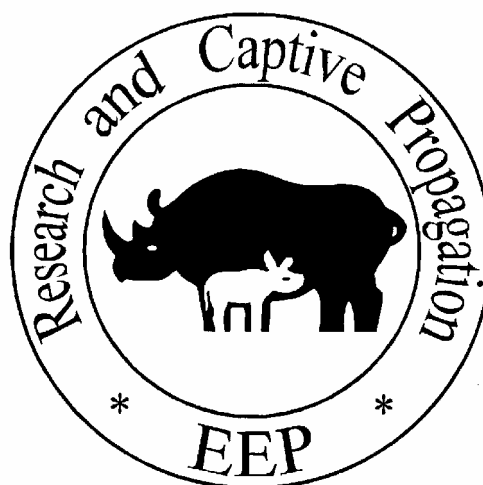


# Research Committee Newsletter

## 9<sup>th</sup> Issue, September 2004

edited by Udo Gansloßer\*



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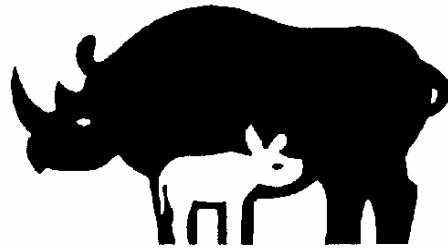
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## 2 Foreword



Dear Subscribers,

Finally! This is the long-overdue next issue of the EAZA Research Committee Newsletter. My apologies for not being able to produce one last year, so this is a double issue.

The next one, however, will be again in a yearly rhythm. We would even be prepared to switch to a 6 months' schedule, but for this to happen I would need more input, more contributions submitted! So it's up to you!

All of you certainly have some project reports sitting on their shelves! So dust them off, send the summary, and we are going to publish it!

All the best,

Udo Gansloßer

[udo@ganslosser.de](mailto:udo@ganslosser.de)

### 3 Introduction - News from the EAZA Research Committee



The EAZA Research Committee met on Saturday 28<sup>th</sup> February 2004 at Chester, UK. The meeting was hosted by the North of England Zoological Society. It was attended by eight people from three countries (Germany, Netherlands, UK). Bengt Holst and Angela Glaston have, from other work pressures, reluctantly withdrawn from the Committee and both were thanked for their most valuable input over many years. Nonetheless, the Committee remains dynamic and had a full agenda such that the business lasted all day!

The Committee reviewed its membership and structure. It is keen to increase representation, especially from eastern European countries and to forge links with other committees. To this end the Committee will be actively seeking representatives from this region and from conservation, education and veterinary specialists across Europe. Certainly, we will be pleased to have expressions of interest regarding committee membership.

The Committee discussed the research input to the World Zoo and Aquarium Conservation Strategy (WZACS) document currently being prepared by WAZA. The EAZA Research Committee felt that a European-focused research strategy would be extremely useful in providing a regional framework for all EAZA zoos. Such a strategy would be consistent with and support and reinforce the WZACS strategic section on research being prepared by Dr John Bonner of St Louis Zoo, USA. We have been in dialogue with John on this topic and sent him the results of an EAZA 'brainstorm workshop' on research in zoos. This received very positive feedback and many of our ideas will be incorporated in the new WZCAS (due for publication in 2005).

We intend during the rest of 2004 to develop a formal Research Strategy for Europe and Dr Anna Feistner has kindly agreed to draw together the material that the Committee has worked up so far. Once complete, this strategy will be very beneficial given that:

- European countries have many different languages and cultures and so it is vital that they all work in harmony on zoo related issues, including research;
- There are currently 15 different nationalities in EU, each interpreting the EU Zoo Directive nationally (including the statutory research 'requirement');
- There are now an additional 10 new countries joining the EU, mostly from the eastern part, and these countries contain many zoos. Some of these zoos have few resources, but many have strong research histories and partnerships with academic institutions. We definitely need to capitalise on this 'eastern expertise';
- EAZA already works with zoos in 31 countries and so it is well placed to help interpret the requirements of the new Directive, including from a research perspective.

Anna has already laid out a framework for the Research Strategy, referring to the Committee's discussions on 'target audiences', remit, format, content, monitoring of impact, etc. The plan is to deliver a near-final draft EAZA Research Strategy document for the 2004 EAZA Annual Conference at Kolmarden, with full production and distribution planned for 2005.

The Research Committee discussed its growing need for an operating budget (especially as there are pilot schemes to support and new members with limited finances will need to attend meetings). An initial sum of about €2, 000 will be requested from EAZA at the Kolmarden meeting.

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The Committee are also promoting the 5th International Symposium on Physiology, Behaviour and Conservation of Wildlife. The EAZA plenary lecture is entitled “Hormone-mediated maternal effects in development of brain and behaviour” and will be given by Ton Groothuis (University of Groningen, The Netherlands). There is a need for more direct input from zoos to this conference.

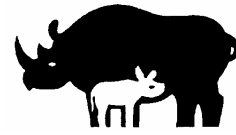
Other meetings being promoted by the Research Committee are the 4th European Zoo Nutrition Conference (January 2005, Leipzig Zoo, Germany).

The Committee will be meeting next informally at the 21st EAZA Annual Conference and then formally in February 2005. Much work will be done by e-mail during the interim!

Gordon McGregor Reid

Alastair MacDonald

Co-Chairs, EAZA Research Committee



## 4 Research Project Outlines

### 4.1 AZA's Biomaterials Banking Advisory Group

Approved in 2002, the Biomaterials Banking Advisory Group (BBAG) is one of the American Zoo and Aquarium Association's newest Scientific Advisory Groups.

The aim of this Group is to assist and advise TAGs, SSPs and AZA institutions in the development of protocols and policies as they relate to the collection, storage and distribution of biomaterials at AZA zoos and aquariums.

Biomaterials may be defined as any organic piece or derivative of an animal, including tissue, urine, feces, gametes, skeletal material, hair and feathers. Biomaterials from animals housed in zoos and aquaria provide an invaluable resource to the conservation research and education communities. These materials are used in many research disciplines, including taxonomy and systematics, population genetics, reproduction, nutrition, pathology, toxicology and veterinary medicine. As it becomes increasingly difficult to obtain samples from animals in the wild, the animals held in AZA collections may provide the scientific and conservation community with resources which otherwise might be unobtainable.

The collection of biomaterials for distribution is a responsibility that should be considered very thoughtfully by AZA institutions. The issues to be addressed by the BBAG are not new and have been discussed within the AZA community and internationally for many years, even decades. It is the goal of this Group to compile and disseminate this information and relate it to current technologies, current policy, current conservation goals and to the current conservation crisis.

Current activities of the Group include the review of selected protocols, the improvement of lines of communication with the Veterinary Advisory Group and other Scientific Advisory Groups, and a review of current institutional policies, including the breeding loan agreement.

This year the BBAG working meeting will be an eMeeting, held exclusively on the BBAG listserv. The agenda of the 2004 eMeeting focuses on the topics of <sup>3</sup>Ownership and Partnerships<sup>2</sup>. In addition to members already subscribed to the BBAG listserv, outside experts have been invited to participate and

discuss selected topics.

The success of this Group depends on the expertise of several different disciplines from within our institutions as well as from outside experts, e.g. veterinarians, registrars, curators, keepers, educators, lawyers, research coordinators and researchers. In order to facilitate communication, the BBAG listserv has been formed and welcomes anyone interested in becoming a member. If interested, please contact:

Cathi Lehn, Ph.D.

Chair, AZA Biomaterials Banking Advisory Group

American Museum of Natural History

## 4.2 Research Reports from Moscow Zoo Research Department

### Estrus cycles in gerbils: method of vaginal smears (Estrus cycles and changes in vaginal cytology in gerbils)

*G.V.Vakhrusheva, O.G.Ilchenko; Moscow zoo*

It is very important to know peculiarities of females' sexual cycles for captive breeding of animals. Methods to determine stages of cycle differ in precision, speed and complication.

#### Sexual cycles in mammals

The sexual cycle is the whole complex of changes which take place in the female reproductive system and form one complete period. This definition was made by Heap in 1894 and it is still acceptable nowadays.

Sexual cycles are to be observed in female gonads (in ovaries) and at the same time in the vagina. Ovarian cycles are determined by development of ovarian follicles. Parallel vaginal cycles are restricted to vaginal epithelium.

Classification of cycles' stages is based on such phenomenon as estrus. Estrus signifies particular physiological, sexual and psychical state of a female, it is the most striking external manifestation of a cycle; usually it could be easily registered. Cycles are traditionally divided into 4 stages: estrus, metaestrus, diestrus and proestrus.

#### Method of vaginal smears

The method of vaginal smears is based on distinct changes in vaginal epithelium and vaginal cytology from one stage to another. Different cell pictures characterize different stages of the reproductive cycle. This method is successfully used to study sexual cycles in different mammals, and traditionally in rodents.

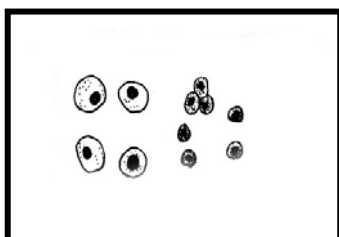
Vaginal smears from small rodents can be prepared from material obtained by a common medical pipette with 2-3 drops of distilled water inserted about 1-2 mm into the vagina. The samples are smeared onto a glass slide, allowed to dry, fixed and stained. We used absolute alcohol for fixation and stained smears with haematoxylin for 10 min. and with eosin for 1 min. Such smears can be kept for a long time. Native smears have to be analyzed immediately. We examine smears under a light microscope with a 8x objective and 7x eyepieces.

#### Cell types in vaginal smears

The stratified vaginal epithelium in rodents demonstrates the process of cornification. As a result surface epithelial cells transformate into cornified cells. So, vaginal smears of rodents exhibit three types of cells; they are epithelial cells, cornified cells and leucocytes (Fig. 1).

Fig 1: Different cell types in vaginal smears of gerbils

**Epithelia cells**



**Leucocytes**



**Cornified cells**



1. Epithelial cells are nucleated and usually oval-shaped. Their size may change distinctly during the reproductive cycle. In our opinion this difference in cells' size is important, but we never met descriptions of different forms of rodents' vaginal epithelial cell in literature (Fig1a).
2. Cornified surface epithelial cells are nonnucleated. These dead cells are relatively large, flat and polygonal-shaped.
3. Leucocytes – white blood corpuscles, they are small and oval.

### **Cytological characteristic of vaginal smears of rodents: *Meriones unguiculatus***

In literature you can usually find descriptions of smears of the four main cycle stages of rodents. The development of all the cycle continues several (usually 4-5) days and every stage changes into the next one very quickly. So, in practice transitional situations are found more frequently and such transitional stages are much more complicated for interpretation.

That's why we have carried out special research of gerbils' cycles. We used mongolian gerbil (*Meriones unguiculatus*) as a model species. Vaginal smears were taken from 2 females every 3 hours during one whole cycle. All smears were fixed and stained. Then we took photos of 19 successive smears (80x) to illustrate in detail the cycle of this species (Fig.2).

Vaginal smears during diestrus are characterised by presence of leucocytes (Fig2.1).

Transformation from diestrus to proestrus is characterised by presence of leucocytes and large oval-shaped epithelial cells in smears (Fig.2.2-2.4).

Proestrus vaginal smears show epithelial cells, occasional cornified cells and leucocytes; now epithelial cells are smaller than previous ones (Fig.2.5).

During proestrus-estrus leucocytes disappear, oval epithelial cells are gradually replaced firstly by multiform polygonal cells with pycnotic nuclei (early proestrus-estrus, Fig.2.6-2.9) and later by cornified cells (late proestrus-estrus, Fig.2.10-2.12).

Estrus is characterised by a clear predominance of cornified cells in vaginal smears (Fig.2.13).

During estrus-metaestrus leucocytes could be seen among cornified cells (Fig.2.14).

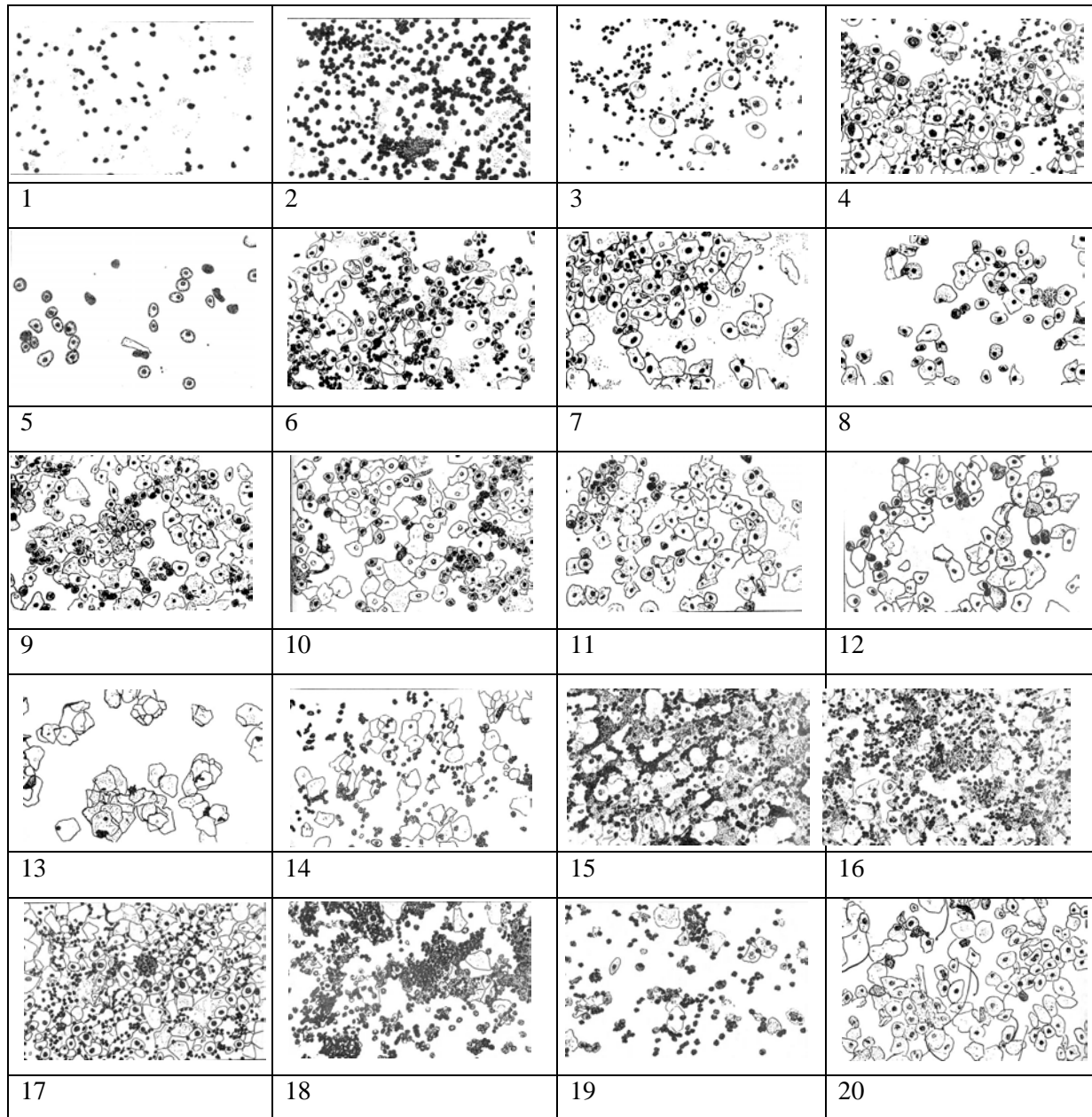
The vaginal picture of metaestrus shows leucocytes, cornified cells and a massive accumulation of cellular debris; epithelial cells appear (Fig.2.15-2.2.16). Typical metaestrus is characterised by approximately equal abundance of all cell types in smears (Fig.2.17).

During metaestrus-diestrus a lot of leucocytes, fragments of cornified cells and single epithelial cells could be seen in vaginal smears. The vaginal picture gradually approximates to diestrus (Fig.2.18-2.19).

Gerbil females are sexually receptive during late proestrus-estrus. In smears of *M. unguiculatus* at this moment epithelial nucleated cells are predominant but surface cells at different stages of cornification could be also seen (Fig.2.20).



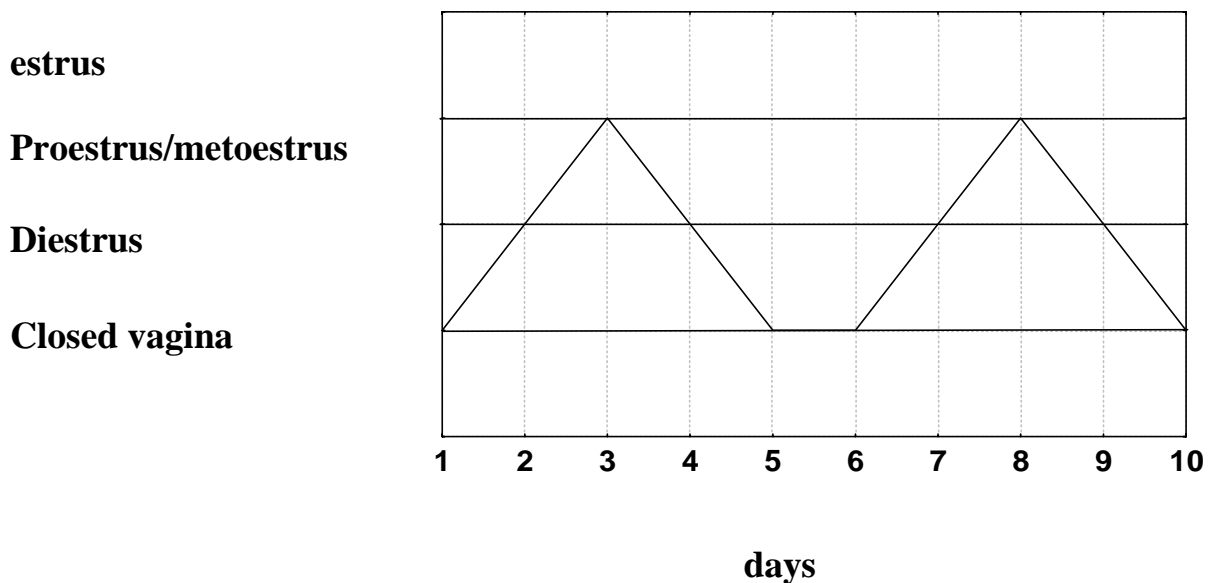
Fig.2. Vaginal smears characterising estrous cycle of *Meriones unguiculatus*. (description of smears is given in the text)



### Practical recommendations

1. In this report we described stained smears but in everyday work we analyse native preparations. It is impossible to see nuclei of cells and we identify cells according to their size and outline.
2. Appraisal of smears is based on the general picture. We don't pay attention on single and occasional cells as they are not typical.
3. The general picture becomes apparent if magnification is low.
4. Inflammatory processes may distort the picture as the vaginal picture shows a massive accumulation of leucocytes in all slides within the whole cycle. In such situation medical treatment of a female is necessary.
5. Length of cycles may differ in different females of the same species. Departure from the typical four-day cycle may be caused by prolongation or shortening of certain stages. Regular taking of smears may lead to two- or three-day cycles.
6. If the slide is questionable we try to describe it in detail and determine the stage of the female's cycle the next day.
7. Results of our work we represent in daily records and in graphs (Fig.3).

Fig.3. A variant of graphic illustration of cyclicity of *Meriones unguiculatus*.



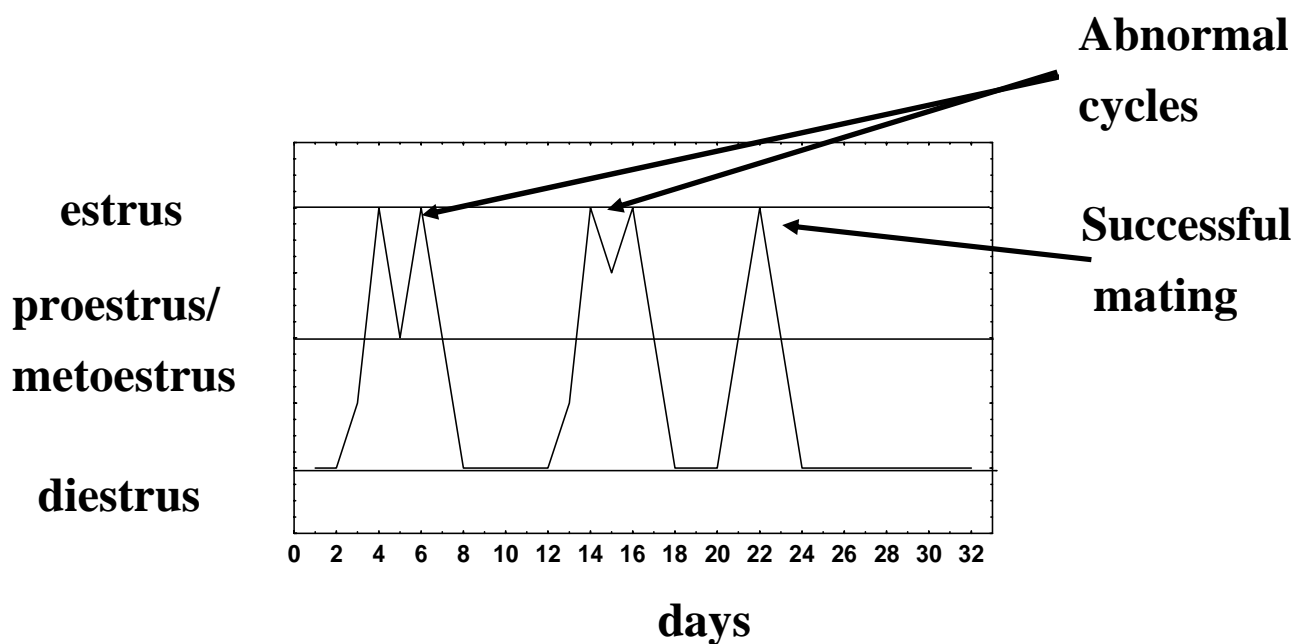
### Work with new species

Starting work with new species we examine daily smears of several females during several cycles. We describe and sketch the smears and represent the results graphically. It is useful to trace 3 or 4 cycles. Testing pairing with a male (introducing of a female and a male) will help to determine the moment of mating (when the female is sexually receptive). Successful mating leading to breeding of animals may be an evidence of normal cycles in the female.

### Application of method

1. The method of vaginal smears is widely adopted to our practice of captive breeding of gerbils and some other rodents.
1. We use it to predict the most reliable time of mating to form breeding pairs of tamarisk gerbils (*Meriones tamariscinus*), persian jirds (*M. persicus*) and short-eared gerbils (*Desmodillus auricularis*).
2. A pair of *Stylodipus telum* was successfully joined after the hibernation period; the moment of introduction was determined according to data on the female's cycle.
3. We used vaginal-smears data to determine the time of hormonal injections during hormonal stimulation of gerbils' breeding. This work was made on Vinogradov's gerbils (*M. vinogradovi*) and midday gerbils (*M. meridianus urianchaicus*).
4. Taking of smears is accompanied by tactile stimulation of the gerbil's vagina. In females with irregular cycles this procedure may lead to normalisation of cycles and to following breeding. Thus we received the first litter from wild-born *M. vinogradovi* (Fig.4).

Fig.4. Normalisation of female's cycles resulting from regular taking of vaginal smears (*Meriones vinogradovi*)



## Breeding of short-eared elephant shrews *Macroscelides proboscideus* in the Moscow zoo

*Ilchenko O.G., Vakhrusheva G.V., Sapozhnikova S.R.; Moscow Zoo*

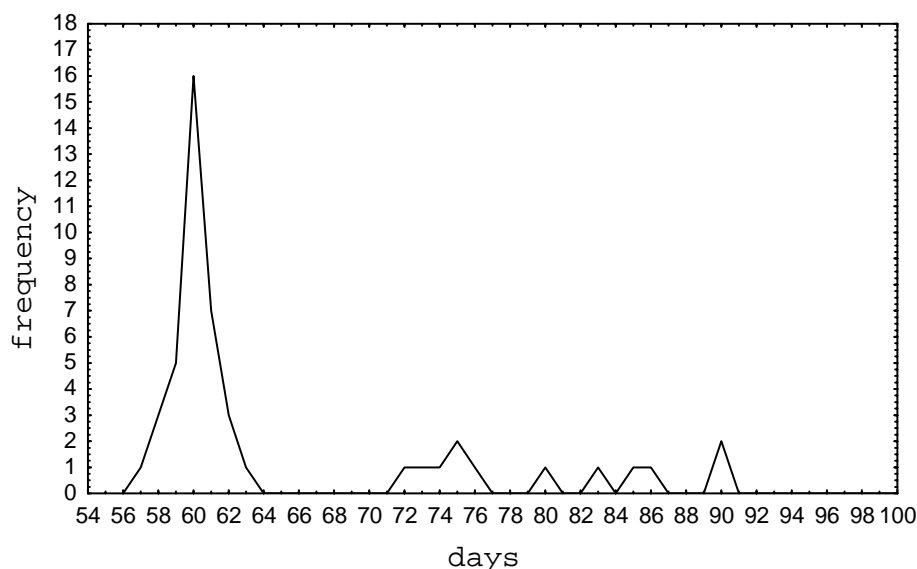
This paper reports some results of breeding of the laboratory colony of short-eared elephant shrews *Macroscelides proboscideus* in the Moscow zoo. The period of analysis covers 10 years and data obtained allow to discuss some aspects of captive breeding of this species.

All the information was collected from 1991 to 2001 when 20 females of *Macroscelides proboscideus* (seven of them were hand-reared) produced 98 litters, 153 young in total. Births, introductions, deaths, etc. were recorded as they occurred. Keeping conditions were described before (Popov et al., 1995).

Forming of reproductive pairs was the first stage of breeding. Young were separated from their mothers between 25 and 30 days of age. Only four of 13 attempts to pair both sexes at this moment were successful. Other pairs were separated later because of sudden and strong aggressive interactions between animals. Pairing of shrews after their maturation when they aged 7-8 months was always successful: all formed pairs were stable and started to breed (Sapozhnikova et al., 1998). The youngest female recorded as mating was aged 4 months (subsequently she produced and reared a litter). The interval between pair formation and the first birth ranged from 65 days to 1,2 years (on average  $5,4 \pm 2,9$  months).

We have analyzed 58 interbirth intervals. The frequencies of this index presented in Fig. 1 illustrates two peaks, one at 60-61 days, and another at 74-75 days. As gestation in *Macroscelides proboscideus* is about 60 days (Nowak, 1991; our data), the first principal peak testifies to postpartum estrus in this species. The second one may be a result of the gestation and infertile cycle of approximately 14 days. Similarly the duration of the cycle in *Elephantulus rufescens* was calculated (Rathbun et al., 1981).

