the work in the vet department. More specifically examples on anesthesia cases, the use of contraceptives, as well as routine medical sampling of urine, blood and feces were presented.
7. Acknowledgements

Special appreciation needs to be addressed to the entire staff of the Zoological Garden Bucharest, coordinated by Dr. Anca Oprea, and to the veterinary staff in particular: Dr. Codrut Visoiu and Dr. Ciprian Petrescu. Without their kind help and allowing access to the zoo's files and records, as well as to the animals themselves, this extended case study could not have been possible. They showed tremendous support for this project, they proved dedication and love for their work and the Zoo's animals and a fantastic aspiration to improvement.

Organizers and participants to the First International Symposium on Wildlife and Exotics Medicine 2010 at the Zoological Garden of Bucharest.

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