Fig.1. Frequency of interbirth intervals in *M. proboscideus*



When males were allowed to remain with females after birth, two or three litters could be produced by the pair in succession (13% and 36% correspondingly). All other parturitions were followed by break of breeding (it lasted more than gestation period). Long periods of continuous breeding were uncommon and were characterized by deviations in maternal behavior. One of our females gave birth to 11 litters in succession but she never reared them; another female produced eight litters but refused to suckle every fourth one.

Usually females gave birth for the first time when they were about 1 year old; only one female produced a litter when her age was 6 months. The maximum number of litters known to have been born to any our female of *M. proboscideus* over her lifetime was 12 (on average  $5 \pm 2,65$ ). Only singleton and twin births were recorded during the analyzed period (correspondingly 39% and 61%); only once (in 2003) a litter consisted of 3 young.

While females reached 3 year old age the number of litters per year increased from  $2,2 \pm 0,8$  to  $3,0 \pm 0,5$  for every female and twins began to prevail. During the fourth year of life females produced on average  $1,5 \pm 0,5$  litters; the probability of singleton and twin births was equal. Only one female from our colony older than 4 years has produced a litter. Females usually stopped breeding in less than 1 year before their death. Maximum litters per year (5) were produced by two females 2 years old.

Most litters appeared in spring and summer (maximum in June). In autumn breeding usually gradually stopped and never has been observed in November (Fig. 2). Infant death-rate varied markedly. Probability of survival of young born in February and spring and summer months was the highest; most losses were due to litters being born in autumn and winter (Fig. 3). We accounted this for parents' molt as we usually found compact fur balls in the stomachs of died young.

Fig. 2. Annual dynamics of breeding in *M. proboscideus*

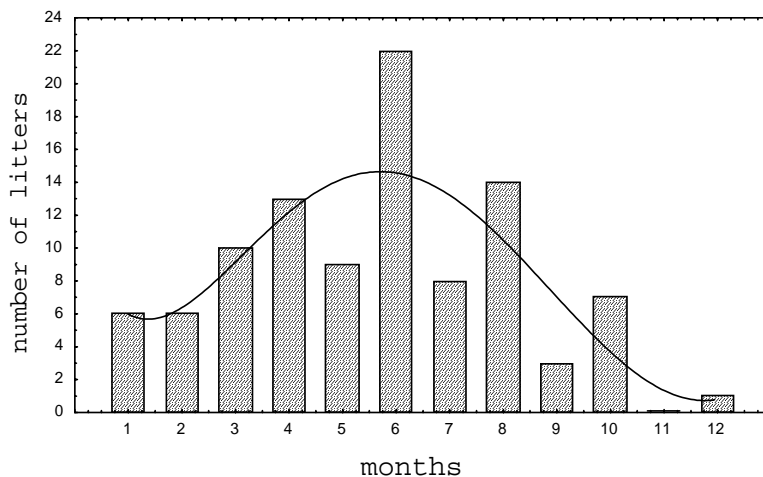
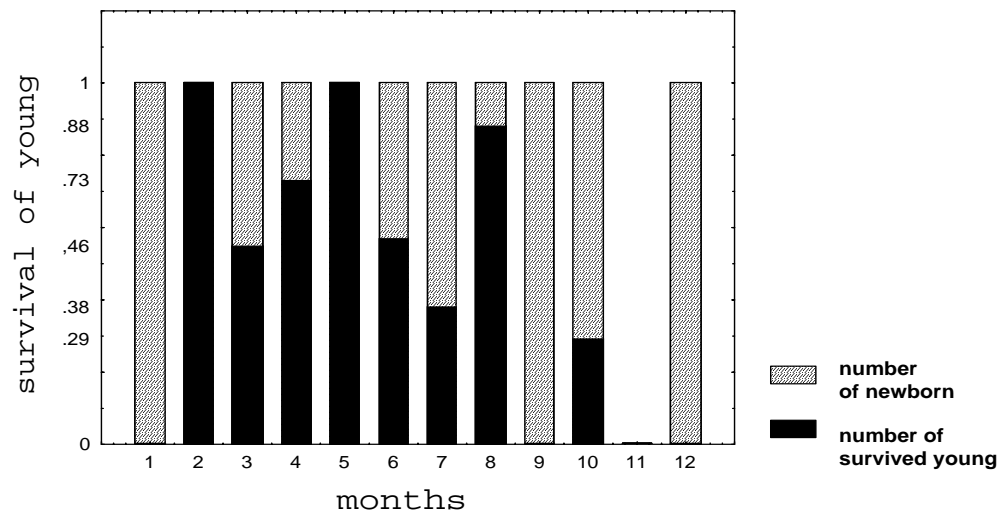


Fig. 3. Probability of survival of young reared by mothers in *M. proboscideus*



Only 54% of all newborn reached 1-month age<sup>1</sup>. It is very interesting that this frequency was not affected by the way of rearing. 71% of females reared by their mothers survived to weaning age, in males it was 59%. As males prevailed in our litters (61%), the sex ratio in weaned young equalized.

Newborn short-eared elephant shrews are precocious. We observed that after birth they immediately showed activity in their relationships with mother and this behavior provided them with normal lactation (Vakhrusheva et al., 1997). Weakened newborn couldn't perform such pattern completely and this often led to death even if the mother's behavior was adequate. In such cases we practiced feeding of young with kefir during first 2-3 days but didn't separate them from the mother. After the young elephant shrews got stronger natural nursing continued without our interference.

Between 1992 and 1994 females of short-eared elephant shrews in our colony ceased nursing of their young and we had to hand-rear all newborn (Vakhrusheva, Ilchenko, 2001). Special attention was given to the colony and its husbandry: we corrected vitamin and mineral supplements (now we use "Kinder Biovital Multivitamin Gel, F.Hoffmann-La Roche Ltd.), increased temperature in cages and in that way decreased humidity of substrate. These actions led to essential increase of nursing females (up to 80%). So, changes in keeping conditions effected maternal behavior in *M. proboscideus*.

When we compared reproductive features of females weaned in different conditions we revealed some interesting tendencies. Hand-reared females could be paired with males in older age in comparison to mother-raised females; they produced more litters over their lifetime and their twin births were recorded oftener (Table 1). These differences were not significant but we related this fact to the lack of data.

Table 1. Breeding features in females of *M. proboscideus*

Breeding features	All females under investigation (n=20)	Mother-raised females (n=12)	Hand-reared females (n=7)
Mean age of females during first parturition (months)	11,7±3,3 (min-6)	10,95±3,13	12,86±3,55
Mean number of litters per life	4,95±2,65 (max-12)	5,13±2,5	8±3,8
Twin births (%)	61	58	64

Hand-reared females had no problems with weaning of their young and successfully brought up their cubs by themselves. So, contacts with mothers in early postnatal period are not necessary for females to demonstrate normal maternal behavior later. More over, violations in maternal behavior of hand-reared females were significantly less frequently in comparison to females reared by their own mothers (27% and 48% correspondingly).

It is known, that animals which were handled regularly during early childhood were not as stressful as control ones (Dewsbury, 1981). We suppose to face the same situation. Females which were often handled by us during hand-rearing became more unreceptive to stress factors and this positively effected their reproductive potential and maternal behavior.

So, we regard maternal behavior of *M. proboscideus* to be innate. In captivity reproduction of short-eared elephant shrews depends on keeping conditions, season and females' age. We suppose that hand-reared females are less influenced by stress factors and this raises their reproductive potential.



Keeping conditions effect the display of behavioral pattern in “mother-cub” dyads and define survival of young side by side with season factor.

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## On Overview of Moscow Zoo’s Research Department

The Research department of Moscow Zoo was established in 1979. In our days the staff of department consists of 32 persons (including 15 research officers). There are 8 working groups with their own long term research themes (see below) and each theme includes many concrete projects lasting from some weeks to some years.

We try to combine problems of basic research with the Zoo’s interests to increase animals’ welfare.

Except for researches the department has some other activities: a scientific library, a young biologist’s club, an experimental exposition “Night World” and collection of small mammals are subdivisions of department. Besides we are publishing scientific research yearbooks and Moscow Zoo’s official site: [www.zoo.ru/moscow](http://www.zoo.ru/moscow) .

More detailed information and some of our publications (in Russian with English summary) are available on this site.

## Current research themes and projects

### **Noninvasive monitoring of physiological status in captive animals by measurement of excreted steroids**

*E. Tkatcheva, O. Lifanova.*

The aim of this project is to estimate the hormonal status of mammals with noninvasive methods (in faeces and in urine). We try to use this method for testing female’s reproduction status (pregnancy, estrous, cyclicity ) and for

estimation of rate of corticosteroids to mark the stress level. Both these tasks are useful for many different breeding and behavioural projects. Last time tests of reproduction status are conducted in the course of breeding projects for Pallas’ cats (*Felis manul*), Amur leopards (*Panthera pardus orientalis*), spectacled bears (*Tremarctos ornatus*) and kiangs (*Equus kiang*). We use measuring of stress to find the differences in species-specific

background stress levels of closely relative rodent species (the project is in the very beginning).

### ***Fertility analysis and artificial insemination of animals.***

*G. Maksudov.*

The main themes of this work are sperm fertility analysis and artificial insemination when they are necessary in breeding projects. The participation in the management of endangered animals' sperm krio-banks is our goal.

### ***Genetic sexing and the studies of the animal karyotypes.***

*O. Nesterenko*

This project, the first in the Russian Zoos, is devoted to introduction and plantation of genetic methods of sexing, systematic identification and relations of problem animals (especially birds). Besides this project includes preparing of the atlas of birds karyotypes. The analysis of Karyotypes, PCR-based and fingerprinting-based DNA analyses are used. The analyses are made mainly in the academy institute of General Genetics

### ***The reproductive biology of small mammals.***

*G. Vakhrusheva, O. Ilchenko, S. Sapozhnikova.*

The investigations of different questions of reproduction of small mammals: marsupials (opossums, sugar gliders), bats (Egyptian fruit bat and Linnaeus fruit bat), insectivores (tenrecs), elephant shrews (*Macroscelides proboscideus*), rodents (many different species of *Sciurimorpha*, *Hystricomorpha* and *Gerbellinae*) are being conducted.

Sexual and parental behaviour (including pair formation), estrous cycles, the duration of gestation ontogeny of young and other characteristics of captive breeding of little-studied species are the questions of different subprojects. Other subprojects are directed to methods of artificial rearing and the hormonal, ecological and behavioural stimulation of breeding.

### ***Scientific basis of Amphibian biodiversity conservation.***

*I. Serbinova*

The development of long-term management of captive populations of endangered amphibian species is the first purpose of this work. The other is reintroduction these animals and the questions connected with such reintroduction: study of ecology and current status in nature (mainly in collaboration with local zoologists), keeping of young amphibians up to metamorphoses and monitoring after reintroduction. The main species in the work are: spadefoot toad (*Pelobates syriacus syriacus*), banded newt (*Triturus vittatus ophryticus*), caucasian salamander (*Mertensiella caucasica*).

Besides methods of keeping and breeding exotic amphibians are developed.

### ***Ethological monitoring mammalian time budgets in Moscow Zoo.***

*V. Dubrovskiy, E. Zubchaninova.*

Long-term time budget monitoring mammals on display in parallel with changes of keeping and physiological status of animals is the item of this project. We plan to use this monitoring to estimate welfare of specific animals.

The observation data are collected and saved as electronic tables and this enables to compare the results easily. Big cats and bears are the main objects of the work. Perspective cooperation will stimulate gathering of data on animals' time budgets in other zoos and in nature.

Volunteers, students and young biologists take active part in this project.

### ***Optimization of mammalian behaviour in captivity.***

*E. Neprintseva, I. Vostchanova, O. Ilchenko, O. Nanova.*

Methods of increasing psychological welfare and correction of captive animals' behaviour are conducted. Except for traditional methods of environmental enrichment methods of social stimulation and homeopathic therapy (decrease of aggression and fear, stimulation of normal sexual and parental behaviour) are used.



A special subproject is aimed to study the cause of zoo animals' abnormal behaviour, especially stereotypies.

***Assessment of psychological welfare of animals in captivity on their behaviour.***

*I. Volodin, E. Volodina, O. Filatova.*

This project realizes another approach to estimate mental status and corresponding welfare of animals by their current behavior. A series of experiments with gerbils was carried out to work out main principles of assessment of emotional condition of animals by means of their vocalizations. In current subproject correlations in behavior of dholes with their vocalizations are under study.

Another subproject is devoted to studying parameters of calls encoding information on sex and individuality (work with domestic dogs, dholes, spotted suslics), with special reference to the role of biphonation and other nonlinear phenomena.

The third subproject is aimed to sexing of birds without sexual dimorphism by their call

characteristics. This method has been developed for white-faced whistling ducks and for chicks of some crane species.

E. Volodina is the curator of the library of animal vocalizations. This library is growing constantly and its records are available for specialists of Moscow Zoo and other institutions.

**Development of ethological approaches to the improvement of bird welfare in the exhibits of Moscow Zoo.**

*M. Tarhanova.*

There are two subprojects: 1) «Social organization of *Branta leucopsis* and their contacts with other species in the Moscow Zoo» - it includes the analysis of factors, affecting to breeding success of these geese and long-term ethological monitoring of their group. 2) «Development of environmental enrichment methods for large parrots» suggestivity and testing different means to increase of parrots occupancy.

## 4.3 Research Reports from Paignton Zoo

### Altering the diet of captive bred dormice increases hibernation

*Matthew Robinson<sup>1,2</sup>, Julian Chapman<sup>1</sup> and Poppy McDonald<sup>1,3</sup>*

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#### Abstract

In order to encourage a longer, more stable hibernation pattern in captive bred dormice, half the dormice kept at Paignton Zoo Environmental Park were fed a reduced calorie diet over winter. From December 2002 until April 2003 activity was monitored in each of 16 cages, with activity recorded when a food bowl had been disturbed. Activity was significantly correlated to temperature ( $p < 0.001$ ). Dormice on a low calorie diet were less active ( $p < 0.001$ ) and showed longer periods of inactivity ( $p = 0.001$ ). There was no relationship between weight change and diet given ( $p > 0.05$ ). Individuals showing signs of stress only appeared to show torpor. Hibernation length is influenced by food availability.

## Introduction

The dormouse (*Muscardinus avellanarius*) has become extinct over a large part of its previous range (Hurrell & McIntosh 1984). Many areas of suitable habitat do not contain dormice, possibly because of very slow recolonisation due to their arboreal nature (Bright & Morris 1991). Therefore reintroduction of captive bred animals forms the basis of English Nature's Species Recovery Plan.

It has been suggested that captive bred dormice travel less far when released thus reducing their chances of finding sufficient naturally available food (Bright & Morris 1994). It is also suggested that captive bred animals have a lower survival rate after release (Bright et al 1996) although there is no data on long term performance or mortality or activity patterns over the winter period.

Hibernation in wild dormice usually lasts from October until April (Hurrell, 1962). It has been noted that hibernation in captive dormice over the winter period is erratic, with shorter hibernation lengths than those typically recorded in the wild and several days of activity alternating with several weeks of sleep (Walhovd, 1971). In English Nature's conservation handbook (Bright et al 1996) a diet of fresh fruit with nuts, biscuit and seed is recommended for captive dormice so that on release individuals have large fat stores giving them a higher chance of survival (Bright & Morris 1994).

This study describes an investigation into whether a lower calorie diet encourages a longer, more stable hibernation in captive bred dormice. A captive dormouse with a hibernation period comparable to that of a wild animal may adapt more readily upon release into the wild.

## Method

The study was conducted on a group of captive dormice at Paignton Zoo Environmental Park from October 2002 until March 2003. Sixteen 1m<sup>3</sup> cages, holding 1- 3 dormice, were divided into two rows of eight. The top row was fed a normal diet and the bottom fed a reduced calorie diet (Table 1). Activity was recorded daily by placing the food only along one side of the dish and checking for disturbance the following morning, a cage was deemed active if the food had been disturbed. Previous data for activity periods revealed no difference in activity between top and bottom cages. Most cages contained one dormouse except three which held a male/female pair and one which had a family group of three dormice were kept together. Both rows contained the same total number of dormice. Maximum and minimum temperatures were recorded daily and each dormouse weighed every month. Data was analysed using SPSS v10.0.

<b>Regular Diet (Control)</b>	<b>Low Calorie Diet</b>
1 part Parrot Mix	2 parts Small Dog Meal
2 parts Mixed Corn	1 part Insectivore Food
1 part Vitalin Dog Food	1 part Vitalin Dog Food
1 part Small Dog Meal	1 part Canary Egg Food
½ part Mynah Bird Food	
½ part Canary Egg Food	
½ part Insectivore Food	
½ part Dried Fruit	
One piece carrot & One piece fruit	

Table 1. Alternative and normal winter diet provided for captive bred dormice.

## Results

There was a large variation in number of nights active between cages, regardless of diet (Fig. 1). Very few of the dormice were active when the minimum temperature dropped below 0°C but in many cages episodes of activity occurred when temperatures fluctuated over 0°C. A correlation between minimum temperature and total number of cages active was highly significant ( $p < 0.001$ ).

Dormice provided with the lower calorie diet had significantly ( $t[125] = 5.35, p < 0.001$ ). fewer periods of activity than the animals fed the normal diet; a mean total of 15 and 38 nights, respectively, excluding animals showing signs of stress. They also had significantly longer periods of inactivity (two-sample  $t[125] = 7.92, p = 0.001$ ; Fig. 1). The longest period of complete inactivity in all cages of dormice given the normal diet was approximately two weeks compared to a month with the reduced calorie diet. There were

also fewer active cages on each day with the reduced calorie diet compared with the normal diet ( $t[125] = 9.82, p < 0.001$ ).

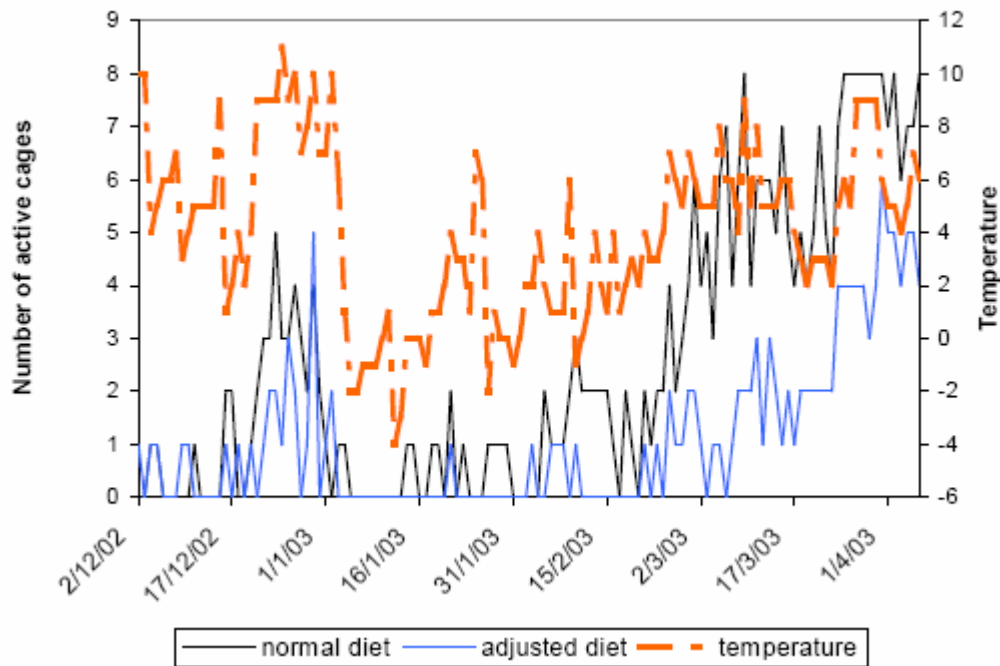


Figure 1. Number of dormouse cages in which activity was detected each day and minimum daily temperature

The average weight loss per animal showed greater variation between individuals than between diets. Weight loss on the adjusted low calorie diet was greater than on the normal diet but this difference was not significant (Fig. 2).

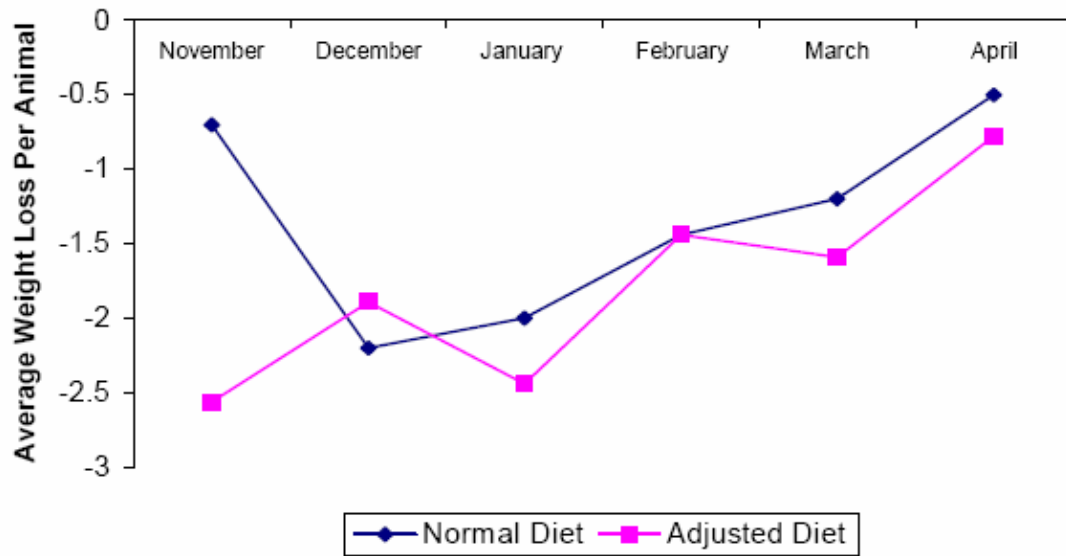


Figure 2. Average monthly weight loss/gain of captive dormice over winter on a normal diet and an adjusted low calorie diet.

### Individuals showing signs of stress

Four cages showed a much higher number of active periods throughout the study (Fig. 3) with brief periods of inactivity only occurring at very low temperatures. These animals also showed signs of stress i.e. hair loss and foot sores. Three of these cages contained more than one animal.

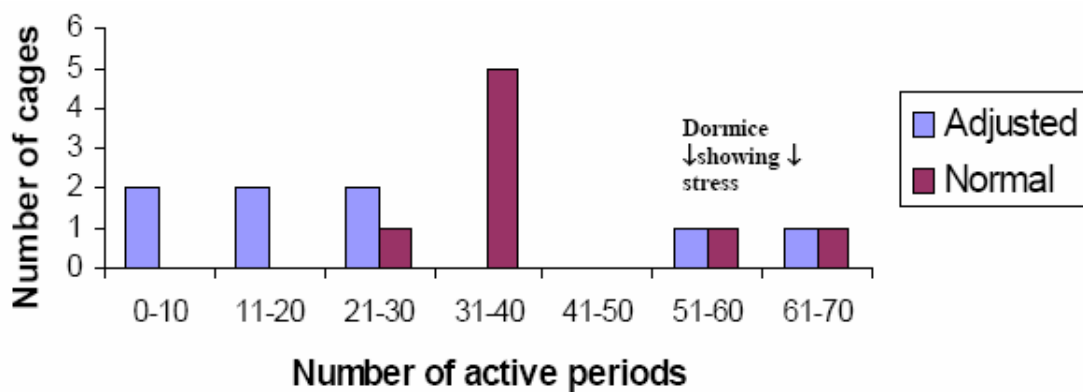


Figure 3. Frequency of active periods of dormice in each cage fed both diets.

### Discussion

Weight change over the hibernation period showed large variation between individuals. All dormice were fed the same diet over spring and summer and have previously showed similar total weight loss

regardless of cage position with similar individual variation. A low calorie diet, although less appetising, is associated with decreased activity, which seems to compensate for a low energy gain. Those individuals constantly presented with abundant appetising food are more active when temperatures allow. Therefore it appears that hibernation is regulated in part by the availability of certain food types. Dormice became inactive around the time of the first frost when temperature fell below 0°C. This is comparable to wild populations (Hurrell, 1962) and thus entry into hibernation appears to be linked to temperature. A low calorie diet, resulted in reduced activity with some cages having only six active periods from December until late March, all of which occurred within the last week of March. More frequent, short periods of

activity, like those seen previously in captive hibernating dormice (Walhovd, 1971), were seen in those animals on the normal winter diet. Therefore by reducing the calorie content of the diet hibernation can be sustained in captivity in comparable periods to those observed in the wild.

Four cages showed frequent periods of short activity interspersed with short periods of inactivity. It appears that the individuals within these cages were unable to sustain hibernation. Of those four two had the normal and two had the adjusted diet. Activity in these cages appeared to be linked solely to temperature as they were only inactive in extremely low temperatures, therefore it appears that individuals or an individual are showing torpor rather than hibernation. Three of these cages were the only ones to

contain more than one individual and were the only ones to contain individuals showing signs of stress such as hair loss. It is possible that housing more than one individual within a cage increases stress levels. Three individuals showing signs of stress were contained within the same nest box. Nest boxes have been suggested to provide insufficient areas in which a dormouse can hibernate (Morris, Bright & Woods 1995), due to their variable humidity and temperature. Bright, Morris & Mitchell-Jones, (1996)

suggest that a soil tray with a moss covering may provide a sufficient place for dormice to hibernate in captivity. This may reduce stress levels and is suggested to be an area for future study along with the separation of individuals over the winter period.

## Acknowledgements

Thanks to Paignton Zoological and Environmental Park especially Amy Plowman for devising the alternative diet.

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## How Enriching Is Training?

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### Abstract

Over the last three decades, environmental enrichment has become commonplace in many zoos to stimulate the lives of captive animals and overcome the inevitable limitations resulting from a captive environment. Enrichment often aims to reduce abnormal behaviour, encourage wild-type activity patterns and increase behavioural diversity. It has been suggested that training animals, as routinely done in many zoos for husbandry purposes, could act as enrichment due to the mental stimulation and physical

activity created. However, to our knowledge, until now there has never been an investigation into the enriching effects of training. The aim of this study was to compare the effects of training and enrichment on the behaviour of captive elephants. The elephants (N=2) at Paignton Zoo Environmental Park were observed over 24hrs during six experimental conditions involving combinations of training and conventional enrichment. The activity budget and behavioural diversity of the elephants were

calculated and compared across these conditions using two-way ANOVAs. Neither training nor enrichment significantly altered the elephants' activity budgets, with one exception; object manipulation by one elephant increased significantly with enrichment. However, enrichment but not training significantly increased the elephants' behavioural diversity. Thus, based on these criteria, training is not enriching and should not be implemented at the expense of other forms of environmental enrichment.

### Introduction

The use of environmental enrichment is now commonplace in zoos to provide stimulation to captive animals and in some situations to mitigate the effects of restrictive environments (Hediger, 1950 in Kleiman *et al.*, 1996; Thomas *et al.*, 1999). Fundamental aims of enrichment frequently include that it should increase behavioural diversity, reduce abnormal behaviour and encourage wild-type activity patterns (Markowitz 1975 in Markowitz *et al.*, 1978; Hutchings *et al.*, 1978a; Mellen & MacPhee, 2001). The methods used to enrich captive animals are diverse, including the daily provision of simple items, such as browse, or more complex devices based on operant conditioning (Markowitz *et al.*, 1978; Hutchings *et al.*, 1978a; Hutchings *et al.*, 1978c; Chamove *et al.*, 1982 in Kleiman *et al.*, 1996). Alternatively, enclosures can be designed to create dynamic environments that provide animals with the opportunity to express natural behaviours (Vargas 1993 in Carlstead & Shepherdson 1994; Kleiman *et al.*, 1996).

Training to facilitate animal husbandry and veterinary health checks has become increasingly popular in recent years as it can make stressful and/or time consuming procedures proceed more quickly and easily (Lewis & Houck 1981 in Kleiman *et al.*, 1996; Line *et al.*, 1991 in Carlstead & Shepherdson 1994; Mineka *et al.*, 1986 in Laule & Desmond 1998; Phillips *et al.*, 1998; Rodgers *et al.*, 1997). In situations where training has been integrated into animal management regimes it has been claimed to have several benefits, including that it can act as a physical and psychological form of enrichment for captive animals (Hediger, 1950 in Kleiman *et al.*, 1996; Hediger, 1955 in Kleiman *et al.*, 1996; Kleiman *et al.*, 1996; Bloomsmith *et al.*, 1998). However, no studies appear to have been undertaken to quantify this phenomenon (Laule, 1993; Mellen & MacPhee, 2001).

There is a long history of training captive elephants in order to adequately and safely manage these animals, particularly to facilitate necessary husbandry procedures such as foot care. Elephants are also prime subjects for environmental enrichment in their daily husbandry as their size, strength, intelligence and complex social structure make them particularly vulnerable to the behavioural changes that can occur in captivity (Thomas *et al.*, 1999; Gloyns *et al.*, 1999).

The aim of this study was to evaluate whether training could meet some of the criteria expected of enrichment through:

- Increasing active behaviours, such as foraging & feeding and object manipulation.
- Decreasing 'undesirable' behaviours, such as swaying and inactivity.
- Increasing behavioural diversity.

The subjects were two adult female elephants which had been studied as part of an intensive enrichment programme over several years prior to this study (Thomas *et al.*, 1999, Gloyns *et al.*, 1999). The elephants' management regime had recently (within the last 12 months) changed to protected contact using positive reinforcement training and thus provided us with the opportunity to investigate whether this type of the training could be used as a form of enrichment as has been previously suggested.

## Method

### *Study animals, enclosure and husbandry.*

Two elephants housed at Paignton Zoo Environmental Park were studied, Duchess, *Loxodonta africana* (34 years), and Gay, *Elephas maximus* (33 years). They have been housed together for 27 years, the last five years in an extensive enclosure (inside area 230m<sup>2</sup> and outside paddock 3200m<sup>2</sup>). The inside house can be divided into two separate areas by a movable gate, although the elephants are only separated during training. A drinking trough is situated between the two areas. Each area has a hayrack just outside of

the perimeter fence (made from six cm<sup>2</sup> wire mesh) to provide enrichment. Other permanent features include several sections of PVC tubing, hung around the wire fencing and, in each area, a large section of log that is used during the foot-care regime. The outside enclosure has both sanded and grassed areas. There are also several upright posts, log piles, a small pool and a selection of enrichment devices, such as tyres and chimes, that are permanently fixed within the enclosure following earlier enrichment studies (see Thomas *et al* 1999).

The elephants receive food throughout the day: 1) 0800hr, a scatter feed is presented outside and the elephants are locked out while cleaning takes place for approximately an hour, 2) 1000hr, a foot-care training session takes place for approximately 30 minutes finishing with a 'jackpot' reward of a bucket of food (this is additional to their normal food ration and does not replace normal feeding), 3) 1130hr and 1400hr, feed either inside or outside, 4) 1700hr, a second training session frequently takes place that involves another 'jackpot' reward feed, or on non-training days a final feed is given at this time.

When browse was available, it was provided *ad libitum* (three or four times per week). Up to four bales of hay (50cm x 30cm x 90cm) were provided for the elephants to feed from *ad libitum* throughout the day. This was normally placed within the racks, although it was occasionally placed



directly into the enclosure to vary the routine. All scatterfeeds, mesh feeders and permanent enrichment devices were maintained throughout the study.

During training sessions the elephants were separated inside (the same side was consistently used for each elephant). Carrot chunks, with the occasional banana half, were used as the reward during training sessions.

#### *Enrichment*

The additional enrichment for this study consisted of pasting a mixture (see below) onto six large stripped beech logs (approximately 20cm diameter and 150cm length). The mixture was prepared using 3 kg of plain flour with enough water to make it viscous. Approximately 600g of Parrot Food Superior Quality (J. E. Haith Ltd, Park Street, Cleethorpes, DN35 7NF, [www.haiths.com](http://www.haiths.com)) was added to half the mixture, and six large finely chopped carrots were added to the other half. Three logs were covered with each mixture and then left to dry overnight. They were then placed in the enclosure at either 1000hr (considered morning enrichment) or 1700hr (considered afternoon enrichment).

#### *Experimental design & data collection*

The experimental design included six conditions: - 1) no training and no enrichment; 2) no training and morning enrichment (1000hr); 3) no training and afternoon enrichment (1700hr); 4) training and no enrichment; 5) training and morning enrichment; 6) training and afternoon enrichment. The order of the conditions was assigned randomly so that each condition was repeated five times and data were collected on a maximum of three days a week.

Twelve, fifteen minute, observation sessions were conducted over 24hrs, starting at 0900hr. Instantaneous scan sampling every sixty seconds was used to record behaviour during these sessions. Observations were not made during training sessions or immediately after presenting the enrichment. Direct observations were made between 0900hr and 1715hr, and outside of these times, observations were made indirectly from video footage.

Behaviours were recorded using a hierarchical system for those that could occur simultaneously. Priority was given to those behaviours that were closer to the feeding and investigative behaviours of wild elephants and thus were recorded preferentially. The hierarchy of behaviour started with object manipulation, locomotion, foraging, and then feeding (i.e. if foraging and feeding were occurring only foraging was recorded).

#### *Data analyses*

All data analyses were carried out per elephant as they were from different species. Only four behaviours were included in the analysis. Activity budgets were determined with respect to swaying, inactivity, foraging & feeding, and object manipulation. They were calculated as the mean frequency of the behaviour per 15-minute session per day. The behavioural diversity was calculated daily using the Shannon-Weaver Index (Fowler *et al*, 1998). Two two-way analyses of variance were used to compare the effects of training with morning enrichment, and training with afternoon enrichment on each of the

key behaviours and diversity. Pearson's Product Moment Correlation Coefficient (Fowler *et al*, 1998) was used to determine the degree of correlation between the diversity indices of the two elephants across the six conditions.

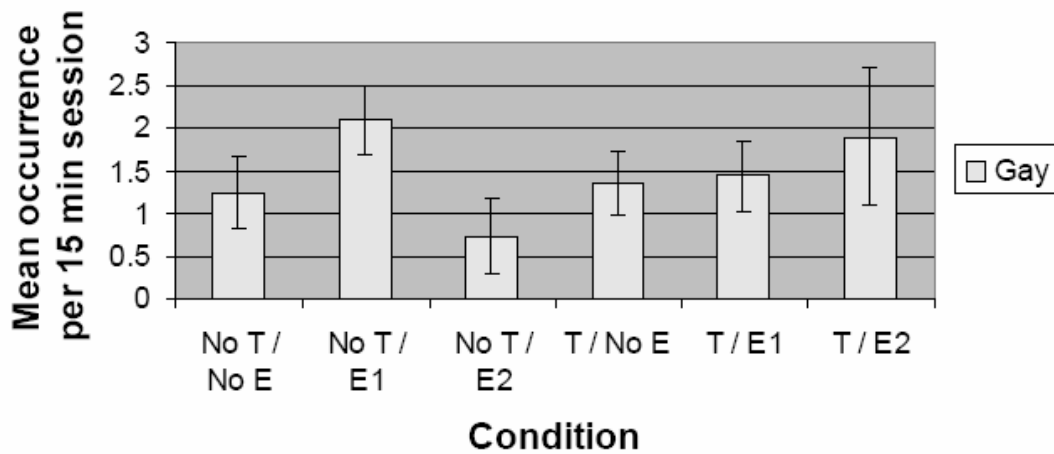
All data analysis was carried out on Minitab version 3.0.



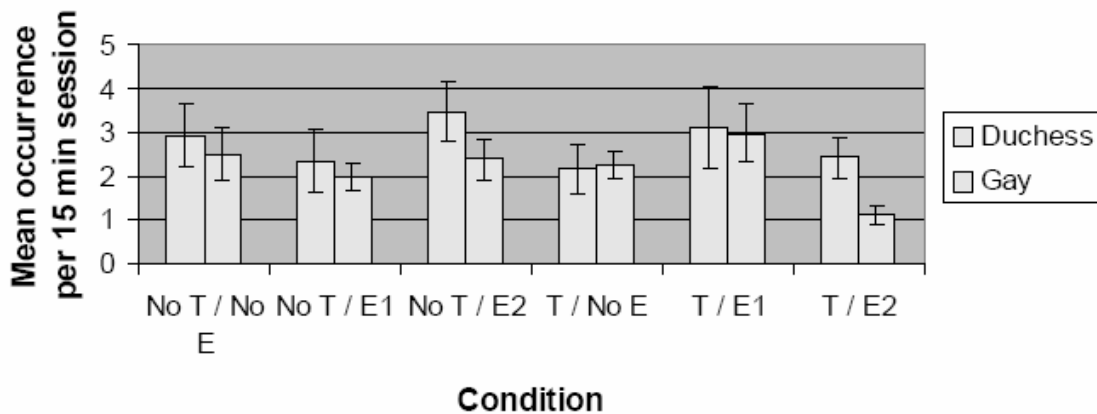
## Results

Neither training, morning enrichment nor afternoon enrichment had a significant affect on the swaying, inactivity, or foraging & feeding of either elephant (see figures 1-3).

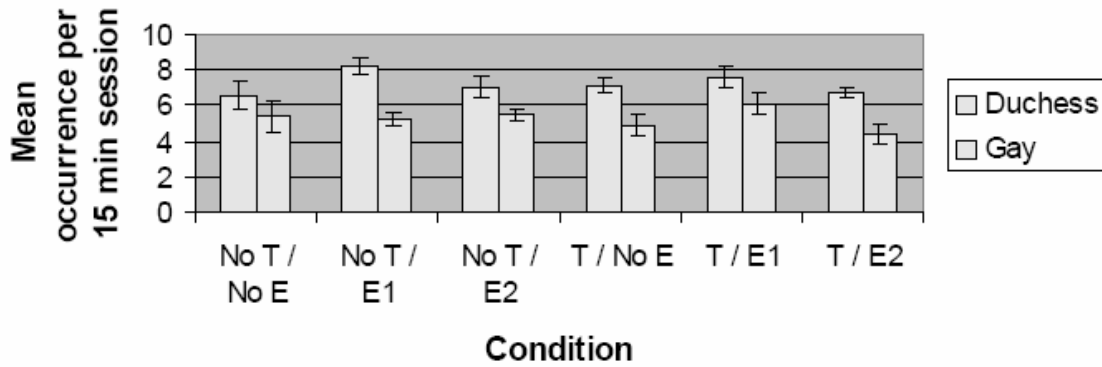
**Figure 1. A Comparison of Swaying Across The Six Conditions Showing Standard Error.**



**Figure 2. A Comparison of Inactivity Across The Six Conditions Showing Standard Error.**

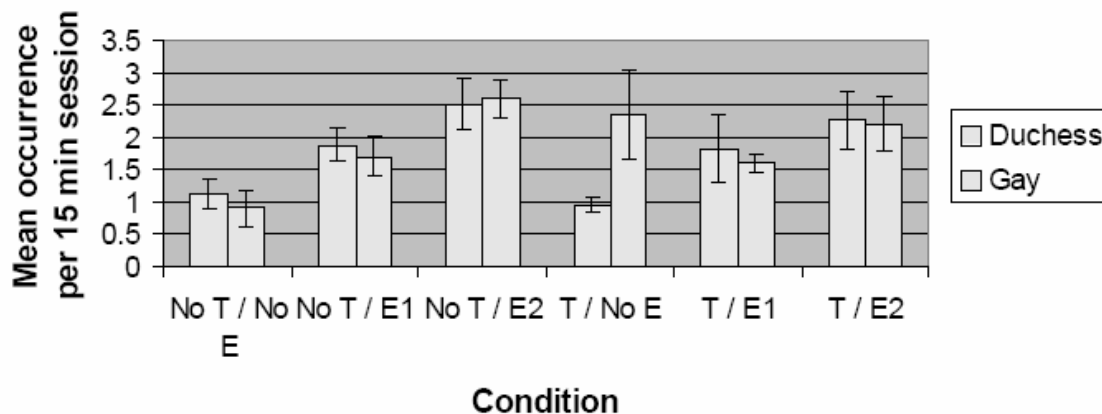


**Figure 3. A Comparison of Foraging & Feeding Across The Six Conditions Showing Standard Error.**



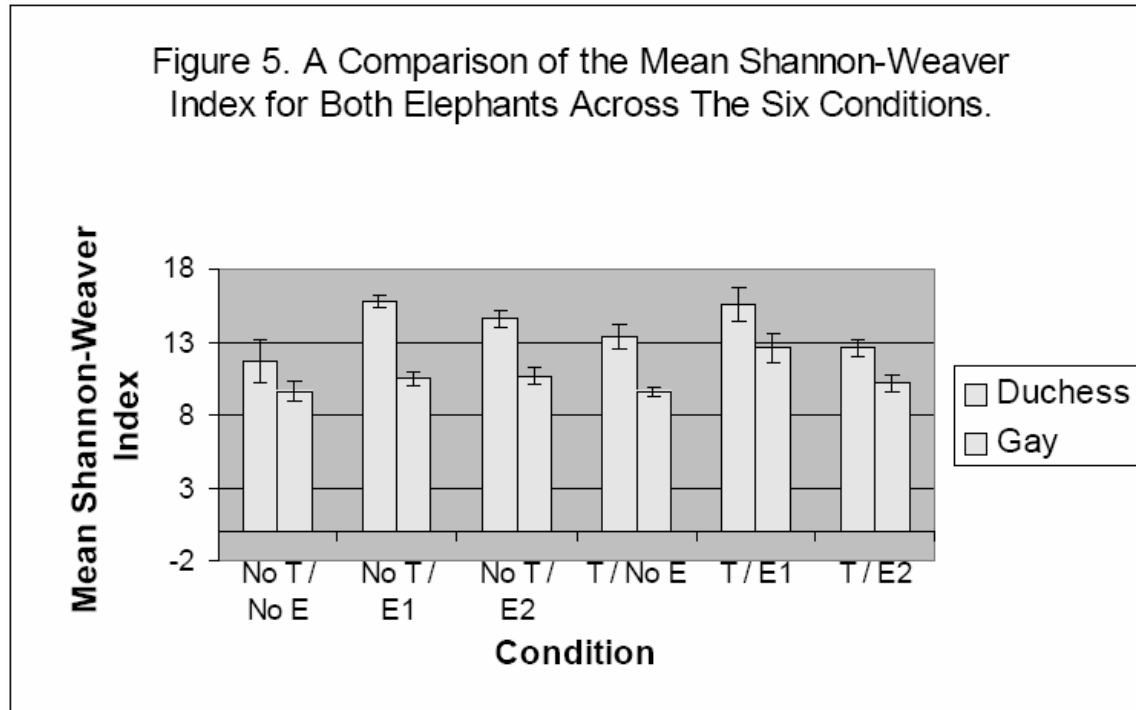
Both morning and afternoon enrichment significantly increased the frequency of object manipulation carried out by Duchess, whether training was present or not (AM:  $F=6.40$ ,  $p=0.02$ ; PM:  $F=16.42$ ,  $p=0.001$ ). There was no significant affect on object manipulation by training or either enrichment with respect to Gay (figure 4).

**Figure 4. A Comparison of Object Manipulation Across The Six Conditions.**



There was a significant increase in both elephant's behavioural diversity with morning enrichment irrespective of training (Duchess:  $F = 9.04$ ,  $p = 0.008$ ; Gay:  $F = 8.30$ ,  $p = 0.01$ ; figure 5), but training and afternoon enrichment had no effect.

There was a significant positive correlation between the behavioural diversity of both elephants across all treatments ( $r = 0.54$ ,  $p = 0.002$ ; figure 5).



## Discussion

Training did not have a significant effect on any of the behavioural categories tested (swaying, inactivity, foraging & feeding, object manipulation) nor on behavioural diversity. These are the traditional ways in which the effectiveness of enrichment is evaluated (Maple & Finlay, 1989; Markowitz, 1975, 1976 & 1977, in Forthman Quick, 1984; Hancock, 1980, in Forthman Quick, 1984; Thomas *et al.*, 1999; Carlstead & Shepherdson, 1994; Whittaker *et al.*, 2002; Bloomsmit, 1992). This evidence suggests, therefore, that training is not enriching.

However, in this study the enrichment used also had very little effect. The only significant effects were an increase in object manipulation by one elephant and increased behavioural diversity of both elephants. The elephants have been provided with an increasingly complex enrichment programme which has been evaluated over the last six years (Thomas *et al.*, 1999; Gloyns *et al.*, 1999). This has already reduced 'undesirable' behaviour (swaying and inactivity) to very low levels (especially during day time) and promotes active behaviours such as foraging and interaction with the environment. The log enrichment used here was additional to the existing programme and other enrichment methods were not stopped or removed. The log enrichment and training may both have caused greater differences to the behaviour of the elephants if they had lived in a previously unenriched environment. In addition, observing behaviour over 24 hours may have obscured some effects. The logs and/or training may have been quite effective for the first five hours but then not as much so over the rest of the sessions.

It is also possible that a different form of enrichment might have produced better results. However, the choice of enrichment is extremely difficult. In order to ensure that both elephants are interested a food-based enrichment device must be chosen, as the African elephant is not motivated to interact with non-food enrichment. As a consequence, the immediate 'life' of the device is quite limited by how long it takes the elephants to retrieve all of the food. They may return over a longer time period to check that they

have collected all of the food items, but would not use the object in such an intensive manner as during the initial period.

With regards to the swaying of the Asian elephant, there is possibly some confusion as to the reason for its occurrence. Although it has long been regarded as a stress-related behaviour it is possible that in some cases it may be connected to excitement. On several occasions it was recorded that Gay swayed having just been given access to the enrichment logs, possibly due to excitement or to concern that Duchess would deny her access to them. It would be useful to correlate some cortisol levels with swaying

occurrence to attempt to unravel these causes. One factor that appeared to be frequently associated with the Asian elephant swaying was the occurrence of the African elephant lying down.

## Conclusions

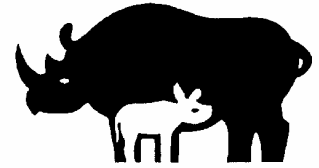
- Neither training nor enrichment significantly affected swaying, inactivity, or foraging & feeding by either elephant.
- Enrichment significantly increased the object manipulation of the African elephant only irrespective of training, but training had no effect.
- Enrichment in the morning significantly increased behavioural diversity of both elephants but training and enrichment in the afternoon had no effect.
- As analysed here training had no detectable effect on the behaviour of the elephants outside training sessions
- According to the criteria used here training is not enriching.

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## 5 News from the UK research group



### 5.1 Zoo Research News

#### Federation Research Newsletter Vol. 4 No. 4 Oct. 2003

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#### News and Views from the Research Group

##### Federation of Zoos 6th Annual Symposium on Zoo Research

The 6th symposium will be held at Edinburgh Zoo in early July 2004. It will follow the established format of talks and posters from students and more experienced researchers on research in any discipline, carried out entirely or predominantly in a zoo environment. As usual there will also be a methods and techniques workshop, which this year will be on Behavioural Profiling. More details on exact dates and costs will be distributed shortly. If you would like to be added to the mailing list or need any other information please contact Rob Thomas at Edinburgh Zoo ([rthomas@rzss.org.uk](mailto:rthomas@rzss.org.uk)).

##### Resignation of Group Co-chair, Anna Feistner

It is with much regret that, due to her departure from the Durrell Wildlife Conservation Trust, Anna Feistner has resigned as member and co-chair of the core group of the Research Group. Anna was the longest standing member of the Group and her wide knowledge of and enthusiasm for zoo biology played a major role in developing the Group into Europe's leading zoo biologist association. The core group is losing a most valuable member and her input will be greatly missed but we hope Anna will continue to contribute as a member of the Reporting Group.

#### A behavioural and biometrics study on endangered Fregate beetles *Polposipus herculaenus* at London Zoo.

*Tse Ling Lee, University College London*

*Polposipus herculaenus* is a flightless beetle (Coleoptera: Tenebrionidae) endemic to Fregate Island, Seychelles. In 1996 the beetle was classified as critically endangered by IUCN and a captive breeding and research colony was established at the Zoological Society of London's Invertebrate Conservation Unit. The beetles have bred successfully to the fourth generation, however there appears to be a slight decrease in average body size. The significance of this trend and its potential connection with the fitness of the ex situ population is unknown. In order to learn more about the beetles' behaviour, this study focused on analysing activity patterns relating to environmental parameters and investigating mating behaviour as a measure of the beetles' fitness. The results showed that the beetles do not display clumped, daily activity patterns and their activity increases significantly with elevations in humidity. Biometric measurements of known sex beetles did not reveal biometric sexual dimorphism. A solid conclusion regarding the fitness of the beetles could not be drawn and further studies are recommended. Further info: Amanda Ferguson at London Zoo.

Email: [amanda.ferguson@zsl.org](mailto:amanda.ferguson@zsl.org)

## The effect of a human audience on the behaviour of a group of Sulawesi crested Macaques

*Peta Dwyer, University of Wales Swansea*

The effect of a human audience on the behaviour of a group of Sulawesi crested macaques was investigated at Newquay Zoo. The group was studied twice a day when the human audience was at a minimum and three times a day when at a maximum. Macaque behaviour was assessed using instantaneous focal sampling every 30 seconds for five minutes for each macaque in turn, giving a total observation period of 35 minutes. ANOVAs were used to test for differences in the time spent performing each behaviour between individuals and between visitor condition. All individuals showed significantly more allogrooming and agonistic behaviour and less foraging and feeding when maximum visitors were present. The dominant male showed more agonistic displays than any other individual. The adolescent male performed more sexual behaviour when more visitors were present. The results indicate that the behaviour of this primate in captivity is significantly altered by the presence of visitors. Further info: Ruth Martin, Newquay Zoo, Trenance Gardens, Newquay, Cornwall, TR7 2LZ. Tel: (01637) 873342, email: [info@newquayzoo.co.uk](mailto:info@newquayzoo.co.uk)

impressions of their animals' personalities, and the results validated by carrying out simple behavioural tests with a novel object. The personalities were then related to environmental factors and to individual breeding success rates to search for any common links. Institutional performance variables were also correlated with the environmental factors in order to explain the great variation in success seen between different institutions. The production of a personality profile for each cheetah in the study was successful and significant correlations were found with the behavioural tests indicating that the traits identified do represent measurable differences. Several effects of environmental factors on cheetah personalities were found, however there were no differences between the personalities of cheetahs who had and had not bred, so no common links could be established. At an institutional level, breeding success was correlated significantly with the regularity of the care-taking regime and with how often a keeper enters the enclosure with the cheetahs. These results suggest that keepers should encourage a predictable and close relationship with their cheetahs to maximise their chances of breeding success. This project was financially supported by UFAW and ABWAK. Further info: Kirsten Pullen, Paignton Zoo Environmental Park, Totnes Road, Paignton, Devon TQ4 7EU. Tel: 01803 697514, email: [kirstenpullen@paigntonzoo.org.uk](mailto:kirstenpullen@paigntonzoo.org.uk)

## Personality profiles of cheetahs (*Acinonyx jubatus*) in the UK and Ireland in relation to environmental factors and performance variables

*Sheila McKay, Manchester University and Paignton Zoo Environmental Park*

The cheetah has a long history of poor and inconsistent breeding in captivity and the current population is not self-sustaining. Since the cheetah is listed as endangered on the IUCN Red Data List there is a strong incentive for addressing the poor breeding success in captivity. By determining the behaviour profile (or "personality") of cheetahs held in the UK and Ireland, it was hoped that some possible behavioural reasons for this variable breeding success could be established. Keeper questionnaires were used to obtain the keepers'

## Horn size and symmetry: an honest guide to male quality?

*Jo Lawton, University of Huddersfield*

The more developmentally stable an animal is the greater its fitness and state of welfare. Fluctuating Asymmetry (FA) can be used as an estimate of developmental stability. Developmental stability is affected by genetic and/or environmental stress. It has been suggested that when there is a negative relationship between size and asymmetry in sexually selected traits they function as honest signals of a male's quality. A male with longer more symmetrical horns is proving his ability to pay the higher cost of displaying these expensive ornaments. The horns of the Indian



blackbuck (*A. cervicapra*) are believed to function as both ornaments in sexual selection and weapons. A post hoc experiment was carried out on male Indian blackbuck to test the hypothesis that black, dominant males have longer, more symmetrical horns than tan, subordinate males. Fifteen adult males, from three zoos were photographed and horn length and span were measured. Individuals were grouped using similar coat colour, body size and horn characteristics. Each individual's horn traits were measured three times and mean values were calculated (with a maximum measurement error of 3.16%). Absolute asymmetry for horn length and span was calculated as the mean difference between left and right values. Horn size and asymmetry were normally distributed indicating the presence of fluctuating asymmetry in these traits. Horns were significantly longer (Mann Whitney  $U=0$ ,  $P<0.05$ ) and more symmetrical ( $U=2$ ,  $P<0.05$ ) in dominant males than subordinate males. Dominant males also had a wider horn span ( $U=0$ ,  $P<0.05$ ). Therefore, dominant male blackbuck expressed a higher degree of developmental stability in these traits. Both traits also showed a negative relationship between trait asymmetry and horn size (Spearman's  $\rho_s = 0.67$ ,  $P < 0.01$  for length;  $\rho_s = 0.65$ ,  $P < 0.01$  for span) i.e. when horn length and span increase in dominant males, asymmetry decreases. These results indicate that some individuals are more susceptible to developmental stress than others i.e. subordinate males experience higher levels of FA and are therefore less developmentally stable than dominant males. FA of horn trait may therefore be used as a guide to male quality and his ability to cope with stress. These results support the theory that not all genotypes respond equally to the environmental conditions in which the individual develops. Tools such as FA can be used to assess how an individual has coped with developmental stresses over its lifetime. This guide can then be used to find out which individuals are best equipped to cope with new and potentially stressful experiences, proving of value for conservation breeding and individual welfare management. Further info: Dr Jo Lawton, University of Huddersfield, Queensgate, Huddersfield. HD1 3DH. Tel: 01484 473989, e-mail: j.lawton@hud.ac.uk

## Visualising social relationships in chimpanzees

*Vicki Fishlock, University of Edinburgh*

Chimpanzees live in complex fission-fusion societies, where individuals tend to associate in temporary parties within the bounds of their community range. Long-term field research has revealed considerable diversity in the extent and patterning of social interactions, though males tend to be more gregarious than females. Describing or answering questions about social structure and organisation is a complex process and, before data analysis can begin, researchers often find it useful to visualise the complex data they have collected. Small world theory has enjoyed considerable interest in recent years and has proved a remarkably successful way of describing complex networks in various contexts. This study examines whether small worlds exist in chimpanzee social structure and how the analysis performs against other methods of visualising data (sociograms and dendrograms). Results indicate that small world networks exist in both wild and captive populations and that the technique may help elucidate principles of social organisation. They have the advantage of incorporating quantitative values that can be used for systematic exploration but lack directionality. The utility of visualising data with this technique may be greatest for larger populations on behaviour measures where relatively few of the possible interactions occur. Small worlds are constructed on the basis of binary data. To be certain small worlds are not artefacts of the methods used to reduce data to the binary state the implications of the procedures used require further exploration. Potential implications of the presence of small worlds in chimpanzee social ecology are discussed.

## Pool use and swimming behaviour of penguins at Edinburgh Zoo

*Stephen Clark, University of Edinburgh*

Penguins spend a vast proportion of their lives in the marine environment, coming ashore only to breed and moult yet there is a paucity of data about their behaviour in the water. Most



detailed studies have focused on penguins' terrestrial life and other than some investigations into diving behaviour, revealing to what depths the birds dive, little is known about what they do in the water. In this investigation at Edinburgh Zoo a series of tests were carried out to look at: what behaviours occurred within the water and to what extent social facilitation might affect this, pool use and preferences for different parts of the pool for various behaviour such as swimming or pool entry. The results indicate that captive gentoo and macaroni penguins congregate in species specific-groups to bathe, rarely interacting with those of other species. Within these species-specific groups behaviour is highly synchronised through the action of social facilitation. Intra-specific aggression was displayed implying the existence of a dominance hierarchy. Substantially more research into this subject is required in both captive and wild populations

in order to obtain a full and rounded knowledge of penguin behaviour.

### Olfactory enrichment for captive red pandas (*Ailurus fulgens*)

*Richard Moore, University of Edinburgh*

The olfactory environment of captive animals is a largely neglected area of environmental enrichment. For the red panda, *Ailurus fulgens*, olfaction is a primary means of perceiving its environment thus olfactory enrichment should be a priority for this species. Red pandas actively scent-mark and individual odours serve an important communication function. In this study, unfamiliar conspecifics' scent marks, collected on lengths of dowel, were introduced into red panda enclosures. Individual pandas were observed for 120 minutes per day over three conditions: Baseline (two consecutive days), Treatment (two consecutive days), and Post-treatment (two consecutive days). A marked increase in the rate of scent-marking in response to the inclusion of conspecific scents was observed. There was also a tendency to increase activity and to display a wider range of species-typical behaviour during the treatment period. Since our understanding of olfactory processes is still in its infancy, the success of olfactory

enrichment procedures should be carefully evaluated to ensure that there are welfare benefits to the animals.

Further info on the above three: Charlotte Macdonald, Research Officer, Edinburgh Zoo. Tel: 0131 314 0316, email: [research@rzss.org.uk](mailto:research@rzss.org.uk)

### Effects of mirror image stimulation on the behaviour of mandrills (*Mandrillus sphinx*)

*Sam Williams, The University of Manchester, and Stephanie Wehnelt, Chester Zoo.*

Several captive primate species have been provided with mirrors as enrichment items and mirror image stimulation (MIS) has been shown to elicit various responses. There is often a social response and in some species a reduction in the occurrence of abnormal behaviours. It has been suggested that this might be the case for mandrills (*Mandrillus sphinx*), however the responses of mandrills to MIS have not, to our knowledge, been investigated. The behavioural effects of MIS were studied in a group of five mandrills at Chester Zoo paying particular attention to the effect on abnormal behaviour. The group consisted of one female with her two male infants, her half-sister and an adult male. The adult male had a history of abnormal behaviour including fur plucking. Other potential triggers of abnormal behaviour such as visitor numbers and noise levels were also measured. Paired t-tests were used to compare behaviour on days when the mirror was present with days when it was absent. Multiple regression was used to analyse the relationship between abnormal behaviours and potential triggers. Dominance and association indices were calculated to determine the dominance hierarchy and quantify associations between individuals.

Although some individuals directed a social response towards the mirror, MIS failed to have any significant effect on the occurrence of abnormal behaviour ( $t=0.20$ ,  $p>0.05$ ). The social response was, however, thought to be responsible for a shift in the location of fur plucking from the front of the enclosure ( $t=2.43$ ,  $p<0.05$ ) to the vicinity of the mirror, located at the rear ( $t=-2.37$ ,  $p<0.05$ ). The

frequency of abnormal behaviour was not associated with visitor numbers ( $t=-0.22$ ,  $p>0.05$ ), noise levels ( $t=-0.01$ ,  $p>0.05$ ) or the amount of time mandrills spent in view ( $t=-0.08$ ,  $p>0.05$ ) or out of view ( $t=-0.02$ ,  $p>0.05$ ) of the public. The frequency of social behaviours differed on days when the mirror was present, although responses varied between individuals. The adult male spent less time allogrooming ( $t=2.65$ ,  $p<0.05$ ) and the frequency of copulations increased ( $t=-2.38$ ,  $p<0.05$ ) when the mirror was present. One of the infant males interacted less with visitors ( $t=3.74$ ,  $p<0.01$ ), while aggression levels decreased in the mother ( $t=2.65$ ,  $p<0.05$ ) in the presence of the mirror. Interactions between

some individuals also decreased significantly when the mirror was present ( $t=-2.50$ ,  $p<0.05$ ).

Individual differences in response to MIS can be explained by age and social status. It is suggested that vocalisations from neighbouring primates as well as sexual tension within the group could be linked to abnormal behaviour. A number of questions were raised regarding the way in which mandrills interpret their mirror images, and further study into their perceptions of 'self' is suggested.

Further information: Sam Williams, email: [s.t.williams@stud.man.ac.uk](mailto:s.t.williams@stud.man.ac.uk)

## 5.2 Zoo Research News

### Zoo Federation Research Newsletter Vol. 5 No. 1 Jan. 2004

#### News and Views from the Zoo Research Group

##### Meeting of the Core Group, 8th December 2003, ZSL

This was a busy meeting for the Core Group and we made many plans for the coming months which we hope will enhance the benefits of the group for all those involved in zoo-based research. We decided on a new(ish) name and format for this newsletter; we still intend that it should communicate highlights of active research, with contact details for those needing more in depth information. However, we will now include a fuller length feature article in each issue and take the opportunity to inform readers about all Zoo Research Group events, publications and resources. We would welcome any feedback on these changes. In 2003 we published the first in our series of Zoo Research Guidelines and we now have three more issues almost complete (see Resources, below). We hope these will be of benefit to potential zoo researchers and we would like to thank all the authors and advisors who have worked with us to produce them.

##### Federation of Zoos 6th Annual Symposium on Zoo Research

The 6th symposium will be held at Edinburgh Zoo on the 8th and 9th July 2004. It will follow the established format of talks and posters from students and more experienced researchers on research in any discipline, carried out entirely or predominantly in a zoo environment. This year the meeting will include a techniques workshop on Behavioural Profiling to be led by Dr Sheila Pankhurst, Anglia Polytechnic University. Registration forms will be circulated shortly. Contact Rob Thomas ([rthomas@rzss.org.uk](mailto:rthomas@rzss.org.uk)) for more information. Statistics Workshop We are planning to hold a statistics workshop for zoo research co-ordinators and supervisors in Edinburgh on 7<sup>th</sup> July, the day before the annual symposium. The aim will be to discuss problems related to statistical analysis of typical datasets generated by zoo research. The outcome of the workshop will be the publication of a Zoo Research Guidelines issue that will help to standardise some of the statistical methods we use for zoo research. All participants will need to be experienced in zoo

research and prepared to actively contribute to the workshop's output. Attendance will be by invitation but if you are interested in taking part please contact Stephanie Wehnelt (s.wehnelt@chesterzoo.co.uk).

### The Reporting Group

The Reporting Group consists of academics, zoo staff and others with an interest in zoo-based research. Its main aim is to forge links between researchers and zoos, in particular with the Taxon Advisory Groups, to better direct research towards the needs of zoos. It is hoped that Reporting Group members will regularly attend the annual symposium and be willing to undertake occasional tasks related to their area of expertise such as contributing to workshops or the production of Zoo Research Guidelines. The group communicates via an email list, if you would like to join please contact Anna Feistner (atc.feistner@virgin.net)

### Zoo Research Group Resources

The following resources can be downloaded without charge from the Federation website ([www.fedzoo.org.uk](http://www.fedzoo.org.uk)):

Zoo Research Guidelines: Project Planning and Behavioural Observations. Wehnelt, S., Hosie, C., Plowman, A. and Feistner, A. 2003.

Research Sampling Guidelines for Zoos. 2002

*Available soon: Zoo Research Guidelines: monitoring of stress*

*Zoo Research Guidelines: nutrition*

*Zoo Research Guidelines: visitor effects*

The following resources are available from the Federation Office (there may be a small charge, please ask; [conservation.fedzoo@zsl.org](mailto:conservation.fedzoo@zsl.org)):

Abstracts of the 1st Annual Symposium on Zoo Research. Plowman, AB (ed.) 1999

Proceedings of the 2nd Annual Symposium on Zoo Research. Plowman, AB (ed.) 2000

Proceedings of the 3rd Annual Symposium on Zoo Research. Wehnelt, S and Hudson, C (eds.) 2001

Proceedings of the 4th Annual Symposium on Zoo Research. Dow, S (ed.) 2003

Proceedings of the 5th Annual Symposium on Zoo Research. Gilbert, T (ed.) 2003

A database of browse use in British and Irish Zoos and poisonous plants information (CD, 2001). Plowman, A.B. and Turner, I.

A Bibliography of References to Husbandry and Veterinary Guidelines for Animals in Zoological Collections. Macdonald, A.A. and Charlton, N. (eds.) 2000

## Feature Article: Social effects on the *Trichuris* burdens of Abyssinian colobus (*Colobus guereza*)

Fay Poyser, Manchester University and Paignton Zoo Environmental Park

### Introduction

*Trichuris* spp. are parasitic nematodes that live in the colon and caecum of their host. There are approximately 60 different species infecting mammals but in primates, including humans it is *Trichuris trichiura*, the whipworm. Worldwide 1000 million people could be infected with *T. trichiura* making it an important zoonosis (Stephenson et al., 2000). Previous studies (e.g. Brown et al. 2002) have indicated a persistent *Trichuris* presence in colobus monkeys at Paignton Zoo, although there have been no detectable symptoms of ill health. However, deaths due to heavy *T. trichiura* infections have been reported in non-human primates (Emikpe et al., 2002). Further research was, therefore, initiated into parasite loads and the efficacy of various antihelminthics. There have been a small number of studies of helminth infection in non-human primates (e.g. Eberhard, 1981; Hasegawa and Takayoshi, 1983; Kessler et al., 1984; Phillipi and Clarke, 1992) and several have shown an effect of social dominance, age, and/or sex on the intensity of parasite infection. However, there appears to be no published information on the intensity or incidence of helminth infection in any colobus species.

This study aimed to determine whether the intensity of *T. trichiura* burden in the captive colobus monkeys at Paignton Zoo was correlated to age, sex or social dominance. Various methods of monitoring and managing *Trichuris* infection were also tested.

## Methods

Two groups of *C. guereza*, A and B (Table 1) were housed separately at Paignton Zoo. Husbandry, management and enclosures were identical except for size, group B being held in a slightly smaller area. The study was conducted between October 2002 and April 2003. Faeces were collected during autumn and spring periods between which the monkeys were wormed with one of two antihelmintics (Panacur and Oramec) and were clear of *T. trichiura* for at least 3 weeks. For both groups faeces voided between 14:00–15:00 were marked on a map of the enclosure and the individual responsible identified. At 15:00 all known samples were collected and stored (at -5°C) for analysis. The total number of samples collected depended on the colobus defecating whilst being observed and varied between 14 and 50 per animal in each period. *Trichuris* burdens were estimated using the McMaster's technique (Urquhart, 1988). There were no significant differences in egg counts between autumn and spring periods for any individual so data were pooled across periods for analysis. Continuous focal animal sampling was used to note all physical displacements of an individual by another. Observations were taken during feeding and non-feeding periods (6 sessions of 15 minutes/animal in each). This data was arranged into displacement matrices to determine a hierarchy with the individual that was never supplanted at the top and the individual that was always supplanted at the bottom. A two-way between subject ANOVA was carried out on transformed egg count data, with fixed factors being sex (male, female) and age group (adult, juvenile). For the whole group and within each sex separately Pearson's correlations were performed between mean individual egg count and body weight, actual age and social dominance (males only).

## Results

There was considerable variation in the *Trichuris* burdens of the 12 individual monkeys (Table 1). Adults had significantly higher egg counts than juveniles ( $F [1, 11] = 56.97, p < 0.001$ ). There was no significant effect of sex but there was a significant interaction between age group and sex ( $F [1, 11] = 51.12, p = 0.001$ ) with the effect of age group being much more apparent in males. Beattie (adult female group B) was an obvious outlier with a mean *T. trichiura* burden five times that of the next highest female and almost twice that of the closest male (Table 1). When she was excluded males had significantly higher burdens than females and there was no significant age group effect in females. There was no significant correlation between mean egg count and colobus weight, or age for the whole group or females only. However, mean egg count did correlate significantly with age for males only ( $r[6] = 0.86, p < 0.05$ ) and with male dominance status ( $r[6] = 0.95, p < 0.001$ ).

## Discussion

One of the adult females had a *T. trichiura* burden almost twice that of the next highest (a male) and five times that of the next highest female. Due to the small population size it is not possible to tell whether it is abnormally high at the population level so whether it can be reasonably excluded as an outlier. Therefore, interpretation of the female results is difficult and this discussion will concentrate mainly on the results in males. Adult male colobus had a significantly greater *T. trichiura* burden than the juvenile males, contrary to previous research in humans that has shown that adults have lower *T. trichiura* burdens than children. This appears to be due to an age-dependent immune response (Bundy et al., 1991). This is not apparent in these colobus monkeys but may have been obscured due to the small sample size or because natural immunity patterns are altered due to some factor associated with captivity. In males there were very strong correlations between parasite burden and age and parasite burden and dominance status. Unfortunately age and dominance were themselves highly correlated in these groups as the oldest animals were also the most dominant so it is not clear what might be the important factor. However, among the females, which have an egalitarian society (Grunau and Kuester 2001) there was no dominance hierarchy and also no correlation between age and *T. trichiura* burden. This suggests that in males it may be dominance rather than age per se that influences parasite load.

Table 1: Mean egg counts for all individuals in the study (L= lactating, P= pregnant, A=anoestrus, 1 = most dominant, 6 = least dominant)

Group Name Mean *Trichuris*  
egg/ gram faeces

### Age in years

Age group Sex Dominance  
rank

A Erroll 5,777 20 Adult Male 1  
A Milo 4,225 5 Adult Male 2  
A Fraiser 2,674 6 Adult Male 3  
A Fergus 1,249 3.5 Juvenile Male 4  
A Lou 1,140 17 Adult Female (L&P) n/a  
A Deanna 942 8 Adult Female (A) n/a  
A Hope 870 1.5 Juvenile Male 5  
A Kabul 749 2.5 Juvenile Male 6  
B Beattie 10,945 11 Adult Female n/a  
B Scragg 2,027 3.5 Juvenile Female n/a  
B Lottie 1,688 3.5 Juvenile Female n/a  
B Diamond 1,154 9 Adult Female n/a

Other studies have indicated dominance as factor in promoting high parasite burdens in non-human. Most notably Hausfater and Watson (1976) found that dominant males and mid-ranking females were most heavily parasitised in olive baboons (*Papio cynocephalus anubis*). While Stuart et al. (in press) found that younger, more dominant male spider monkeys were most heavily parasitised. This relationship may be due to increased stress levels caused by maintaining dominance or higher testosterone levels in dominant animals. These hypotheses could be tested in future by investigating cortisol and testosterone levels in relation to parasite load this and other similar captive primate groups. Faecal samples have been saved from this study to do this and development of a cortisol assay is underway.

### Implications for monitoring and management

The anthelmintics Panacur and Oramec were both found to be effective in this species, however as with parasite load there was considerable individual variation in the length of time monkeys remained clear of *Trichuris* after worming. Traditionally, routine monitoring has been by means of a group sample (a well mixed sample of several unidentified faecal piles) and anthelmintics administered via group feeds. Variation in individual load and estimated intake of wormer seen in this study suggests that individual monitoring may be more appropriate. If the correlation between dominance and parasite load proves to be reliable individual monitoring could focus on certain monkeys likely to have the highest loads. This study also suggests that individual dosing of wormer may be advantageous. Since the study Group A have been trained to allow dental checks so it is possible to administer drugs individually. Further studies will investigate the relative effectiveness of individual and group dosing.

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## Research Snippets

### How Enriching Is Training?

*Wanda McCormick, Cardiff University and Paignton Zoo Environmental Park*

Over the last three decades environmental enrichment has become commonplace in many zoos to help overcome the inevitable limitations resulting from a captive environment. Enrichment often aims to reduce abnormal behaviour, encourage wild-type activity patterns and increase behavioural diversity. It has been suggested that training animals, as is routinely done in many zoos for husbandry purposes, might act as enrichment due to the mental stimulation and physical activity created. However, until now there has been no empirical investigation into the enriching effects of training. The aim of this study was to compare the effects of training and enrichment on the behaviour of captive elephants. The elephants (n=2) at Paignton Zoo Environmental Park were observed over 24hrs during six experimental conditions involving combinations of training and conventional enrichment provided in the morning or afternoon.

Each treatment was repeated on five occasions in random order. The activity budget and behavioural diversity of the elephants were calculated and compared across these conditions using two-way ANOVAs. Neither training nor enrichment significantly altered the elephants' activity budgets, with one exception; object manipulation by one elephant increased significantly with enrichment. However, enrichment but not training significantly increased both the elephants' behavioural diversity ( $F[3,29]=9.04$  and  $8.30$ ,  $p<0.01$  for both). Thus, based on these criteria, training of these elephants was not enriching

and, therefore, should not be assumed to be so in other individual and species. Training is can be extremely beneficial for many reasons but if the goal is environmental enrichment then training should not be implemented in isolation or at the expense of other forms of enrichment.

Further info: Dr Vicky Melfi, Paignton Zoo, Totnes Road, Paignton, Devon TQ4 7EU. Tel: 01803 697514, email: vicky.melfi@paigntonzoo.org.uk

### The influence of environmental enrichment on the welfare of captive felids (*Panthera tigris sumatrae*) at the Welsh Mountain Zoo, Colwyn Bay

*Jessica York, University of Wales, Aberystwyth*

This study on environmental enrichment to increase welfare of captive tigers concentrated on behavioural

stereotypies as an indicator of poor welfare, and evaluated the effectiveness of environmental enrichment devices to reduce stereotypic behaviour. The tigers were observed over eight separate days, four with enrichment and four without. The behaviour of both animals in the group was recorded at five minute intervals. Five different scents were used as for the enrichment: two being carnivore faeces, two herbivore faeces and one human perfume. Shannon diversity indices showed a significantly greater diversity of behaviour with enrichment for both of the tigers. The spread of participation index (SPI) was also used to determine whether the tigers spent more time in any one part of the enclosure. Both animals had more equal utilisation of the whole enclosure when the enrichment had been added (SPI = 0.3 for the male and 0.4 for the female). This study

appeared to show that stereotypical pacing of the tigers was reduced with the introduction of different scents into the enclosure. Assuming that the reduction of pacing is positively correlated with an increase in the welfare standards of the animals involved, and then further assuming that these two individual tigers are representative of the captive population as a whole, the results appear to indicate that the simple addition of scents into the enclosure will have a beneficial effect on captive tigers. Future studies would need to increase the sample size of captive tigers, in addition comparison of types of scents could be used to find if a preference exists and the technique could be trailed on other species.

Further info: Sarah Lawrence, Welsh Mountain Zoo, Colwyn Bay, Clwyd, LL26 5UY. Tel: 01492 532938, Email: wmzoo@hotmail.com

### **Olfactory enrichment for the black-footed cat, *Felis nigripes***

*Deborah Wells and Justin Egli, Queen's University Belfast*

The value of olfactory enrichment for captive-housed animals is now well recognised. Large cats have been shown to benefit from the introduction of odours to their captive environment, but to date the effect of odour introduction on the behaviour of small cats remains unknown. This study investigated the behaviour of six black-footed cats, *Felis nigripes*, housed at Belfast Zoological Gardens, in response to four odours (no odour [control], nutmeg, catnip, body odour of prey) introduced individually into the animals' pens for 4 hours every day over a period of 5 days. All of the experimental odours influenced the cats' behaviour, resulting in an increase in the amount of time that the animals spent in active behaviours (moving, grooming, exploring) and a decrease in the amount of time that the cats spent in sedentary behaviours (standing, sitting, resting). Nutmeg exerted less of an effect on the cats' behaviour than catnip or odour of prey. The cats' response to all of the experimental odours waned over the course of the 5 day observation period, suggesting that the animals habituated to the stimuli. Overall, the results highlight

the potential for odour to be employed as a method of environmental enrichment for small

captive-housed felids, if presented in an appropriate manner.

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### **The effects of feeding "enrichment" for captive dendrobatid frogs**

*Roisin Campbell-Palmer, University of Edinburgh*

Frogs are widely kept in captivity, both as part of professional institutions (display and research) and by the public for hobby interest purposes. Although the feeding of live prey ensures that hunting is provided for, space constraints and the presentation of food in a single source location are presumed to significantly reduce energy expenditure during feeding in captivity. This study aimed to determine whether enrichment feeding techniques influenced the behavioural repertoire displayed by captive dendrobatid frogs. The enrichment treatments consisted of: i. food hidden amongst leaf litter in the same locations as the feed dish (LFT) and ii. food scattered over the whole tank (MFT). Exhibition of social behaviour was strongly influenced by feed treatment ( $F[1,2] = 5.48$ ,  $p = 0.01$ ), with MFT having least recorded social interaction and LFT the most. There was no significant difference in the mean number of individuals displaying foraging behaviour between the two tanks and across all feed treatments ( $F[1,2] = 2.35$ ,  $p = 0.12$ ). Females were seen foraging more often than males ( $\chi^2 = 123.95$ ,  $p < 0.001$ ) on each feed presentation. Females also made significantly more prey captures than males ( $\chi^2 = 18.871$ ,  $p < 0.001$ ). Dendrobatids are active foragers and with a long life expectancy. In captivity an unchanging and unstimulating environment may result in poor welfare and decreased behavioural diversity. More demanding foraging could raise individual

welfare by reducing periods of excessive lethargy and also incidences of some nutritional disorders by reducing rapid feeding rates and prolonging foraging activity.

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### Using linear measurements and mass to assess incubation stage of eggs laid by captive greater flamingo, *Phoenicopterus ruber roseus*

*Nigel Jarrett, Vikki Mason, Lucy Wright and Veronique Levassor, The Wildfowl and Wetlands Trust, Slimbridge*

Each year at WWT Slimbridge, 80 pairs of greater flamingos (*Phoenicopterus ruber roseus*) compete intensely for nest sites. Nest competing pairs often displace eggs from nests. These eggs are usually replaced, within minutes, by usurping pairs. Invariably, replacement eggs are adopted by the original nest-tenants. Unless keepers witness such egg-replacement events, they often surmise an egg that is incubated beyond its normal 28-30 day incubation period to be non-viable.

Consequently, they sometimes remove and destroy viable eggs believing them to be beyond their hatch-by-date when instead, they are viable but at an earlier stage of development. As flamingo eggs have thick shells which make them difficult to candle in the field, the egg mass loss and the egg density loss techniques present practical options for determining their true incubation stage. Linear measurements and mass data were used to develop the mass loss and the density loss techniques to assess the incubation stage of greater flamingo eggs. The accuracy of each technique was tested on 20 parentally incubated eggs by comparing actual hatch date with predicted hatch date. For the mass loss technique a strong positive correlation existed between actual and predicted

fresh mass suggesting that model accuracy was high. For both techniques predicted hatch date was within two days of actual hatch date 80% of the time. We found these techniques to be useful for accurate incubation stage assessment of greater flamingo eggs and encourage others to develop and test these techniques for other species.

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### Social housing in Captive Chimpanzees (*Pan troglodytes*): The influence of Group Size and Complexity on Behaviour

*Matt McLennan, Oxford Brookes University*

While Chimpanzees in the wild live in very large multi-male, multi-female groups, in captivity in order to manage levels of aggression it has sometimes been thought necessary to keep small groups or even individual males. This study at Twycross and Chester Zoos compared the behaviour of males in small groups (three or less individuals) to males kept in very large groups. Overall activity levels did not differ between the categories, however, males in small groups spent less time in species-specific behaviours. The early rearing environment was also shown to be a factor in that hand-reared animals displayed increased levels of species inappropriate behaviour. Previous studies have highlighted important social relationships between particular males, as a significant feature of group cohesion in the wild, however, little evidence of such close affiliations was found in this study. Higher levels of aggression were detected in larger groups, but this was not linked to the number of oestrous females that were present. Although the optimum size and composition of groups in captivity has not been resolved, male chimps maintained in small groups (due to a reduced social complexity) may be restricted in their expression of species-specific

behaviours. This study recommends, wherever possible, that chimps be kept in large and complex social units. Suggestions for future work should involve comparisons of chimp group size and composition in several collections, thereby increasing the sample size, and where possible examine behaviours of chimps in several group sizes, over a longer period of time.

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## Can't stop, won't stop: is stereotypy a reliable animal welfare indicator?

*Georgia Mason and N R Latham, University of Oxford*

We estimate that stereotypies are currently displayed by over 85 million farm, laboratory and zoo animals

worldwide. We investigated their reliability as welfare indicators, by surveying studies relating stereotypy to other welfare measures and by analysing the mechanisms underlying this behaviour. Where data exist, most (approximately 68%) situations that cause or increase stereotypies also decrease welfare.

Stereotypy-eliciting situations are thus likely to be poor for welfare, although exceptions exist. Within such an environment, however, most (approximately 60%) accounts link individual stereotypy performance with improved welfare (cf approximately 20% linking it with reduced welfare). Thus, in a sub-optimal environment, nonstereotyping or low-stereotyping individuals could well have the poorest welfare, although again exceptions exist. Examining the mechanisms underlying stereotypy performance, we investigated four processes that could account for these complex links between stereotypy and welfare. Beneficial consequences from performing the specific source-behaviour of the stereotypy ('do-it-yourself enrichment'), or arising from repetition per se ('mantra effects'), may

ameliorate welfare in poor environments. In addition, stereotypies that have become centrally controlled (habit-like), or that arise from autistic-like changes in the control of all behaviour (perseveration), are likely to be unreliable indicators of current state because they can be elicited by, or persist in, circumstances that improve welfare. To refine the role of stereotypy in welfare assessment, we suggest the collection of specific additional data to reveal when any of these four processes is acting. Until such research increases our understanding, stereotypies should always be taken seriously as a warning sign of potential suffering, but never used as the sole index of welfare; nonstereotyping or low-stereotyping individuals should not be overlooked or assumed to be faring well; simple measures of frequency should not be used to compare stereotypies that differ in age, form, or the biological or experiential characteristics of the performing animal; enrichments that do not immediately reduce stereotypies should not be assumed failures with respect to welfare; and finally, stereotypies should not be reduced by means other than tackling their underlying motivations. Full paper in press in *Animal Welfare*.

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## Review

### Special issue: *Journal of Applied Animal Welfare Science* 6, 2003. Training nonhuman primates using positive reinforcement techniques.

*Mark J. Prescott and Hannah M. Buchanan-Smith (eds.).*

*Christine Caldwell, Paignton Zoo Environmental Park and School of Psychology, University of Exeter*

This special issue on the use of positive reinforcement training (PRT) with primates in zoos and laboratories follows a symposium on the same topic, organised by Mark Prescott and Hannah Buchanan-Smith at the 19th Congress of the International Primatological Society in Beijing. The collection includes papers written by those that participated in the symposium, as well as some additional contributions. Reading this special issue reinforced my general impression that those involved in PRT programs with captive animals are, almost without exception, unreservedly enthusiastic about its benefits, both to the animals being trained, and to the humans that work with them. So why do we not make greater use of such a potentially useful tool in zoos? There are a number of reasons, and fortunately, this special issue contains solutions which can help to address the

questions and fears of even the most apprehensive primate keeper. Firstly, it is difficult to know how to start a PRT program. Which behaviours should we train? And even if we have a good idea of what we would like our animal to do, how do we go about getting from square one (completely untrained) to a situation where we have our animal producing the desired behaviour as and when we request it? For some general tips on useful behaviours to train, Colahan and Breder's paper on primate training at Disney's Animal Kingdom is excellent: they detail the hierarchy of priorities they used to drive their training program. Animals were first trained to shift on and off exhibit. Then additional behaviours were added, such as stationing and separation. Laule, Bloomsmit and Shapiro's paper contains a no-nonsense guide on how to implement PRT, decoding much of the jargon, and providing useful practical advice on breaking down training into manageable progressions towards the final goal. Another concern tends to be whether the training program itself will end up being excessively time-consuming. However, in the paper by McKinley, Buchanan-Smith, Bassett and Morris, they

demonstrate that, even after a short period of training (between two and thirteen ten-minute sessions), both urine collection and weighing could be achieved significantly more quickly with trained marmosets, as compared with untrained subjects. Thus any initial time investment is likely to provide a rapid payoff in most training programs. All in all, this journal issue provides a wide variety of perspectives on nonhuman primate training, from authors from many different backgrounds. It will make extremely useful reading for anyone currently planning on

embarking on a PRT program with their primates.

### 5.3 Zoo Research News

#### Zoo Federation Research Newsletter Vol. 5 No. 3 Jul. 2004

#### News and Views from the Zoo Research Group

##### **Federation of Zoos 6th Annual Symposium on Zoo Research**

The 6th symposium was held at Edinburgh Zoo on the 8th and 9th July 2004 and included many excellent talks and posters from zoo and academic researchers, covering a wider range of species and topics than ever before. This year's workshop, led by Dr Sheila Pankhurst (Anglia Polytechnic University), was on behavioural profiling, how to do it and its possible uses in zoos. Behavioural profiling has been the source of some controversy lately and the discussion groups gave plenty of opportunity for lively debate! The workshop outcomes will be published as an issue in the Zoo Research Guidelines series and should provide interesting reading for researchers and animal managers alike. Symposium prizes for student/keeper presentations went to Stephanie Armstrong (Trinity College Dublin) for A Taste for Grass. (best talk) and Rhian Hughes (Paignton Zoo Environmental Park/Cardiff University) for Play in Juvenile

Baboons . Lessons for Life. (best poster). Congratulations to them and to all the oral and poster presenters. The standard of presentations at the annual symposium has been increasing rapidly each

year and this year certainly did not disappoint. Congratulations and thanks also to Rob Thomas and Charlotte Macdonald of Edinburgh Zoo for their excellent organisation of the symposium.

##### **Workshop on Statistics for Typical Zoo Datasets**

This workshop was held at Edinburgh Zoo on 7th July and attended by a mixture of zoo based researchers, academics with interests in zoo research and statistics advisors. The aim was to agree the most appropriate statistical tests for typical zoo research situations and provide solutions to commonly encountered statistical problems. The workshop went extremely well and we believe we have come up with good answers

for most of the difficulties and criticisms we meet in this field of research. The results will be written up as an issue of the Zoo Research Guidelines series, hopefully by the end of this year. Once produced we hope these guidelines will help to standardise the methods used and lead to greater consistency and higher quality analyses and interpretation, and ultimately more publications. Many thanks to all those who attended the day, especially the statistics advisors

Graeme Ruxton, Nick Colegrave and Juergen Engel.

### The Reporting Group

The Reporting Group consists of academics, zoo staff and others with an interest in zoo-based research. Its main aim is to forge links between researchers and zoos, in particular with the Taxon Advisory Groups, to better direct research towards the needs of zoos. Most Reporting Group members regularly attend the annual symposium and many have led workshops and written parts of the Zoo Research Guidelines series. The group communicates via an email list, if you would like to join please contact Olivia Walter (conservation.fedzoo@zsl.org) or Anna Feistner (atc.feistner@virgin.net)

### Zoo Research Group Resources

The following resources can be downloaded without charge from the Federation website ([www.zoofederation.org.uk](http://www.zoofederation.org.uk)):

Zoo Research Guidelines: Project Planning and Behavioural Observations. Wehnelt, S., Hosie, C., Plowman, A. and Feistner, A. 2003.

Zoo Research Guidelines: Monitoring Stress in Zoo Animals. Smith, T.E. 2004.

Research Sampling Guidelines for Zoos. 2002

*Available soon:*

*Zoo Research Guidelines: nutrition*

*Zoo Research Guidelines: visitor effects*

*Planned:*

*Zoo Research Guidelines: statistics*

*Zoo Research Guidelines: behavioural profiling*

The following resources are available from the Federation Office (there may be a small charge, please email [fedzoo@zsl.org](mailto:fedzoo@zsl.org)):

Abstracts of the 1st Annual Symposium on Zoo Research. Plowman, AB (ed.) 1999

Proceedings of the 2nd Annual Symposium on Zoo Research. Plowman, AB (ed.) 2000

Proceedings of the 3rd Annual Symposium on Zoo Research. Wehnelt, S and Hudson, C (eds.) 2001

Proceedings of the 4th Annual Symposium on Zoo Research. Dow, S (ed.) 2003

Proceedings of the 5th Annual Symposium on Zoo Research. Gilbert, T (ed.) 2003

A database of browse use in British and Irish Zoos and poisonous plants information (CD, 2001). Plowman, A.B. and Turner, I.

A Bibliography of References to Husbandry and Veterinary Guidelines for Animals in Zoological Collections. Macdonald, A.A. and Charlton, N. (eds.) 2000

## Feature Article: Crocodile environmental enrichment: as necessary as monkey puzzles!

Vicky Melfi, Paignton Zoo Environmental Park and Charlene Uwakaneme and Merry Rees, Drusillas Park

### Introduction

Reptiles are often overlooked in zoo research, especially when it comes to the study of animal welfare and the effect of housing and husbandry on behaviour. The captive care of crocodilians and the promotion of their welfare is commonly limited to the provision of an enclosure with the appropriate climate and feeding regime (Britton, 1995-2003). In part, this is probably due to a lack of research on wild reptiles and as such no yard stick by which to judge what our captive crocodilians

should or could be up to. The mental abilities of crocodilians is under- explored, despite them being used in training programmes in zoos and entertainment shows. in farms (personal communication VA Melfi). So why should we consider enriching crocodilians? We recognise that crocodilians spend long periods of their time basking, or lying in wait to attack their prey. Research has also demonstrated that

crocodilians show quite complex social behaviours, both in terms of nesting and raising young (Bustard, 1986) but it has also been suggested that they take part in cooperative hunting (Gans, 1989; King et al., 1998); a complex behaviour also noted in lions and chimpanzees (Estes, 1991). Captive crocodilians, kept for farming, are also known to display distinct food preferences, preferring live fish over live chicks or mince (Morpurgo et al., 1991).

It seems likely, from this research and our knowledge of other animals, that crocodilians take in a large amount of information from their environment. So what information is being provided for most zoo housed crocodilians and could we improve this through enrichment? The aim of this study was to address this question, by studying two African dwarf crocodiles at Drusillas Park. Given the natural history of crocodiles, we expected that if our enrichment was successful we would observe subtle behavioural changes, mainly through increased behavioural diversity. As crocodiles do not spend a great deal of their time in active behaviours, we did not expect or intend our enrichments to increase activity per se, but to provide the crocodiles with the opportunity to express a greater range of their naturally occurring behaviours.

## Methods

### *Subjects, husbandry and housing*

The behaviour of two (2.0) African dwarf crocodiles, *Osteolaemus tetraspis*, housed inside (24°C, at 70% humidity) were studied. The enclosure consisted of a heated (28°C) pool and beach area (comprising of stones and sand), both areas had some overhanging vegetation and there was uninterrupted public viewing along one side of the enclosure.

### Data collection and analyses

Behaviour of both crocodiles was noted using instantaneous scan sampling every 1min, for 10 mins, seven times a day. The time of each session was evenly balanced between 0800 and 1700 daily. The experimental design included four conditions; control (no enrichment), enrichment 1 (ice blocks), enrichment 2 (locusts) and enrichment 3 (cockroaches). The presentation of the enrichment occurred early in the morning (about 0900) and was randomised so each of the four conditions occurred randomly throughout the study period. Each condition was repeated six times (total of 24 days).

The crocodiles' behavioural diversity and activity budgets were calculated. Daily Shannon-Weiner diversity indices ( $H'$ ) were calculated for each crocodile [ $H' = -\sum (p_i \times \ln p_i)$ , where  $p_i$  is the mean frequency of observations for each behaviour]. Activity budgets were generated by calculating the mean daily time spent performing behaviour. One-way repeated measures randomisation trials were used to compare resting behaviour and the behavioural diversity indices across all four conditions (Todman & Dugard, 2001); two-tailed hypotheses were tested using a 4 condition x 2 subject design.

## Results

The crocodiles spent most of their day in one activity prior to enrichment (fig.1); one rested in water, while the other rested on land. With the provision of the enrichments the crocodiles spent significantly less time in these two behaviours ( $p < 0.001$ ) and their behavioural diversity also increased significantly ( $p < 0.001$ , noted on figure 1). The crocodiles' behavioural diversity more than doubled, when enrichment was present. The greatest increase in behavioural diversity expressed by the crocodiles was observed when ice blocks were provided; behavioural diversity indices rose from 0 and 0.24, for each crocodile during baseline, to 1.11 and 1.42 for each crocodile with ice blocks.

Figure 1. Mean ( $\pm$  SE) time spent performing behaviour by two crocodiles at Drusillas Park. Mean behavioural

diversity indices for each condition are noted.

0

1

2

3

4

5

6

7

8

9

10

1 2 1 2 1 2 1 2

Baseline Ice blocks Locusts Cockroach

Mean daily time spent (10 mins)

Rest (land) Rest (water) Rest (submerged)

Basking Move Move stones

Tail Pulsing Submerging Feed

## Discussion and conclusions

All the enrichments used were cheap, easy and successful in increasing the crocodiles' behavioural diversity. This increase was not just a result of resting elsewhere in the enclosure but the expression of additional behaviours, including basking, moving and feeding. The provision of ice blocks had a larger impact on the crocodiles' behaviour than the food enrichment and also resulted in a higher level of basking behaviour. This is not surprising, as Seebacher (1999) found that crocodiles change their body posture and behaviour to thermoregulate and by adding ice to the enclosure we had provided a homeostatic challenge for the captive crocodiles. As the crocodiles had access to a heat source, enabling them to bask, the promotion of this behaviour was considered stimulating.

The enrichments provided in this study increased the information available in the captive crocodiles' environment and stimulated the expression of a wider array of natural behaviours. This study illustrates how non-food enrichment can be a very effective way of introducing more complexity to the lives of captive animals and enable them to respond naturally to challenges in their environment. The food enrichments were also successful and highlight the need to vary the food (and potentially its presentation) provided for crocodilians; indeed at Paignton Zoo the Cuban crocodiles, *Crocodylus rhombifer*, and dwarf caimans, *Paleosuchus palpebrosus*, receive more than ten different types of food, including fish, chicks, meat and insects (personal communication Rod Keen, Senior Reptile Keeper). This study demonstrated that the behaviour of crocodiles can be successfully influenced by environmental enrichment.

This project was undertaken as part of the Zoo Research Services scheme operated by Paignton Zoo Environmental Park, Devon, UK.



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**0 0.24 1.11 1.42 0.89 0.79 0.85 0.94**

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## Research Snippets

### Self-injurious behaviour in zoo primates

*Geoff Hosey, Bolton Institute and Lindsay Skyner, University College Chester*

It has long been known that social isolation, particularly in infancy, can lead to the development of abnormal behaviours in some primates, and that this can include self-injurious behaviour (SIB), where the animal repeatedly injures parts of its own body. SIB can, however, also occur in non-isolate-reared primates and can be triggered by frustration or environmental events. SIB has mostly been reported from laboratory primates, and is usually associated with macaques. Whether it occurs in zoo primates, and if so to what extent, has not previously been systematically studied. A questionnaire-based survey of 42 British and Irish zoos was carried out (with support from the Zoo Federation) to find out the extent of SIB in zoo primates, and whether it was associated with any environmental or developmental events.

Responses to the questionnaire indicated that although SIB occurred across a range of primate species, its incidence was very low. Only two forms of SIB were reported, hair pulling

and self-biting, the latter being the most common. A variety of environmental events were identified by the respondents as implicated in initiating SIB, and although the data set was too small to confirm these statistically, several trends were discernable. It was concluded that SIB is not a major problem in zoo primates.

A paper on the results of this study is in preparation for publication at present. Further info: Dr Geoff Hosey, Psychology and Life Sciences, Bolton Institute, Deane Road, Bolton, BL3 5AB. Tel. 01204 903647. Email: [gh2@mail.bolton.ac.uk](mailto:gh2@mail.bolton.ac.uk)

### **A novel computer program to calculate spatial proximity in captive primates**

*Lindsay Skyner, Jason Roberts and Tessa Smith, University College Chester*

Measures of social proximity are an important tool for monitoring the type and intensity of social relationships in primates. Scientists can use a variety of methods when assessing spatial distances but the results of these methods may not concur. The current study was part of a larger research project assessing social dynamics in the lion-tailed macaque (*Macaca silenus*). The aims of our research were 1) to assess the utility of a novel program designed to compute social proximity and 2) to assess the effectiveness of the new program in comparison to a standard proximity assessment method. The novel computer program required data to be entered on the position of an individual in a 3-dimensional grid system. Pythagoras' theory was then used to calculate distances between individuals. The standard proximity method quantified the number of instantaneous sample points that animals were or were not within arms reach during focal animal observations. We found that the computer program successfully calculated proximity data, was cheap, flexible, easy to use and the data collection method allowed other questions to be answered, for example on enclosure use by the study animals. The two methods of proximity measurement provided a different picture on the spatial relations of individuals in the group. The results have implications for how proximity data is scored since the methods used seem to bias the results.

A paper on the results of this study has been submitted for publication. Further info: Lindsay Skyner, University College Chester, Department of Biological Sciences, Parkgate Road, Chester, CH1 4BJ. Tel: 01244 375444 (EXT 3007). Email: [l.skyner@chester.ac.uk](mailto:l.skyner@chester.ac.uk)

### **An enriching method to investigate colour discrimination in foraging behaviour of small primates**

*Jessica Bradford, Alaina Thomas and Phil Gee, University of Plymouth and Christine Caldwell, Paignton Zoo*

There is a large amount of scientific literature regarding the discrimination abilities of typical lab species, such as rhesus macaques, capuchin monkeys, pigeons, and rats. However, very little such research has been carried out on zoo species. In this study, a method of testing for discrimination learning in the zoo environment was investigated. A group of seven Goeldi's monkeys (*Callimico goeldii*) housed at Paignton Zoo Environmental Park were used as

test subjects. The apparatus used took the form of a foraging task, made up of 36 different boxes in which food could be hidden. The apparatus was designed in such a way that the front sections of each box could be removed and replaced with alternative sections of different colours. In this study, black and white discrimination was tested, using multiple presentations of the apparatus with the black and white boxes appearing at random locations on each occasion. White boxes were always rewarded (contained food) and black boxes unrewarded. The apparatus was used effectively by all the subjects, and over the course of the study it was clear that the black/white discrimination was being learned. It was concluded that the apparatus was an effective method of testing for discrimination learning in the zoo setting, and that further research could readily capitalise on the wide range of manipulations that the apparatus allowed.

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### **The importance of 24-hr observations for behaviour studies on zoo animals: the orang-utans at Chester Zoo as an example**

*Stephanie Wehnelt, Chester Zoo and David Williams, Liverpool University.*

Most studies that investigate the behaviour of zoo animals focus on daytime activities. This is due to restricted access to the premises outside zoo opening hours and problems with visibility of the animals caused by light levels and off-show night enclosures. Studies that focus on environmental manipulations or the short term effect of certain events that occur at daytime are not affected by this constraint. However, a narrow observation window can cause problems for some zoo research. It is often impossible to compare time budgets of zoo animals with those observed for the species in their natural habitat, since daylight hours of the two conditions vary greatly and the full daytime activities are usually not recorded in a zoo. Also, daytime events, such as novel enrichment, can have long-term effects, which usually stay undetected. Further, zoo animals are known to behave differently (e.g. greater enclosure use, increased socio-positive behaviours) in the absence of the public and keeping staff, which also remains undetected in the common zoo study.

As part of the ongoing welfare assessment of the orang-utans at Chester Zoo, infra-red CCTV equipment with time-lapse function is being used. A preliminary 5-day investigation of the five adult females revealed that all animals built nests and rested between 8.30pm and 06.45am, i.e. for the majority of the time when no keepers were present. The rest of this time is mainly taken up by feeding and social interactions (grooming and play). No stereotypical or other undesired behaviours occurred. Ongoing 24hr-studies will allow for a comprehensive assessment of the animals, activities and a valid comparison once the new orang-utan facilities are in use in 2006.

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### **The effect of visitors on captive non-human primates**

*Laurie Simpson, University of Stirling*

It has been suggested that visitors can be enriching, stressful or of no consequence to captive primates. Previous research has shown that high visitor density can have a detrimental affect on psychological well-being, and that small primates tend to be most affected by visitors. Camouflage nets can reduce negative visitor effects by increasing the frequency of species-typical behaviours and decreasing the frequency of abnormal behaviour. The aims of this study were three fold: 1. to investigate whether visitor density had any effect on the well-being of three primate species, stump-tailed macaques (*Macaca arctoides*), Goeldi.s monkeys (*Callimico goeldii*), and western lowland gorillas (*Gorilla gorilla gorilla*); 2. to investigate the effect of camouflage netting on observed behaviours of these three species; 3. to investigate the effect of visitors in a walk-through enclosure on red-ruffed lemurs (*Varecia variegata rubra*). In each case data were collected at Edinburgh Zoo using scan and all occurrence sampling over two conditions: baseline and camouflage net manipulation (for the three former species) and .visitors. and .no visitors. for the red-ruffed lemurs in the walk-through enclosure.

High visitor density was significantly positively correlated with increased aggression in the macaques ( $r = 0.31$ ,  $p < 0.05$ ) and foraging in the macaques ( $r = 0.31$ ,  $p < 0.05$ ) and Goeldi.s monkeys ( $r = 0.36$ ,  $p < 0.05$ ), and significantly negatively correlated with grooming in Goeldi.s monkeys ( $r = -0.30$ ,  $p < 0.05$ ). The behaviour of the gorillas was not significantly affected by high visitor density but all three species spent less time at the front of their enclosures (i.e. near to visitors) when visitor density was high. Camouflage netting resulted in a significant decrease in aggression in macaques ( $Z = -0.89$ ,  $N = 7$ ,  $p < 0.05$ ) and an increase in play ( $Z = -0.91$ ,  $N = 7$ ,  $p < 0.05$ ). The Goeldi.s monkeys were less active when the nets were in place ( $Z = -0.94$ ,  $N = 5$ ,  $p < 0.05$ ). The gorillas were unaffected by the nets. The lemurs were more active and utilised their walk-through enclosure more, spending more time nearer to the visitors. path when visitors could walk through their

enclosure than when it was closed to visitors, suggesting that they may find visitors enriching.

It is concluded that high visitor density had a negative impact on the stump-tailed macaques and the Goeldi's monkeys and that the camouflage nets were effective in reducing this impact in the stump-tailed macaques, whose enclosure has many viewing windows. Contrary to previous research in this area, the gorillas were unaffected by high visitor density. The study illustrates that the effects of visitors on zoo primates are likely to be influenced by many factors such as species, exhibit design and ability of the animals to choose to approach or avoid visitors.

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### **A peanut-shuttle feeder as enrichment for the elephants at Blackpool Zoo**

*Rebecca Whitefield, Myerscough College*

This study of the four female Asian elephants at Blackpool Zoo was designed to test the effectiveness of a feeding enrichment device designed for their indoor enclosure, an area that is often overlooked with regards to enrichment. Previous feeding enrichment for the elephants had focused on substituting usual feeding rations with other types of food, changing the feeding regime, or hiding food items within the enclosure. This enrichment, the peanut shuttle, was a novel feeding device designed to encourage feeding behaviours similar to those seen in wild elephants. The shuttle was threaded onto a high-tension cable across the width of the enclosure, above elephant height, thereby avoiding problems of destruction associated with ground or wall mounted enrichment for elephants. The shuttle was filled with peanuts, which were dispensed when it was manipulated by the elephants using their trunks. The aims of the enrichment were to: increase feeding and foraging behaviour, reduce inactivity and stereotypic

behaviour and increase social interactions between the four elephants. Three of the four elephants were known to occasionally exhibit stereotypic behaviours.

Scan sampling at 5 minute intervals for one hour on each observational day was used to record general behaviour, position within the enclosure and proximity to other elephants. The observation period (December 2002-April 2003) was split into pre-, during and post-enrichment phases and 10 hours of observation for each elephant was recorded in each phase. Behaviour was compared across phases using ANOVAs. Only one elephant, considered to be the matriarch, actually manipulated the shuttle, although all four elephants consumed the food items that were dispensed. Overall during the enrichment phase time spent feeding and foraging significantly increased, time spent inactive and performing stereotypic behaviours significantly decreased but there was no significant difference in social interaction between the three phases. The peanut shuttle can be considered a successful enrichment for these elephants and could be tested for captive elephants elsewhere.

### **The learning abilities of a Californian sea lion *Zalophus californianus***

*Louise Wagstaff, Bishop Burton College*

Training is an important part of animal husbandry in zoos to facilitate routine and veterinary procedures and possibly as a form of enrichment. Operant conditioning, a form of training involving positive reinforcement, can be used on a wide range of species and a well planned training routine can make procedures such as taking blood sampling or foot care quicker, easier and safer for staff. It can also reduce stress to the animal during these procedures. Although the learning abilities of many animals have been studied for many years little is still known about many marine mammals such as the Californian sea lion, particularly their vision and discriminative learning. This information could aid in the training of animals as vision plays an important part in learning and cognition.

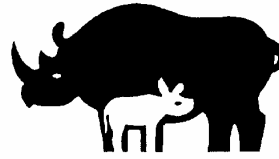
In this study the ability of a male Californian sea lion at Blackpool Zoo to discriminate between colours was assessed. The sea lion was conditioned, using positive reinforcement training, to touch a yellow target. He was then tested using yellow, blue, red and black targets, introducing one at a time

until all four were presented at once, always only being rewarded for touching the yellow target. The sea lion rapidly learned the command to touch the yellow target being successfully conditioned after the fifth attempt during the first week. During the testing week he was asked to select a target 15 times per day. By the end of the week he was scoring 93% correct responses (i.e. touching the yellow target). Assuming that this male is not atypical, these results demonstrate the rapid learning

ability of sea lions, that they respond well to positive reinforcement training and can discriminate between colours. This implies that different individuals could be trained to respond to specific coloured targets providing a simple means by which keepers could differentially manage individuals within a group.

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## 6 Congress Reports



### 6.1 Research in Zoos: A Conference at Poznan Zoo 27/28-5-2004

#### Research and Conservation – why behavioural biology and ecology matters

Behavioural biology is at an important interface between evolution and genetics on the one hand, ecology and adaptation on the other. Whenever something changes in an animal's or a population's external situation, behaviour is the first biological system to react.

But also, whenever some genetically influenced trait starts to interact with the outside, again it is often behaviour that mediates and modulates the reaction.

Some important areas where this can be demonstrated are

- ontogeny and socialization:  
The social situation an animal is reared in, but also the amount of control it can exert over its environment, tend to shape its personality. Whether it will become a gregarious or a solitary individual, what sort of stress response it will show and how it is going to explore novel situations, all depend to a large amount on its rearing situation (and often the mother's condition prenatally!).
- mate choice and reproductions.  
Again, the situation e.g. a male lives in, the quality of his territory, the amount of stress he had, the number of females he already controls, influence his attractiveness, and thus his future reproductive success.

But what about differences in behaviour between zoo and freeranging mammals? This has to be evaluated, but in many cases the basic traits remain the same. Differences between “good” and “bad” enclosures tend to be greater than between “good” enclosures and the field studies.

Data will be presented and reviewed from a variety of studies on rodents, carnivores, ungulates, rhinos and marsupials.

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#### Some studies concerning human-animal relationship in zoological garden

Recently increasingly more and more studies show the beneficial effect of pet animals on physical and psychical health in human beings. As it is known wild animals in zoological gardens and even in the wild (national parks) may have another specific effect on humans provoking them to some types of behaviour and reflections, for example it was observed the “social construction” of watched tropical rainforest apes expressed in ecotourists opinion. Moreover, zoo experiences indicate that visitors for some reasons prefer one animal species and practically ignore another. The effect of animals on man in zoo has also practical dimension as it enables to assess exposition enrichment.

Finally, interesting but poorly understood aspect of human –animal relation in zoo is the behaviour of children-the petting zoo visitors.

The author of present paper showed also the results of his introductory observations of visitors watching the chimpanzee exposition in Warsaw ZOO. The elements of verbal, non-verbal communication, the effect of sex and age were analysed. The effect of visitors age on their behaviour was ascertained and the classification of opinions concerning observed animals was prepared.

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### Selected problems of creating and enrichment environment of gorillas Gorilla gorilla living in captivity

The aim of this study is to identify the major problems of creating and enrichment environment of gorillas living in captivity, as well as to point out the best exhibitions.

The problems connected with the issue include the creation of new environment projects, bearing in mind the needs of particular animals, and simple methods of enrichment, which may be put to use by the keepers of the animals. Information from literature on the biology of gorillas (their natural environment, biotic dependencies, behaviour, stereotypical and pathological behaviour), as well as breeding animal data (breeding guidelines, behaviour measurement, environment enrichment, plans and descriptions of enclosures) have all served as a basis for identifying seventeen factors which influence the creation and the enrichment of gorillas' environment.

The factors were divided into four groups, according to their importance: A - social relations, B - social conditions, C -enclosure equipment, D - climatic conditions. The groups were assigned a k coefficient, which equalled the values of 10, 5, 2, and 1 respectively. Group A (k=10) includes: data about the group, maternal experience of the females/ "hand births", reproduction/contraception, stereotypical/pathological behaviour. Group B (k=5) includes: the size of the inner and outer enclosure, the possibility of alienation, the availability of rooms, arrangement/flexibility of the enclosure, the way of distributing food. Group C (k=2) includes: the enclosure's components/toys, the fence, the water, the vegetation, the ground of the enclosure/the relief. Group D (k=1) includes: the heating, the ventilation/airing, the lighting, the humidity, the position.

I visited eleven zoological gardens and analysed the collected material from the point of view of the identified factors, which were graded according to a ordinal scale from 0 to 3 and multiplied by the k coefficient. The resulting values of the particular factors and their interdependencies, have all determined which factors are the most important ones for the creation and enrichment of the environments intended for gorillas that live in captivity. Moreover, by means of summing up of the results I was able to select the best designed gorilla exhibitions, which are the ones in the zoological gardens of Cologne, Münster and Hanover.

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### Enriching the life of captive primates – case story

The research concerned behavioural enrichment of the life of captive primates. The subject of the research was a family group of red ruffed lemurs *Varecia variegata rubra* kept in Poznan ZOO. The

aim of this action was to present the difference in activity and behavioral patterns of lemurs being fed by use of different methods.

The methods were the traditional one and a new method that was supposed to enrich their environment in the outside paddock area.

The quantity, quality, and the food preparation method remained the same in both methods. The difference concerned only the way of presenting the food.

The change in the way of serving the food was aimed at stimulating the lemurs to become more active. The most important goal was to provide the animals with the conditions closely imitating their natural environment, which has considerably reduced drowsiness of lemurs and improved their physical condition. The additional positive aspect that emerged in the course of the research was the fact that the method made the animals more attractive for the visitors of the zoo, which made the paddock more inviting as it also increased its educational values.

The research provided a lot of valuable information confirming how important it is to enrich the life of animals in the paddock areas of zoological gardens.

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## The pattern of olfactory behaviour within the family Lemuridae in the Poznan ZOO

The importance of the olfactory behaviour in the suborder Prosimii has been well documented in a number of studies of the prosimians families such as Lemuridae, Galagidae, Lorisidae, Olfactory behaviour contains of continuous signals, which modify the behavior of the recipient of this olfactory message, while simultaneously delaying the answer – thus the sender avoids possible threats in direct confrontation. Olfactory clues, such as saliva, urine, faeces and the secretions of glands, seem a good source of information about the status of an individual, its sexual arousal and the size of its area.

In Poznan Zoological Garden I have observed three species of lemurs (*Eulemur rubriventer*, *Eulemur mongoz*, *Varecia variegata rubra*), which were exhibited as monogamous species. I formed categories of social behaviour; among the different categories I distinguished a category of olfactory behaviour. For all species, which were observed, I noticed sniffing, licking the ground and - typical of males – marking with the top of the head. The repertoire of olfactory behaviour was more complex in the family groups of *E.rubriventer* and *V.variegata rubra* than in the parental pairs of *E.mongoz*. Further, scent-marking with the anogenital region of another member of the family group, marking with the wrist by males and marking with the chin by females was characteristic for *E.rubriventer*. In the Red Bellied Lemur male's olfactory behaviour I have also observed "stink fighting", which was related to agonistic interactions. Black-and-Red Ruffed Lemur's male marked with the cheek and with the chest. Scent marking behaviour in this species were intensified during the period just before the birth of offspring. Lemur males of these three species often marked over the anogenital mark of an adult female. I think that the pattern of olfactory behaviour is closely related to reproductive conditions and sex-specific.

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## Behaviour of the Golden headed lion tamarin (*Leontopithecus chrysomelas*) at the Poznan ZOO

Golden headed lion tamarin belongs to the family Callitricidae. *Leontopithecus chrysomelas* lives in the Atlantic rainforests in family groups dominated by a one pair. Habitat destruction reduces this species to extinction. International programme of protection is only one hope for it to survive.

Winter 2002/2003 we observed the behaviour of two female tamarins at the Poznan ZOO. Total time of observation amounted 50 h and the method all occurrences of some behaviours was used. The aim of the study was to distinguish types of behaviour and compare them to the fragmentary data from the literature of this species (collected in the field and in captivity). We observed such category of behaviour: a) social: neutral and allogrooming, b) non-social: exploration, selfgrooming, marking, foraging and resting. In total 2397 behaviours (357 social and 2040 non-social) were noticed. The social behaviour the most frequently observed: the body-to body contact (N = 207) and allogrooming; the number and frequency of exploration (N = 409) and selfgrooming (N = 811) were significant. Often tamarins marked the enclosure by the rubbing of the anogenital region (N = 179). Both females distributed the secretions from this glands and urine on the branch area.

The differences between females were significant in number and type of behaviour: female "A" (N= 781) was less active than female "B" (N = 1259), what may suggest the dominance of "B" in the enclosure. Results were discussed in the light of other data.

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## Non-social and social behaviour of the Galago *Otolemur garnettii* at the Poznan ZOO

*Otolemur garnettii* belongs to the family Galagonidae. These prosimians are nocturnal and omnivorous, and distributed on the area of Eastern Africa.

From October 2002 to February 2004 at the Poznan ZOO, two males (2 and 4- years old) were being observed in the nocturnal house. The method all occurrences of some behaviours was used and total time of observations amounted 40 h. We distinguished 9 types of behaviour: social identification, allogrooming, playing, aggressive behaviour (social) and exploration, marking, selfgrooming, foraging and resting (non-social). In total 301 social and 334 non-social behaviors were noticed. Galagos performed the high level of locomotory activity and exploration prevailed over types of behaviour (n = 701); the least frequently marking was observed (n = 2). In social behaviours the most number was the social identification (n = 193) and the aggressive behaviour was very rare (n = 3). Results didn't differ from the earlier reported in the literature.

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## The behaviour of twins of the Pygmy slow loris under zoo conditions-preliminary observations

The Pygmy slow loris (*Nycticebus pygmaeus*, Bonhote 1907) belongs to the family Lorisidae. It is distributed in Cambodia, China, Laos, Thailand and Vietnam. Biological and ecological data of this species are fragmentary. Observation of behaviour of twins was conducted in 2001 and 2002 at the Poznan ZOO. The behavior was studied in a family group composed by parents and two juveniles (twins of different gender). The aim of this research was to distinguish and describe types of behaviour



of twins. "All occurrences of some behaviours" was used as a method and total time of preliminary observation amounted 31 h.

Types of behaviour:

- a) social behaviour: identification, allogrooming, playing, sexual, following and aggressive.
- b) non-social: exploration, selfgrooming, selfplaying, foraging and resting.

In total 719 social and 1002 non-social behaviours were observed. Identification ( $n = 542$ ) and allogrooming ( $n = 73$ ) prevailed over other social behaviours, aggressive behaviour was noticed only two times. Exploration ( $n = 658$ ) and selfgrooming ( $n = 170$ ) dominated in non-social behaviour (selfplaying was very rare-  $n = 5$ ). Studies are being continued.

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## Results of studies on wolf, *Canis lupus*, breeding in Experimental Station in Stobnica

The basic requirement for the change in the present attitude of man towards wolves, and the guaranty that legal wolf protection in Poland will be effectively realized is the formation of ecological awareness. It is assumed that it will be possible to form a pack of wolves for the needs of the first "Wolf park" in Poland being under development in Stobnica.

"Wolf Park" permits a close and sometimes even a direct contact with this rare and mysterious animal. Parallel with the scientific function, the "Wolf Park" gives the possibility of a wide education by means of lectures, participation in seminars and by other educational forms. "Wolf Park" permits to shoot films and take photographs of animals in conditions similar to the natural ones and prepare materials for didactic and scientific purposes referring to wolves. Studies on the breeding of wolves have been uninterruptedly continued since 1996 in the Department of Zoology Agricultural University in Poznań, Experimental Station in Stobnica localized in Notecka Virgin Forest.

In the years 1996-2004, our studies included 15 wolves (6 males and 9 females) in different age. Among all wolves living on the area of Stobnica Station, 4 individuals (1 male, 3 females) originate from Zoological Garden in Nowy Tomyśl and 1 wolf (male) came from Zoological Garden in Białystok. In our breeding, young wolves were born twice (2000, 2001) in a total number of 7 pups. From the number of 15 wolves living in the station, 3 died. Actually, there are 11 wolves in Stobnica (5 males and 6 females). The animals are kept in aviaries whose sizes are from 225 m<sup>2</sup> to 800 m<sup>2</sup> on a total area of 2500 m<sup>2</sup>. Within scientific and breeding cooperation, one wolf (female) was transferred to Zoological Garden in Cracow.

The wolves in the Experimental Station in Stobnica are under permanent veterinary physician Paweł Botko from Zoological Garden in Poznań.

Studies being carried out since 1996 refer to problems of wolf's ethology in breeding conditions. Scientific works developed in the Experimental Station include among others wolf's territorialism in breeding conditions, food digestibility, vocal activity of wolves in the annual cycle, comparison of the behaviours of wolves and dogs and the keeping of wolves in breeding conditions.

Actually, on the terrain of Stobnica Station, an enclosure of about 6500 m<sup>2</sup> is under construction which is designed for a socialized group of six-year old individuals (2 males and 4 females) born and bred in the Experimental Station in Stobnica.

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### **Social behaviour of the Asian small clawed otter *Amblonyx cinereus* in the Poznan ZOO**

The Asian small clawed otter is the social species living in groups up to 14 individuals led by the female  $\alpha$  with the male  $\alpha$ .

In the Poznan ZOO the social behaviour of this species was observed. Studies were being conducted during 4 months, from September to December 2002. Three adults were observed: female A, male K and male M. The standard method of observation was used (with 15 min. periods). Total time of observations: 72 h.

Vocalization, identification, social exploration, agonistic behaviour, marking, resting, social foraging, social defecation and playing were distinguished. The least frequently noticed behaviour were social defecation and playing. The high level of aggressive behaviour was recorded what is in contrast to earlier reports from captivity. The interindividual differences in behaviour was an evidence of the linear social hierarchy in this group: the  $\alpha$  pair composed by the female A and male K dominated on the subordinate male M and time spending together by the pair was significantly longer than in contacts with the male M.

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### **Studies on the reintroduction results of European bison (*Bison bonasus*) population in Wałcz forests (West Pomerania province) carried out in the years 1980-2004**

The population of bison, *Bison Bonasus*, actually living in the world originates from the individuals saved from extinction and bred in zoological gardens. On the basis of bison bred in a closed breeding, a free living herd was created in 1952 in the Virgin Forest of Białowieża. That herd gave the origin to wild living bison in West Pomerania.

After about six centuries of the absence of European bison in West Poland, on the 29<sup>th</sup> of February 1980, in Wałcz Forest Inspectorate, the first restitution of this species (4 bulls and 4 cows) was carried out in the region. The reintroduced bison originated from a free living herd in Białowieża Virgin Forest. The bison settled in West Pomerania are chronologically the youngest free living herd in Poland and they represent a wild population living in the farthest end of the European continent.

Observations of the behaviour of the reintroduced bison population have explicitly indicated that they are wild animals showing a significant degree of anthropophobia. The area settled by bison in West Poland province actually includes 10 500ha. The present number of the reintroduced bison population is estimated for about 18-20 individuals. The total increase of young animals during the past 24 years after reintroduction amounted to about 46 bison. In the studied population, a great number of animals was lost in result of poaching. A documented loss of bison during the past 24 years refers to 32 animals. The greatest uniform herd observed included about 16 individuals. That herd does not cause any major economic damages in the forest and fields. No negative action of the bison was reported in relation to the populations of deer, roe-deer or wild boar. Bison have been accepted by the local inhabitants as a natural element of the environment.

The bison from Wałcz Forests may initiate the creation of separate subpopulations distributed in adequate biotopes on the area of the whole West Pomerania and North Wielkopolska.

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### The influence of inbreeding into European bison survival

The inbreeding is inevitable to the European bison population and the level of genetic diversity is very low because of serious bottleneck. In the nineteen twenties two last natural populations were extirpated and only 54 animals survived in captivity. For them the European Bison Pedigree Book was established. Currently, the population of the species consists of 3100 individuals.

All European bisons are descendants of only twelve founders. Within species two genetic lines are distinct: Białowieża (B. b. bonasus) Lowland-Caucasian (the crossbreds of two subspecies B.b.bonasus and B.b.caucasicus). The gene pool of Lowland-Caucasian line contains genes of all 12 ancestors; the gene pool of Białowieża line contains genes of seven founders only.

The material was pedigree data of 7777 European bison born between 1946 and 2002. The inbreeding coefficient was calculated for every animal. In the study of relationship between the inbreeding level and the survival included maternal inbreeding and the effects of decade, sex and season.

The results of analysis showed the lack of inbreeding influence into calves survival for the Białowieża line. For Lowland-Caucasian line the influence was negative, high and significant. The addition into model the mother-inbreeding coefficient explained for the Lowland line that maternal inbreeding positively modified the negative inbreeding influence. On the ground of these results it could be shown that Lowland line of European bison, which not affected by inbreeding depression on calves survival, probably passed the period of „purging” the gene pool at the beginning of its restitution.

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### Are there existing mechanisms of population self-regulation in captive population of Central American Agouti (*Dasyprocta punctata*)?

The fundamental factors reducing the population in the wild are: availability of food resources and predation. Both factors are practically excluded under captive conditions. The goal of this paper is to analyze whether the fecundity of females depends on factors like size of the group and changes in group composition due to transfers and mortality.

1170 individuals (including 457 females) kept in 7 collections had been analyzed using Spearman Rank Correlation factor.

The results were not statistically significant what suggests that the regulation of numbers occurred only due to other factors.

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## The principles of organising exhibition areas in zoological gardens on the basis of the example of Asian elephants (*Elephas maximus*), or the co-operation between the landscape architect, the breeder animals, and the zoologist in the process of designing and modernising animal enclosures.

The aim of this study is to identify the principles of organising exhibition areas on the basis of the example of Asian elephant enclosures, as well as to point out the most important issues concerning the Cupertino between experts in the process of designing and modernising animal enclosures. The conclusion is a result of theoretical (chamber) and outdoor research.

The issues that were taken into account during the theoretical stage include: data about the animals (i.e. elephants), such as their natural environment, behaviour, stereotypical and pathological behaviour, reproduction, biotic interdependencies, and EEP breeding guidelines, as well as the principles of exhibition designing and already existing plans and descriptions of enclosures and their particular components. The information which was obtained during this stage was subsequently analysed. I defined eleven characteristics which influence the functioning and the organisation of elephant exhibition areas in zoological gardens. These include: position (or orientation), location of the enclosure, size of area, vegetation, water, relief, ground (its surface), light, position of particular exhibition components, shaping of visibility, behaviour of the animals.

I visited ten zoological gardens, where I evaluated the animal exhibitions on the basis of the eleven identified characteristics, which were arranged according to an ordinal scale from 0 to 3. On the basis of the graded characteristics' point values, I was able to observe mutual interdependencies which influence the organisation and the functioning of elephant enclosures (size of area and the behaviour of the animals). I was also able to determine that the presence of water improves the aesthetic qualities of the exhibition, by means of provoking many interesting ways of behaviour and by allowing to present a greater number of animals. Moreover, as a consequence of summing up the obtained results, I was able to select the best designed elephant exhibition, which are the ones in Emmen, Rotterdam and Wuppertal.

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## Is there a future for elephant breeding and keeping in zoos?

The paper analyses the development of elephant keeping in the current European zoo history. It pinpoints the problems in establishing self-sustaining population encountered, like unacceptably high neonate mortality, shortened longevity and accident rate.

Activities that should lead to alleviate the problems are presented on the basis of some new, revolutionary holding and breeding facilities.

It also presents the social, biological, veterinary and educational conditions that have to be taken into account when planning new elephant facility with a goal of establishing acceptable and viable at a long term conditions for breeding.

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### Kowari (*Dasycercus byrnei*) – a marsupial carnivore

The Kowari is a marsupial belonging to family Dasyuridae. It is a carnivore restricted in distribution to small, sparsely covered by vegetation desert area in Central Australia. In the 1994 it was considered Endangered and in the 1996 threatened by Australian sources.

First kowaris had been imported to Europe in the 1997 by University of Erlangen from Adelaide ZOO. Poznan ZOO imported first individuals from Erlangen in the 1986. Since then 150 youngsters had been recorded born in Poznan ZOO and over 100 individuals had been shipped to other holders.

During the last couple of years the number of kowaris kept in European collections shrunk significantly, perhaps due to too high inbreeding level. The only chance to keep this species in Europe long term would be importation of unrelated animals.

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### The history of keeping and breeding the Bawean Deer *Axis kuhlii* in Poznan ZOO.

The Bawean Deer (*Axis kuhlii*) is the most threatened deer species of the World. It is endemic to a small island north of Java called Bawean where it inhabits forests. First researches on the status of that species date back to the years 1976-78. The latest reliable population estimate dates back to the year 1986. The estimated population in late 80's numbers 200-400 individuals. Until recently that species, apart from Indonesian zoos like Surabaya (perhaps a few other as well) was kept in Singapore, San Diego and Poznan zoos. At present the only captive group outside of Indonesia lives in Poznan ZOO. First group of four individuals had been imported from Singapore ZOO in the 1988, further four (4.4) in the 1993 from Kebun Binatang (zoo) Surabaya and those animals founded the current group. During 16 years of continuous maintenance 26 calves had been born, but the rearing remains a problem. The current population, however stands at the all time high with 7 (2.5) individuals. Efforts are underway to form two breeding groups.

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### Alpine marmot (*Marmota marmota*) – proposal in situ and ex situ programme for Tatra population

The Alpine Marmot occupies Alps, Carpathians and Tatra Mountains of Europe. According to Nowak populations of this species are introduced in the Pyrenees (where it occurred naturally during the Pleistocene).

In Poland it occurs in one isolated population and it is endemic in the High Tatra Mountains, ascribed to a separate subspecies *Marmota marmota latirostris* Kratochvil 1961. Today the size of this populations for both sides – Polish and Slovak is areas estimated for nearly 800 specimens, but in Polish Tatra Mountains lives only 190-200 of marmots. In our region this species is strictly protected by law and is issued endangered species (EN category by Polish Red Data Book). Big influences for this situation have antropogenic factors including tourist pressure in Tatra National Park areas. The major past and present threat is poaching. Last confiscation of 50 marmot furs was recorded in February 1982 in Krzeptówki near Zakopane. Very attractive is also marmot fat – panaceum for many diseases; is an old tradition for local peoples. For this reasons in the early part of the 19<sup>th</sup> century it was on the verge of extinction. It has survived owing to legal protection initiated in 1868, probably by the first conservation act in Europe for fully protected species.

The Tatra marmots occupies grass-opean areas under 1.700 m high and lives in a small family colony composed usually of three animals. Density of Polish population is two times lesser than of Slovak marmots. Marmots have single mating season per year, which usually begins shortly after they emerge of winter hibernation. The young are born in a grass-lined nest from April to June. Reported litter size ranges from 1 to 6 average 2,4 in Alpine Marmot, which breeds every year. In Poland we can observe low fertility – 80% of our litters are composed of 1-2 young (max four). Acc. to Gąsienica-Byrcyn in Tatra National Park it was observed in 1982 45% young marmots off whole Polish populations (120 animals).

Polish zoos keep this species only sporadically; usually marmots originated from our native populations: three in 1924 – 1935 was transferred to Poznań ZOO and four in 1927 to Kraków ZOO. After the Second World War zoological gardens in Poland did not keep Tatra marmot any more, but in Czechoslovak zoos they have only single animals e.g. Bojnice.

Since 1960 few zoological gardens in Switz, Germany and Austria have been breeding regularly Alpine Marmots, some time in native mutations e.g. in Zurich it was born 43 young (1962-1994) and in Basel – 37 young (1974-1992) acc.to International Zoo Yearbooks.

We are looking also for future more optimistic breeding of endangered High Tatra marmots. A mixed population in the Lower Tatras (from Slovakia sides) has resulted in introduction of both subspecies. It is the last moment initiated by the author ex situ and in situ programme of this species in Poland with cooperation with Tatra National Park. We also need more genetic research concerning different data of speciation of isolated endemic Polish marmot populations. TNP created high mountain strictly protected district near Five Lakes Valley and Dry Water Valley and it will be transfer for all Tatra marmot nesting-burrows places, because of high tourist pressure areas in Kościeliska and Chochołowska Valleys.

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## Posters

### Types of social behaviour of the Striped possum (*Dactylopsila trivirgata*) under zoo conditions

Since 1995 the behaviour of 17 individuals of the Striped possum, keeping in groups of different composition, has been observed at the Poznań ZOO. Data from three pairs and one group with two females and two males were statistically analyzed (the chi-square, U- tests and the 95% intervals of confidence were used). Total time of observation: 190 h. We distinguished in social behaviour: threat postures, attack, defend, escape, avoidance, indirect and direct identification, sexual and vocalization. In 200/2001, 1068 social behaviours were observed in three pairs of possum (it was 12% of all recorded behaviours). In the group of 4 possums in 1998/1998- 369 social behaviours (38 %). Independent on the group composition, agonistic behaviour was the most frequent. Females tended to dominate males and limited access to food. Size of enclosure influenced on the frequency of different types of behaviour: in larger enclosures agonistic behaviour was rarer. Results have been discussed in the light of hypotheses about the evolution of marsupial social behaviour.

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## Gene pool of the population of Fennec Foxes (*Fennecus zerda*) in European zoos

The European Studbook for Fennec Fox was appointed by EAZA in 2001 and confided to Krakow ZOO. This smallest fox of the world has been exhibited in European zoos for about 150 years.

At the beginning this collection was based on animals donated by private owners keeping fennec foxes like pets. Now the number of the animals keeping in European zoos is around 100 and has been stable since 1995. About 40% fennecs living in European zoos in 1994 came from the wild. Due to decrease in the number of the animals captured in desert areas of North Africa and Middle – East and also due to the improvement of reproduction in captivity, in 2002 more than 80% of fennec foxes were zoo-origin. Unfortunately only 10 out of 31 pairs living now in European zoos breed regularly. As genetic diversity of fennec fox population living in European zoos seems to decrease, careful breeding management is required. For that reason, since 2003, the European Studbook for Fennec Fox has been conducted according to European Endangered Species Program (EEP).

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## Space use of a pair of the Bat-eared fox (*Otocyon megalotis*) under zoo conditions

*Otocyon megalotis* is a small carnivore belongs to the canid family. It is distributed in the field in two disjunctive populations, in the southern and eastern Africa. The range of this species is closely connected with the distribution of ant *Hodotermes mossambicus*- its main food resource. In the zoological gardens- rarely kept; in Poland we have the bat eared fox only in Poznan.

The aim of the study conducted from July 2003 to April 2004 was to describe the social and non-social behaviour and the patterns of space use of enclosure. The foxes the period from spring to autumn are living in the outdoor enclosure (132,5 m<sup>2</sup>) and in winter- in the indoor cage (14, 6 m<sup>2</sup>).

Exploration prevailed other types of behaviour. The space of enclosure was explored partly, with the different intensity. The sand part was preferred by foxes and on this area the female path was situated. The male used not the stable paths during exploration. In the grass part both individuals moved by the definite paths between branches and stones in the near of the resting and the feeding places.

Foxes marked the area enclosure and the most frequently the urination was noticed. The male and the female marked one time or several times each after other. Urination had different intensity: the highest in the sand part, and never was observed on the grass, bushes or on the other elements of enclosure. The marking by the secretion from anogenital region was noticed on the frontal part of enclosure and both individuals marked in this way. Defecation was observed sporadically on the area of and around the main path of exploration.

The characteristic areas of resting and social behaviour were recorded. The male explored more frequently the whole space of the enclosure than the female did.

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## Parental behaviour of the snow leopard (*Uncia uncia*) at the Poznan ZOO

The Snow leopard (*Uncia uncia*) is distributed in the Himalayan's region in central Asia. IUCN has classified this species as critically endangered. At the Poznan ZOO the behaviour of one pair (13 years old male and 12 years old female) and of its daughter was being observed from Mai 2003 to April 2004. Data was collected from 50 h of observation randomly chosen.



The parental investment was analyzed. The mother played with the child more frequently, females commonly foraged and explored the enclosure. The mother was in a stable vocal contact with the child, and the father wasn't. The father reacted rarer aggressive and the young female bit his tail as well as took away his food, cuddled together and rested in a close bodily contact. The father presented the threat postures seldom. In the field the paternal care has never been observed and the infanticide has occurred.

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### Interindividual differences in social behaviour of cheetah females (*Acinonyx jubatus*) under semi-natural conditions

Research has been conducted on the group of cheetah females (*Acinonyx jubatus*) at Cheetah Conservation Fund under seminatural conditions (6 ha enclosure) in Namibia in 2003. The group consisted of 6 adult females, two sisters and 4 unrelated females. The aim of this study was to determine differences and similarities in the cheetah social behaviour.

Types of social behaviours recorded during observations: social exploration, social resting, social grooming, social chasing and vocalization. There has been noted that observed cheetahs have created two groups, each consisting of:

- group A: Blondi, Dusty and Sandy
- group B: Solo and Nina
- satellite: Leia,

Female from group A during all the observation spent time together and was resting in southern part of facility. Members of group B were on the north part of facility. Leia appeared to be "satellite" cat and was seen alone pacing from one to another group, but she has never taken part in group movements or resting. Solo was the female the most frequently resting in a company with the others. The social grooming was characteristic for sisters. Vocalization was typical for behaviour of Dusty.

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### Non-social behaviour of the Asian small clawed otter (*Amblonyx cinereus*) under zoo conditions

The Asian small clawed otter is the smallest species in the world. It is distributed on the area of the south-east Asia and is keeping in zoos over the world. In spite of that this species is classified by IUCN as "insufficient known".

The goal of this study was to identify the non-social behaviour in the newly established otter group consisted of two adult males, one adult female and four juveniles. Observations were conducted at the Poznań ZOO in 2002.

In behaviour of adults, selfgrooming, marking and exploration were in the highest number. Juveniles the most frequently presented exploration, foraging and self-playing. Swimming was observed sporadically, what confirms earlier reports about the habitat preferences of this species. All the results were discussed and interpreted.

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### Breeding of European mink *Mustela lutreola* in Poznan ZOO

The European mink is the most threatened European carnivore. The only way to save it from total extinction appears to be captive breeding and reintroduction.

Poznan ZOO since 11 years is involved in breeding European mink. Twelve out of total 28 individuals bred in our zoo had been transferred to Tallin ZOO, the main institution involved in reintroduction of that species. The remaining animals supported breeding in other institutions within the framework of European Endangered Species Programme (EEP).

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### Thomson's gazelle *Gazella thomsonii* – management in Poznan ZOO

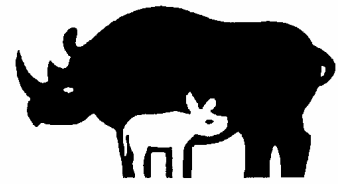
The Thomson's gazelle inhabits savannah of the Eastern Africa. In spite of reduction in available habitat it is still numerous in the wild, especially in national parks and reserves.

Unfortunately it remains a rarity in zoos. Due to activities of three zoos – Hannover, Arnhem and Poznan a new effort to establish a viable population in European zoos had been undertaken.

The species requires maintenance in a group and breeds in zoos with some difficulties. In our zoo the beginning of our efforts dates back to 1998 and 9 kids had been born since then.

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## 7 Abstracts of Student and similar Projects

### 7.1 Birds

#### Behaviour of juveniles of Humboldt penguins (*Spheniscus humboldti*) in captivity and the consequential impact on breeding couples.

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The continued existence of the Humboldt penguin (*Spheniscus humboldti*) is according to the criteria of the IUCN vulnerable. Although the Humboldt penguin is often kept in aquariums and zoos all over the world there are only a few studies about this species.

In wilderness the chicks of Humboldt penguins leave the breeding colonies without their parents and after spending approximately a year apart from the breeding ground they usually return for their first moult. However, penguins living in captivity stay in the colony for their whole life.

This study surveys if the presence of juveniles in the colony during the breeding season disturbs breeding pairs because in wilderness adults and juveniles never stay together in one group during breeding time. Further it is examined if there is a parent-offspring conflict between the juveniles and their parents.

Therefore this study investigates the behaviour of the juveniles in two zoos and examines the question whether they disturb the parental or other couples during the breeding season. This knowledge is important to avoid faults of keepings. Otherwise it could be necessary to separate the juveniles from the colony.

Places of investigation are the Zoo Landau and the Zoological Garden Schwerin having similar colony sizes and keeping conditions for Humboldt penguins. As the study is based on behaviour observation the used sampling methods are focal-animal and scanning. The size of spot check is four juveniles for each zoo and the scanning contains also four adults. In the centre of interest are the interactions between juveniles and adults.

The amount of interactions of the general behaviour is very low and not connected to age. Juveniles have more social contacts to non-breeding Humboldt penguins than to breeding penguins. There is more agonistic behaviour to breeding penguins because non-agonistic includes mainly behaviour between couples. The intensity of aggression has a very low level. All in all was the recorded behaviour more defensive than offensive. The results do not show any active disturbance to the breeding penguins; however due to personal views the existence of family bounding also during the breeding season can be presumed.

In summary, there is no reason to suppose that presence of juvenile Humboldt penguins during the time of reproduction give disadvantages to the breed.

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## Agonistic intra- and inter-specific interactions of two colonies of Waldrapp ibis (*Geronticus eremita*) housed in mixed-species exhibits at Chester Zoo

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*Rosalind Sedman-Smith (BSc) and Dr. Lottie Hosie, University College Chester, UK*

### Introduction

European zoos have set up a successful conservation breeding programme for the critically endangered Waldrapp ibis. Due to its sociable nature, colonies of this bird are often kept in mixed-species exhibits. Waldrapp ibises generally breed well in captivity, but their complex social structure is little understood. Results of this study, which focused on agonistic encounters, were used to develop welfare and husbandry recommendations.

Information on inter- and intra-specific interactions in mixed bird exhibits are very limited. The breeding success in such exhibits, however, depends to a high degree on the level of compatibility of the species involved. This study aims to contribute to the knowledge of inter-species relationships in the mixed aviaries at Chester Zoo.

### Methods

At the time of this study, Chester Zoo housed two breeding colonies of Waldrapp ibis separately in two mixed avian exhibits. The groups had an equal sex ratio, 16 individuals (Colony 1) were kept with 16 other bird species in the 'Europe on the Edge Aviary' (35,000m<sup>2</sup>) and 10 ibises (Colony 2) were kept with four other bird species in the 'Ape House Aviary' (8,000m<sup>3</sup>).

Using focal and all-occurrence sampling, a total of 40hrs of data were collected over a four week period in December 2001 and January 2002, focussing on agonistic inter- and intra-specific interactions. In addition to the behavioural data, initiator/receiver information as well as the site and species involved in interaction were also recorded.

Z-scores were calculated for the significance of behaviour sequences linked to agonistic interactions. For the comparison of two independent samples, the Mann-Whitney U test was used.

### Results

Overall, aggression levels were low in both aviaries and lay within the expected natural range. There were 35 intra-specific and 63 inter-specific agonistic encounters, mainly consisting of displacements and displays. Aggression involving physical contact was only observed twice during the entire observation time.

An event of intra-specific aggression was mainly followed by one of the ibises moving away without showing any signs of counter-aggression (74%) or with non-contact display (17%). Overt inter-specific aggression was very rare and occurred significantly less often than passive display or moving away.

Behaviours observed before and after aggression were mostly feeding and foraging. Other behaviours that led up to or followed aggression were significantly less frequent.

Some incidences of redirected aggression towards other species or objects were observed and occasionally pair-bond behaviour immediately after agonistic interactions occurred. Also, often the whole colony responded with increased vocalisations to an agonistic encounter between two individuals.

In the larger Colony 1, there were significantly more agonistic intra-specific as well as inter-specific interactions than in Colony 2.

With one exception, there were no agonistic encounters between ibises and any of the 10 Anseriformes species. Of the more terrestrial birds, aggressive interactions in Colony 1 were mostly (60%) observed with Little egrets (*Egretta garzetta*) and secondly (16%) with Griffon vultures (*Gyps fulvus*). Although

most aggression occurred at the feeding station on the ground near the reeds, encounters with egrets were also observed on the rock cliffs that hold the breeding caves. Agonistic interactions with the vultures and the other bird species occurred entirely at the feeding site. The Waldrapp ibises were displaced in all of the encounters with vultures or storks, also lost most of their encounters with egrets and lost half of their encounters with Eurasian spoonbills (*Platalea leucorodia*). The ibises won all their encounters with Rock doves (*Columba livia*) and Lapwings (*Vanellus vanellus*). In Colony 2, the ibises had occasional agonistic encounters with Black storks (*Ciconia nigra*), Red-billed choughs (*Pyrrhocorax pyrrhocorax*) and Golden pheasants (*Chrysolophus pictus*), none of which occurred on the cliffs but all on the ground at the feeding station. Apart from encounters with the Black storks, the ibises won all their encounters with the other species in this aviary.

## Discussion and Conclusions

Generally, Waldrapp ibises seem to avoid overt aggression against group members. The infrequent occurrence of attacks directed at group members suggests the existence of an intra-specific dominance hierarchy in both colonies, which is typical for the species. For details of this hierarchy, further research into individual dominance relationships is required. Redirecting frustration towards other targets than conspecifics can help in a group of animals with fixed social positions to prevent costly fights.

Aggression was closely linked to feeding. Therefore, food competition can be assumed to be the main cause for conflict within the colonies as well as between species.

It is possible that the higher levels of overall aggression in Colony 1 can be linked to a higher level of competition over food and perhaps over other resources such as nesting or resting places in this multi-species aviary. In addition, Colony 1 had more juveniles than Colony 2, which could have led to more intra-specific interruptions to the established hierarchy by juveniles challenging adults.

Due to total lack of inter-specific aggression, the Anseriformes species involved in this study can be suggested as birds well suited for mixed aviaries with Waldrapp ibises.

Since aggression mainly occurred at feeding stations, spreading the food bowls throughout the aviaries seems a necessary precaution to prevent aggression.

The Little egrets were the only species that showed a comparatively high level of aggression, whereas other species exhibited only mild aggression with no physical contact. Due to the high level of agonistic encounters at the feeding station near the reeds but also at roosting and resting sites, keeping Waldrapp ibises with Little egrets needs a well designed aviary and close monitoring. If kept together, food bowls should be placed away from the territories defended by egrets in the reeds.

Results suggest the existence of fixed inter-specific dominance systems in both aviaries.

Generally, the levels of severe aggression were very low and both aviaries can be used as an example of how to design multi-species bird exhibits. The zoo made slight adjustments to the husbandry of the species following the recommendations of this study, e.g. varying the position of the food bowls and spreading out the food (scatter feeds) away from the reed beds.

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## The Food Intake and Communication Behaviour of some Kinds of Birds at the Zoo in Schwerin

*By Eva Trappmann, Essen (contact via U. Gansloßer)*

For four weeks I observed different kinds of birds at the zoo in Schwerin. I studied in which way they behaved when they were eating and when they contacted other birds. The observations took place at a big pond at four different points. Sometimes I used the binoculars. The animals could see me the whole time.

### Greylag Geese

#### ***The Behaviour of Food Intake***

Observing these two geese, different kinds of eating behaviour could be seen. On land they used the top and the sides of their bill to pull out and bite off the young plants. Because of the projections along the borders of the bill they could also filter out minute food organisms from water and soft mud.

Looking for food alone, the goose went slowly forward, turning the head alternatively to the left and to the right side on land. In between it looked up to make sure that there was no danger. In the same way it happened in the water and "Food - Channel" where it got food which was pressed.

Most of the time the two geese were together (and did the same). Whatever they did, a definite distance could be seen between them, in the water it was the length of their bill and half of it on land. If a goose came too near to the other, it got a light stroke with the bill, and a stronger stroke when they struggled for the same plant. The "Food - Channel" was the exceptional case. Here they stood side by side and sometimes they defended that place together.

Sometimes they were accompanied by a White-Fronted Goose and from time to time also by a Bar-Headed Goose or two. As long as they kept a definite distance between them, always the length of their bill, one accepted the company of the other geese, otherwise it bit with its bill (on land and in water).

In contrast to little waterfowl like Northern Mallards, Greater Eider Ducks or Stiff-Tailed Ducks, the Greylag Geese didn't get frightened. When they wanted to be at the place where these birds were, they chased them away, sometimes with the help of their bill.

Birds of the same size were accepted by the Greylag Geese when they didn't come too near to them. In contrast to the geese went away when birds were coming which were bigger than they, like the Pelican.

An order of precedence could be observed in the "Food - Channel". When little waterfowl like Northern Mallards were in it and the Greylag Geese wanted to eat there, they came in and chased them out. Often one of them bit in a wing of the duck, tugged it a few seconds before the duck could flee. But when a Bar-Headed Goose was eating there, the Greylag Geese had not any chance to enter it. They had to wait till the Bar-Headed Goose left the "Food - Channel". A White-Fronted Goose was accepted by the Bar-Headed Goose, but not by the Greylag Geese.

There was one exception, seven White-Faced Whistling Ducks. They were smaller than the Greylag Geese, but they were a very good unity and had no respect for bigger waterfowl. When they were hungry, they went into the "Food - Channel". When it was occupied, they chased out the other waterfowl, the two Greylag Geese, too (l. White-Faced Whistling Ducks - Report).

#### ***Contact between the Greylag Geese and the other Waterbirds***

Most of the time the Greylag Geese were in contact with each other. During or after they had looked for something to eat, they extended their necks towards each other and called "wi" to welcome the other, whereby their unity got more strength.

When they went (picking) along the hedge, they called “wi-wi-wi” sometimes and thereby their necks were extended parallel from time to time. That kind of call could also be heard when they were eating in the water or when one of them left the other at the sleeping - place. Sometimes an other call “gack-gack” (like a hen) followed without extending the necks.

When they felt that they were in danger, their neck extended upwards very fast, a short, very loud and shrill call could be heard (like a trumpet) and they were looking around (alarm - call).

When a Greylag Goose chased away a strange waterfowl, it came back to the other with a call of triumph. The other joined in and both started to cackle.

When these geese were very restless, they wailed loudly.

Looking for something to eat in the water, sometimes you could hear a kind of quack.

When the two geese lost sight of each other, after a short time some very loud, shrill calls could be heard from both up to the moment when they were together again. The calls were longer than the alarm-call. You could also hear that call, when one goose didn't follow the other at once.

Every day the Greylag Geese were in contact with other kinds of birds. Depending on which situation these geese were in you could hear different kinds of calls.

When one of these waterfowl noticed something unusual, most of the time it was the White-Fronted Goose, it extended the neck upwards at once and you could hear the short, loud “alarm - call”. The other geese did the same. When they were a little bit excited, one of them began to trumpet and the other followed.

In other cases the two geese communicated with the other waterfowl in a very peaceful way, it sounded like the call of a hen: “Gack”.

Having a dispute both geese extended their necks in the direction of the other and they both were crying. At the end of the quarrel one of them fled or all the waterfowl were crying.

*To chase someway away:*

On the one hand the Greylag Geese chased away Mallards and Barnacle Geese when they were cleaning their plumage, but most of the time it happened when they were looking for food. On the other hand they were chased away by the Bar-Headed Geese and sometimes by the Pelican when they were going along the lakeside.

*Size of the Group:*

The two Greylag Geese were together with four Bar-Headed Geese, two Snow Geese, two Emperor Geese, five Barnacle Geese, one White-Fronted Goose and one swan. Most of them were together when they were cleaning their plumage, sleeping or swimming, only the number of Barnacle Geese and Emperor Geese changed. Looking for something to eat most of the time the two Greylag Geese were followed by a White-Fronted Goose, sometimes also by one or two Bar-Headed Geese.

## **The Grey Herons**

The Grey Herons didn't belong to the zoo animals, like the Northern Mallards. Every day they came to the lake in the zoo some minutes before the Pelicans got their food. Some of them settled down near the lake, the others on the trees. During the feeding time some of the Grey Herons flew into the water and tried to steal the food from the Pelicans.

Sometimes, when a Grey Heron had a fish in its bill, two other Grey Herons came to him at once and tried to take it away from him. But most of the time the first owner of the prey was the winner. It was more difficult fighting for a fish with a sea gull, because the gull was more aggressive than the birds of his own species. In that case the Grey Heron had to be very quick to get the prey.

Other Grey Herons waited up to the moment when the feeding was finished and the Pelicans were gone. Then they took the fish which the Pelicans hadn't eaten. If they were still hungry, they tried to catch fish. In that case they went slowly through the water. When they had seen something, they



stopped, aimed and snapped very quickly. On land they did it in the same way. In between every Grey Heron watched out for the other birds.

While bathing a Grey Heron always moved in slow motion. Here he observed the other waterbirds again and again. If one of them was too near to him, he stopped his bathing at once.

The cleaning of the plumage took place near the shore or on the tree afterwards. In contrast to ducks and geese it wouldn't take long by the Grey Herons. There wasn't any contact between them, they kept their distance to their species and other kind of birds. Often a Grey Heron chased away another of his species. If two Grey Herons met, they went away at once, each of them his on own way.

The Grey Herons were not afraid of other kinds of birds (with the exception of the Pelicans) and they didn't chase them away.

After cleaning their feathers the Grey Herons disappeared. Some of them flew to other places in the zoo, but most of them flew to places outside the zoo.

### **The Northern Mallards**

The Northern Mallards were represented in greatest number of all kinds of waterbirds in the zoo. To clean their plumage they went on land. Most of them did it together with Greater Eider Ducks, Red - crested Ducks, Caroliner Wood Ducks, Tufted Ducks, Smews, Red - breasted Merganser, Ruddy Shellducks and Common Shellducks. It was a peaceful atmosphere. The others preferred to clean their feathers near Greylag Geese and Bar - headed Geese, but not in the middle of that group otherwise these geese would chase them away.

After cleaning the plumage and sleeping, the Northern Mallards began to look for food in the water. Sometimes they visited the "Food - Channel". To come in they used different tactics. One of them entered the free "Food - Channel" very quickly and ate. Suddenly a Greylag Goose stood behind it. The duck didn't hesitate very long, jumped on the back of the goose, slipped down and ran away. The Greylag Goose was very surprised and stood there motionless.

An other Northern Mallard ran into the "Food - Channel" which was occupied at that moment, ate and left it very quickly so that the other birds in the channel couldn't see it.

A third one chased away a Red - crested Duck, a Carolina Wood Duck and several Northern Mallards in front of the "Food - Channel" before the duck entered it.

But most of them swam to the "Food - Channel" after the other kinds of birds had left it.

No kind of bird drove away so many of its own species as the Northern Mallards.

When a swarm of crow flew to an oak - tree near the ducks, they rushed into the water at once. A few minutes later a lot of acorns fell down and the Northern Mallards left the water and went to the oak - tree very carefully and ate the acorns. When the next swarm of crow came, the ducks flew back into the water and swam back and forth very excited. Every day at dusk one swarm of Northern Mallards after the other flew to a lake near the zoo.

### **The White-Faced Whistling Ducks**

The seven White-Faced Whistling Ducks attracted attention because of their plumage and their contact-calls. They have characteristic 3-syllabled whistle: "swee-swee-sweeu" falling slightly in pitch. There wasn't any community with other waterbirds.

They stayed together the whole time, were bursting with self-confidence and were not afraid of most of the birds.

After having food they swam to one of their sleeping-places and began to clean their feathers in the water, no matter which waterbirds were there. They stood side by side, keeping a distance of ca. 30 cm, only one of them two meters far away from the others and finished the cleaning on land behind them. When there were Pelicans, they preferred to go to another place, but when there were Northern Mallards or Tufted Ducks, they extended their necks, opened their bills and chased them away to

continue cleaning their feathers. In between they cleaned and stroked each others necks and heads, possibly they wanted to free the others from parasites or perhaps it strengthened their feelings that they belonged together. Then they began to sleep, at first they stood again side by side, later they sat on the ground, no distance between them and not in a row.

While cleaning the plumage and sleeping they accepted the presence of Common Shelducks, Red-breasted Geese, Northern Mallards, Ruddy Shelducks, Carolina Wood Ducks, Tufted Ducks and Red-breasted Mergansers. Sometimes the Northern Mallards even stood in the row with them.

After sleeping one of them went into the water, swam some meters and called the others which answered and came at once. One after the other they followed the first one to different places and began to stretch or they swam along the shore and picked plants. After that they visited the "Food - Channel". Five of them went into it and started to eat while the others stayed in front of it, one of them with the back to the "Food - Channel", they chased away all the other kinds of birds which wanted to enter it, the others which were inside did the same before. In between they changed their places so each of them got the opportunity to eat something. Then one White-Faced Whistling Duck left the "Food - Channel", shouted and the others answered and followed at once. Every time when they were swimming, each of them was shouting. If one White-Faced Whistling Duck was missing, one of the others swam back a little and waited for the last one, both were shouting and returned to the group.

Now only four, perhaps a fox was the culprit, their behaviour changed at once. Now they came to the "Food - Channel" very carefully and they didn't chase away waterbirds in front of it. If it was occupied, they waited until it was free and they all came in. None of them stood in front of it to scare off the other waterbirds. Then one White-Faced Whistling Duck left the channel and called. The others answered and followed with the exception of one which was still eating. When it realized that it was alone, the duck called the others, but they didn't answer and disappeared. The whole time it was calling and searching for the others. After one hour the ducks came back and they were together again.

When a Peafowl was in front of them, they stood one after the other at once and looked at him. The first duck opened the bill while extending the neck horizontally in the direction of the Peafowl. The neck of the second and third one was a little bit higher and the bill was not so wide open. The last duck extended the neck straight up, its bill was closed. Then they all went away in a peaceful way. When they were in danger, their call was an alarm note, a single: "sweee".

## 7.2 Mammals

### Feeding preferences of a colony of Seba's short-tailed bats (*Carollia perspicillata*) at Chester Zoo.

*Dr Stephanie Wehnelt, Research Officer, Chester Zoo, North of England Zoological Society, UK  
Penny Lowe (BSc), and Juliet Leadbeater, University College Chester, UK*

#### Introduction

To improve the protein intake, Chester Zoo recently introduced primate pellets (SDS) to the diet of a colony of Seba's short-tailed bats by mixing the pellets with chopped fruit and offering the mix in a bowl. This project investigates feeding behaviour of Seba's fruit bats with emphasis on food preference measuring time and frequency of feeding visits. Aim was to establish if and to what extent Seba's bats feed from the bowl with the pellet mix while other food was freely available. The study also investigated preferences for different food types and for ripeness of fruit (banana) and described feeding times.

#### Methods

Approximately 140 animals are held in the 'Twilight Zone', a large (60m<sup>2</sup> x 6-8m high) free flight exhibit that they share with 34 Rodrigues fruit bats (*Pteropus rodricensis*). Feeding times were

measured during the day, which equals 'night time' for the bats since the Twilight zone is on a reversed night/day cycle. As part of the daily husbandry routine, a variety of whole fruits and vegetables are scattered throughout the exhibit; they are fixed on spikes, branches and ropes. Preference was established by the frequency of visits to the food items within the first four hours after the food was presented.

Pearson's chi-square tests were carried out to test for significant differences between visit frequencies of the different food types. A two-way ANOVA was used to determine if the time of visit had an effect on visit frequencies.

## Results

The pellet-fruit mix was only occasionally visited (ca. 10 visits/hr compared to banana 150 visits/hr). Preference tests revealed that whole fruit is highly significantly preferred to chopped-up fruit (without the primate pellets). When the bats were given a choice between a fruit mix with and without primate pellets, there was a significant preference for the mix without the pellets. The bats showed a significant preference for banana, which was visited more frequently than all the other foods in total. The other food items were visited in the following order of preference (descending): grape, pear, pellet mix, melon, lettuce and orange, the latter being visited less than two visits/hr. Observations extending beyond the first four hours revealed that visit frequencies to all food items but banana increased. Preference tests for fruit ripeness showed that the Seba's bats have a highly significant preference for yellow (ripe) and brown (very ripe) bananas over green (unripe) bananas.

## Discussion and Conclusions

Following the results, at zoos we need to consider the bats' preferences when attempting to influence their dietary intake. The time of feeding in relation to other food items is important and a time delay might increase intake when feeding out important diet components such as primate pellets, which might not be the preferred food. Other factors such as food presentation (whole/chopped) and fruit ripeness need to be taken into consideration when designing the diet and feeding regime of a species. Energy rich food such as banana could be used as 'motivators' to e.g. stimulate flight but should be rationed and its time of presentation needs to be assessed carefully.

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## An investigation into the effects of olfactory enrichment on Colombian black spider monkeys (*Ateles geoffroyi robustus*)

*Eleanor Condon (BSc), Research Assistant, and Dr. Stephanie Wehnelt, Research Officer, Chester Zoo, North of England Zoological Society, UK*

*Claire Price (BSc) and Dr. Colleen Schaffner, University College, Chester, UK*

## Introduction

Olfactory enrichment has been used successfully mainly with carnivores but is rarely used with monkeys or great apes. Primates use olfactory signals to determine sex, age, reproductive condition and social status, therefore the introduction of different scents into their enclosure could provide a supplementary form of enrichment. Spider monkeys were considered a suitable species in which to study olfactory enrichment as wild Colombian black spider monkeys have been observed responding to citrus scented plants by rubbing the leaves on their bodies. The two aims of this project were, firstly to determine if olfactory enrichment elicited any new behaviours in the group of spider monkeys at Chester Zoo and secondly to determine if the presence of olfactory stimuli lead to an increase in the frequency of certain existing behaviours.

## Method

The study animals were eight spider monkeys, one 10yr and two 2yr old males and five females, all over 7yrs old. The spider monkeys receive regular non-olfactory enrichment as part of the normal husbandry routine and this was continued during the study. The odours used in the study were chosen to include two animal-based scents that were ecologically relevant and two that were plant-based. The ecologically relevant odours were the scents of a sympatric predator species, the Jaguar (*Panthera onca*) and a sympatric non-predator species, the Buffy-headed capuchin (*Cebus apella xanthosternos*). Lemon and eucalyptus extracts were chosen to be the plant-based odours. Each of the scents were soaked onto pieces of hessian sack and tied inside two wire balls hanging from the roof of the enclosure. Each time an odour was introduced the spider monkeys could not observe the keepers or where the odours were placed.

A pilot study was carried out using the Jaguar scent to ensure this did not cause undue stress to the monkeys. The odour was placed in the outside enclosure so that they could retreat inside if scared and no lingering smell remained after the rag had been removed.

Observations took place on days with olfactory enrichment over three consecutive one-hour periods: before the odour was introduced, while it was in the enclosure and after it had been removed. Within each hour a focal sample of each individual was taken for 5min and the behaviours recorded onto an ethogram every 15sec using instantaneous sampling. The monkeys were given each of the four odours twice.

A series of 3x3 within subjects analyses of variance were performed on the mean proportions of focal behaviours. Simple effects and interaction differences were tested using Cichetti's modification of Tukey's HSD.

## Results

No new behaviours were exhibited in response to the different odours. Olfactory investigation and running away from the stimulus occurred significantly more often while the scents were present. These behaviours were observed with the Jaguar scent and the plant odours, but not with the Capuchin scent. A manual investigation of the scented object was performed on all odours and was most frequent in the presence of the Jaguar and Capuchin scents. Manual investigation significantly increased when odours were present. A monkey investigated the Jaguar odour to the same extent when it was on its own compared to investigations together with a social partner. None of the monkeys investigated the capuchin odour in presence of a partner, always on their own.

Only the two youngsters played with the scented enrichment and this behaviour occurred in the presence of all the odours, but was most frequent with the Jaguar scent, the difference was not significant. Play did increase while the scents were presented and in the hour after the presentation phase, but this was not significant.

Resting and sleeping behaviour decreased when the odour was present but not significantly. Resting and sleeping was at its least frequent in the hour after the odours were removed. The frequency of resting and sleeping was highest during the Jaguar scent trials and lowest during the non-ecologically relevant odours, but the effect was not significant. Foraging behaviour increased significantly in response to the odours and in the hour after presentation. Foraging was at its highest in response to the plant odours and lowest in response to the Capuchin scent, the difference was significant. Feeding behaviour was observed significantly more often in the hour after the presentation phase compared to the other two phases. Locomotion increased significantly during the presentation of the odours and decreased in the hour after the presentation, but this could have also been due to animals reacting to the presence of the keepers. The type of odour did not appear to make a difference. The frequency of social body contacts (grooming, embracing) increased significantly in response to the odours. It was significantly higher during the presentation phase compared to before and after presenting this odour. The response to the Jaguar was significantly higher than the response to the others, Capuchin scent had the least effect.

## Discussion and Conclusions

The odours used in this investigation did not stimulate any new behaviours in the spider monkey group, however the introduction of olfactory enrichment was shown to increase overall activity levels and did increase the frequency of certain existing behaviours. The younger group members showed the most interest and directed investigative and play behaviour towards the scents.

If social contacts such as grooming and embraces, group investigations and running away from the odour are interpreted as the animals being in a state of elevated anxiety, it can be concluded that the capuchin odour did not raise the monkeys' anxiety levels. The Jaguar scent, however, slightly increased behaviours that could be interpreted as anxiety indicators. With the Jaguar odour, animals performed the highest levels of social contacts, high levels of olfactory investigations and some avoidance response in the presence of this odour. On the other hand, other behaviours such as play and resting behaviour did not support this finding. Therefore, the hypothesis of raised anxiety levels due to a predator scent needs further investigations. The Jaguar scent stimulated socio-positive behaviours including social play and predator odour could therefore also be considered as being a suitable olfactory stimulation for a healthy, stable group of spider monkeys.

Increased locomotion and foraging behaviour generally benefits the animals' physiological fitness and has the additional effect of increasing visitor enjoyment by showing active, natural behaving animals. However, it is unclear if the increased activity levels in this study were a result of the odours only or due to an increase in keeper activity when introducing and removing the odours. The animals might have expected to be fed when the keepers re-entered the exhibit. A control trial would need to be carried out in order to completely interpret the meaning of the behaviour changes observed.

We suggest that olfactory enrichment needs to be considered carefully, but can have beneficial behavioural effects and should be investigated further using different odours with spider monkeys but also with other primate species.

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## Behaviour and demographic aspects of Mandrills (*Mandrillus sphinx*) in zoos (Augsburg & Ueckermünde)

*Andrea Pruckner, Zool. Inst. Erlangen (contact via U. Gansloßer)*

This study is divided into three parts.

First I will concentrate on a behavioural study about group structure with a main focus on groups with subadult, castrated males and their status in the hierarchy. The observation takes place at Tierpark Ueckermünde and Zoo Augsburg. First of all it is important to figure out the hierarchy by social interactions and tasting as well as eating of available food.

With this knowledge it could be possible to demonstrate that a positive social behaviour is given from lower to higher individuals in the hierarchy as it is expected. Perhaps subadult castrated males are more often target of negative social behaviour than other group members and do not achieve positive social behaviour. Also it has to be investigated if successful breeding of juveniles has an influence in the status of the females in the hierarchy.

The second part is the study book analysis. The most significant point of view in this task is the high mortality of offspring, its possible reasons and its effects on the age pyramid. Another aspect is whether the mortality is different between primiparus and multiparus mothers or not and if there is a correlation to the age of the mothers.



The influence of inbreeding need to be tested, too -if possible-.

The last part is a comparison of the enclosures in the zoos mentioned above. Which contents the factors of construction and fittings as well as the feeding habits. Furthermore it will be surveyed if all parts of the enclosure are used equally.

### **The timebudget of captive Corsac Foxes (*Vulpes corsac*) sharing an enclosure with Asian Lions (*Panthera leo persica*) at Stralsund Zoo**

*Kristina Hähn, Univ. of Greifswald (contact via U. Gansloßer)*

Examples for multi-species enclosures, such as aquaria, aviaries and reptile houses can be found in the very beginning of animal keeping by man [1Hammer..]. However, steadily growing numbers of joint enclosures containing carnivores and species usually referred to as their competitors or prey a more recent development. Although they may result in an increased risk of interspecific disease spreading and hostile interactions, recent studies [2Kolzen ..., 3Weidel..] also show the opportunities of this approach to animal keeping. The visitors interest is kept longer by multi-species enclosures and thus a thorough insight into the natural habitat and lifestyle of a variety of animals can be achieved. An animal facing individuals of a different species is put under a certain amount of stress and is forced to react to the situation. If open aggression and total withdrawal into hiding can be avoided, this constellation may lead to a variety of behaviour usually not shown by single-kept animals. Monotonous daily schedules and stereotype behaviour caused by boredom, isolation and lack of motivation can make way for "Behavioural Enrichment" [Hamm., Kol..]. These considerations led to the start of a scientifically monitored

joint-enclosure project at Tierpark Stralsund (Germany), where in the autumn of 2002 constructions of a new enclosure for two Asian lions had just been completed. The main goal was to determine the impact the lions would have on another species by collecting data concerning timebudget, activity and enclosure acceptance of the latter. This species was to be the Corsac fox, following the assumption of some authors [...] that its natural distribution overlaps that of the Asian lion in India today. Observations were carried

out during daytime and after adding a vixen to the fox group also at nighttime. The methods used were focal animal sampling and scan sampling. The results were interpreted using non-parametrical statistics for dependent samples [Lehner]. The open area of the enclosure measuring approx. 1200 square metres was covered with natural vegetation and several planted shrubs. Near the front a long mound had been heaped up, providing a raised lookout and the possibility for the foxes to dig themselves burrows. This part of the enclosure became the permanent residence for three captive-bred male Corsac foxes on 14.11. 2002. A month later the lions were introduced to spend the opening hours of the zoo outside and the nights inside a separate house. While they remained on their own the Corsacs showed a wide range of behaviour, but no considerable digging activities could be observed. The animals spent the day resting or sleeping on the mound chiefly around noon, occasionally roaming the area, while observing their surroundings and

sniffing the ground and the fence repeatedly. After a first encounter with the lioness on 20.11. 2002 one fox was taken back to his old home due to obvious signs of nervousness. The remaining Corsacs seemed to cope well and continued their daily schedule in a similar way, slightly extending the periods spent resting behind cover or observing the lions. Occasionally a fox would start digging on the banks of the mound, though never for very long. Eleven days later a burrow had been completed, obviously big enough to provide shelter for both foxes. From that day on the foxes retreated into the burrow while lions were still in the enclosure and did not come out before 4 pm. Presumably the foxes had by then shifted their activity spatially (into the burrow) and/or temporally (towards the evening), but no accurate statements can be made, since there is no account of the activities inside the burrow. With



these changes in mind and the vixen being introduced to the enclosure on 31.1. 2003, additional nighttime observations started in

february. Although the statistic verifications revealed no significant changes in timebudget and activity, there are some obvious tendencies. Especially during evening (6-9:30 pm) and night (9:30 pm-1 am) the behaviour shown was more complex than usual. Social interactions were observed almost entirely

at these times. Periods of inactivity and enduring absence (in the burrow) decreased notably and the foxes were most active in the early morning hours. In general the foxes used the entire area within the enclosure preferring certain spots chiefly in the front. Evaluated significances are mainly due to preferences hanging with the time of day or night, respectively. Small sample numbers for every particular period (morning, forenoon, afternoon, evening, night) since february have to be kept in mind, though. An clear influence of the lions on the Corsacs cannot be denied, although it could not be clearly verified by statistics in the present study. Still, it becomes visible when comparing the 9.1. 2003 with any other day from december 2002 till february 2003, the only day on which the lions stayed entirely inside. On that day the Corsacs where seen outside frequently, even resting out of the burrow and showing the complex behaviour later only observed during nighttimes. It also seems reasonable to assume, that the presence of lions in the enclosures triggered or precipitated the lay out of a burrow by the foxes. In conclusion to the above the project is a success judging by the observed array of behaviour, that showed no clear signs of monotonous daily schedules. Social and locomotary play as observed by both species can be considered as evidence of animal welfare. However, the present situation does not yet meet the expectations of a well working joint enclosure. Direct interactions between the two species are practically non-existent apart from the first encounter, in which the lioness engaged herself in a fox chase for some 30 minutes. That could change in days to come with more foxes joining the group, as it is planned by the zoo manager. Ongoing studies are necessary here. To this date the burrow is the only safe retreat for the foxes. Added shelters, which are accessible to the Corsacs only and preferably offer an inside view for the visitors might improve the situation. This way guests to the zoo would be able to observe both species inhabiting the enclosure, whereas at the moment the presence of Corsacs inside the lion enclosure in Stralsund is not even known to some of the people, who come to the zoo. All in all the continuation of this joint enclosure seems promising and exciting, especially since it is still unique in Europe.

## Replacement and Occupational Therapy with Wolves and Bears at the Zoo Bischofswerda (Saxony)

*Anke Schlachter, Univ. of Oldenburg (contact via U. Gansloßer)*

As the zoo in Bischofswerda only has limited space, the enclosures of both the bears and the wolves, are also rather small. With a dimension of about 66m<sup>2</sup> at the bear enclosure and about 100 m<sup>2</sup> at the wolf enclosure it is necessary to offer adequate activity to the animals to avoid stereotypys. In the observation period from august 18<sup>th</sup> to october 1<sup>st</sup> 2003 the animals got observed, enrichments were introduced and completing examinations were taken.

As the enclosure of the wolves had been enlarged at the beginning of the year, it was not necessary to take up replacements again. Previous observations, using scan-methods, showed that both animals rarely frequented the new part of the enclosure. Under stressing conditions such as loud noise they didn't enter the compartement at all. If they got locked into the new compartement due to works in the old part, they almost instantly fell into stereotypys. To give relief it was suggested that the animals could be distracted by interesting smells, the stress could thus be reduced and the animals could easier be acclimated to the new area. Over several days, dung from the donkeys of the zoo was distributed at three different places into the sandy ground of the compartement. During the distribution the two

wolves showed modified attitudes, they were excited and stayed longer than usual in the new compartement.

Previous observations showed that the two bears mostly received their food at one or two places of their enclosure. Since bears in the wilderness use to spend much more time on searching for food than the animals in the zoo, it was suggested that the animals would keep themselves busier if their food was distributed all over the enclosure and if it would be more difficult for them to reach their food. This should be realized with two food dispensers for carrots and apple pieces which were hung over a trunk with a thick crotch. Furthermore the food was distributed and hidden as good as possible. In fact, the behaviour changed: the bears slept less than usual before, scented more than ever before and accepted the new trunk in an instant. It could be ascertained that the young animal (age of 20 months) was able to adapt faster to the new situation than the mother bear (age of 23 years). The new situation in the enclosure caused less stress for the young animal compared to the older one.

### Analysis of the combined keeping of the Syrian brown bears and Corsac foxes in the zoos of Heidelberg and Saarbrücken, Germany

by Christina Kolzenburg, Ringelnatzweg 3, 64658 Fürth/Odw., Germany

#### Abstract

When I visited the zoo of Heidelberg/Germany in the spring of 2002 to find a topic for the “young researchers competition” the Syrian brown bears and the Corsac foxes „crossed my way“ and because I thought that this combining of species was very interesting I decided to focus my research on this. I spent a total number of 53 hours to study and evaluate this unusual mixture of carnivores. I also analysed the keeping of the Corsac foxes in the zoo of Saarbrücken/Germany, because there the foxes are not kept together with bears.

To judge the keeping in Heidelberg I determined the duration of the foxes' stay in the outer enclosure in both zoos with the scan-method and compared them. In addition I recorded the different kinds of behaviour shown by the foxes in a specific time range in both zoos and compared them again.

The number of foxes is shown in the unit “foxunit (fu)”. This unit represents the number of foxes in the outer enclosure divided by the total number of foxes that are kept. The zoo of Heidelberg has seven foxes and the zoo of Saarbrücken has six. By using foxunit it is much easier to compare the data.

As material for my comparisons I used a series of data, which consisted of the number of foxes in the outer enclosure at a specific time and the certain behaviour the foxes show, again at a given time.

I evaluated the data series with the help of two statistic procedures.

I received the following results:

- The duration of the foxes' stay in the outer enclosure in the zoo of Heidelberg depends on the number of bears that are outside. The more bears there are in the outer enclosure, the fewer foxes can be observed. This shows that the foxes in the zoo of Heidelberg spend less time outside than the foxes in Saarbrücken do.
- The number of foxes which are in the outer enclosure during the day is significantly smaller than the number of foxes in the outer enclosure in Saarbrücken during the day.
- The foxes in Heidelberg show fewer varieties of behaviour in a certain time range than the foxes in Saarbrücken do in the same time range.

These results show clearly that the combined keeping of the Syrian brown bears and the Corsac foxes in the zoo of Heidelberg is a disadvantage for the foxes and definitely no enrichment. Consequently, the keeping of the Corsac foxes in Heidelberg needs to be improved to guarantee an appropriate keeping of this species.

Methods to improve the situation could be to create an enclosure of its own for the foxes or to give the four bears that are outside in the morning to another zoo, so that the foxes are only together with two bears. When there are only two bears outside, a lot more foxes can be observed than with four bears present.

## Observation study of Black Bears: Integration into a Bear Park

*A-level study ("Facharbeit") by Jessica Meißner at E.T.A.-Hoffmann-Gymnasium Bamberg, Bärenpark Worbis*

### Abstract

Because of transfers from substandard enclosures the integration of new bears into an existing bear park gets more and more necessary. On account of field studies<sup>2</sup>, you wonder if black bears (*Ursus americanus*) get along with brown bears (*Ursus arctos*) in a mixed species enclosure of about 40 000 m<sup>2</sup>. The behaviour of two black bears, who are brothers and had lived together in a circus before, was observed with scan and all occurrence samplings. The behaviour was measured while contact with the 10 brown bears, at feeding time and while in contact to each other (black bear-black bear). The two black bears regularly approached the brown bears in 13% of the observation and showed generally a high level of alertness. At feeding time they frequently kept a small distance to each other but often were not visible, 17% of the observation, or alone (38%). The black bears terminated contact to brown bears rarely. For 38% of the observation time the brothers were together and showed similar activities and kept a distance smaller than 10 m to one another in 26% of records. Thus, they were not anxious while having contact with brown bears and seemed to have integrated themselves well.

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## Behavioural Enrichment for Brown bears at Nürnberg Zoo and Wildpark Bad Mergentheim

*Julia Mäsichig, Univ. Würzburg (contact via U. Gansloßer)*

### Abstract

This Diploma work deals with the influence of a feeding enrichment measure on the behaviour of brown bears (*Ursus arctos*) in captivity. For this, the behaviour of five brown bears, three European brown bears (*Ursus arctoseuropaeus*) and two Syrian brown bears (*Ursus arctos syriacus*), in two different zoological gardens was observed. The three European brown bears Bert, Cindy and Elli were living in the game park Bad Mergentheim at the time of the data observation. The two Syrian brown bears Mammi and Sarah were living in an enclosure in the Nürnberg zoological garden. The data collection took place during the months of June to September 2003. There were two observation phases each day, one in the morning, the other in the afternoon. The observation phases depended on the times at which the bears were allowed into the outdoor enclosure or in Bad Mergentheim after the daily show-feeding for visitors as this was not to be included in the data collection. Massive oak trunks were offered to the brown bears as feeding enrichment. Each oak trunk had twelve holes in which various types of food (hazel nuts, dog food and raisins) were hidden. In order to avoid that the food fell out and to occupy the bears, the holes were closed with beech wood plugs. The filling of the trunks took place in the morning before the bears were allowed into the outside enclosure.

The aim of the survey was to ascertain whether the offering of a feeding enrichment-measure had an influence on the behaviour of the five bears such as changing time budgets or an enlarged behaviour repertoire. In particular it was checked whether the activity/passivity, the exploration behaviour and the amount of stereotyped behaviours of the bears changed due to the enrichment. Furthermore it was investigated whether the bears showed individual differences in their reaction and dealings with the enrichment measure.

The activity/passivity of the bears did not change significantly during the feeding enrichment. Three bears showed a trend to reduce passivity and thus an increased activity in the mornings. In the afternoons this trend could be observed with four bears. After the removal of the oak trunks, some of the bears continued to show a tendency to an increased activity as at the beginning of the data collection. However other bears were more passive after the enrichment measure than before. No uniform and significant increase in the quantity of active behaviour was observed.

Three of the observed bears showed significant increases in their exploration behaviour during the enrichment in the observation phase in the mornings. On the whole, an increase with four bears could be observed in the morning. The data collection in the afternoons also showed an increase in the percentage part of the exploration behaviour of four bears, however without any significant change. The quantity of explorative behaviour could be increased through the enrichment for the majority of the bears.

The amount of time spend with stereotyped behaviours of the bears were not significantly reduced through the enrichment. The stereotyped behaviours of the three Bad Mergentheim brown bears varied during the whole of the data collection without a direct connection with the enrichment being revealed. The stereotyped behaviours of the bears in Bad Mergentheim seemed rather to be influenced by the implemented food management there. The two Nürnberg bears hardly stereotyped during the whole time of the data collection, therefore also no reduction of stereotypy during the enrichment could be observed.

The quality of the exploration behaviour of all bears was changed through the feeding enrichment. Each of the five brown bears showed new behaviours during the enrichment which could be attributed to the functional circle of the exploration and searching for food.

No individual differences could be ascertained during the removal of the wooden plugs from the holes in order to reach the food in so much that all the bears removed the plugs by pulling strongly on them with their teeth. However, Bert, one of the Bad Mergentheim brown bears acted considerably more skilful than his two companions Cindy and Elli. The skill of Mammi and Sarah, the two Nürnberg brown bears, was comparable with Bert's skill.

Four of the bears (Bert, Cindy, Elli and Mammi) occupied themselves to equal parts with the oak trunks. Sarah, the fifth bear, occupied herself less than the other bears with the enrichment in the mornings but in the afternoons more than all other bears. Personal observation suggests that the reason for this was the dominance of Mammi over Sarah who did not allow Sarah on to the trunks in the mornings.

No individual preferences for certain types of food could be ascertained.

Presumably the opening of the holes with food took place by chance as there was no connection with the contents of the holes.

## **Diet selection, feeding and foraging behaviour of Eurasian otters (*Lutra lutra* L.) in the Zoo Nuremberg**

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Aim of this study is to test and observe diet selection, feeding and foraging behaviour of two Eurasian otters (*Lutra lutra* L.) under controlled conditions in the Zoo Nuremberg to deduce possible proximate and ultimate reasons for behaviour of free-ranging otters.

For the selection tests dead animals were used which were presented to the otters in a twofold simultaneous test. Feeding behaviour was examined with dead fish, foraging behaviour with living fish and crayfish.

Both otters preferred large fish of trout, carp, perch and tench. In nature small sizes are often taken what can point out that otters would favour large fish (larger energy amount) there also, but this is often influenced by numerous factors (e.g. fish availability and behaviour). Smaller fish was taken frequently of pike. That can indicate a dependency of fish species in size selection.

The male gave preference to trout before pike before carp before tench, the female carp before trout before pike before tench. This reflects the variability of diet choice of otters in nature.

Both otters started feeding at the head of the fish, the feeding pattern showed a fish species and fish size dependence that also was observed in leaving rests of a fish meal.

Otters chose mackerel before chicks before mice before prawns before snails before crayfish. That means a selection of the shortest handling times and the highest energy amount.

Feeding places were next to water which provided a perfect control of the environment and secured a fast flight into water in the case of danger.

Otters are searching actively for prey. Hunting success is influenced by fish behaviour. Fish determines the flight direction when it is chased by an otter. Highest hunting success was counted in deep water.

The otters were able to minimize the danger of injury from crayfish chelae by optimizing a special capture method.

## Fully feathered turkey carcasses as enrichment for Felids at Chester Zoo

*Dr. Stephanie Wehnelt, Research Officer, Chester Zoo, North of England Zoological Society, UK*

*Anne Roth (MSc, MRCVS), University of London, UK*

### Introduction

From a visitor's perspective, 'big cats' are amongst the most popular animals at a zoo and therefore offer multiple opportunities for visitor education and appreciation. From a conservation perspective, many felid species are of high importance, and most large collections hold at least one species of big cats. However, the display value of big cats is often reduced as this taxonomic group seems to be prone to develop repetitive, stereotyped locomotion patterns in captivity and is often inactive when on public view.

In their natural habitat, wild cats spend a large proportion of their time with feeding related behaviours; investigating their environment, searching for prey, stalking, hunting, killing it, processing and consuming the carcass. Since zoos are also responsible for the welfare of food species, feeding live vertebrates is not permitted in British legislation. Therefore, felids are mainly fed meat that is already processed by humans, often presented at set times that are predictable for the cats. As a result, a large part of feeding related appetitive behaviours are not performed. However, there is evidence that felids are strongly motivated to perform such behaviours and depriving them of these behavioural opportunities may result in abnormal behaviour (e.g. stereotypic pacing, grass plucking, extreme inactivity).

Environmental enrichment is an animal husbandry principle that seeks to improve the quality of captive animal care by identifying and providing environmental stimuli that have a positive effect on

physiology, psychology and behaviour. Feeding enrichment can be a powerful tool to counteract those constraints that the captive environment imposes on wild cats. At zoos, enrichment has proven to be successful in influencing behavioural time budgets positively, stimulate the cognitive abilities and decrease undesired behaviours. There is some evidence that elements of hunting behaviour are stimulated by feeding whole animal carcasses, joints of meat “on the bone”, multiple small feedings, and distributing, presenting, and hiding the food in appropriate ways. However, these techniques are still not sufficiently evaluated scientifically for big cats in zoos.

At the time of this study, Chester Zoo held the following felids:

Asiatic lions (2.1)	<i>Panthera leo persica</i>
Amur tigers (1.1)	<i>Panthera tigris altaica</i>
Jaguars (2.2)	<i>Panthera onca</i>
Servals (1.1)	<i>Felis serval</i>

The cats receive a complex environmental enrichment programme, including scatter feeds, scent trails, hiding food under log piles, in trees and the pond, essential oil and herbs as olfactory stimuli, melons whole or filled with frozen fish pieces, meat in hessian sacks, meat pieces fixed to enclosure structures, and more.

The enrichment investigated in this study consists of providing the cats with ungutted, fully feathered turkeys. The aim of this enrichment is to stimulate the animals to carry out elements of their natural behaviour that are not shown with conventional feeding methods and to increase the frequencies of behaviours that are perceived as being positive from a welfare and public education point of view. Particular behaviours that the turkey feed aims to encourage are exploring, foraging and manipulating food. In addition, the carcasses are hoped to lead to extensive self-cleaning behaviour after feeding encouraged by carcass size and its feathers.

## Methods

Although the cats had previously been fed whole carcasses in form of chickens, the study was conducted when the turkey carcasses had just been introduced as a new enrichment. Turkey carcasses were acquired in sizes that suit each felid species but that are always significantly larger than normal meals (2-3 kg for Servals, 5-6 kg for Jaguars, 10-12 kg for lions and tigers). All the turkeys used to be free-range animals, suitable for human consumption. The birds used are usually surplus animals (e.g. old or ex-breeding) and the cost is £4 per bird. The turkeys replaced the usual daily food portion and were hidden in the enclosures, thrown over the fence or dragged around to create a scent trail before being hidden. The turkey feeds were programmed in with the usual enrichment and husbandry programme for the cats.

The main study period ran from 16<sup>th</sup> June to 27<sup>th</sup> July 2002, during which three turkey feeds were carried out. Instantaneous sampling at 30sec intervals over a 20min focal period were used for behavioural time budget estimates. Four observation periods per animal were taken to cover each hour of the day evenly over 36 observation days. Observation times started approx. at 6am and finished at approx. 9pm.

Non-parametric tests were used to test for statistical significance, Wilcoxon Signed Rank Test for two dependent samples and the Friedman two-way analysis of variance test (ANOVA) for more than two variables.

## Results

On days when fully feathered turkeys were fed in place of normal meals the cats spent significantly more time performing ‘desirable’, active behaviours, including: licking food, carrying carcass, feather-plucking, Flehmen, sniffing, self-grooming, object scratching, urine-spraying and vocalising. Time spent feeding increased nearly fourfold on days when turkeys were fed. The cats spent significantly less time with ‘undesirable’ behaviours such as pacing and being inactive.



There were no significant differences in locomotory behaviour and the category 'out of sight' when all the cats were included. Compared to the other cats at Chester Zoo, the Servals are known to spend a larger amount of time inside their den, which is not on public show. If data from these two animals are excluded from analysis the amount of time all other individuals spent out of public view showed a significant decrease on turkey days.

Feather plucking was observed in all four species and the different feather plucking techniques that have been previously described for New World and Old World felids could be confirmed.

For the three repetitions of feeding turkeys, habituation was not found to take place.

## Discussion and Conclusions

Whole carcass feeds are viewed by some zoos as being controversial since the sight of whole dead animals may distress the occasional visitor. However, the obvious welfare benefits strongly suggest that this feeding method should be included in the general husbandry regime in zoos.

Feeding whole turkey carcasses led to a significant change in behaviour of the cats by increasing behaviours that are generally regarded as being indicators of well-being. Also new behaviours such as feather plucking and Flehmen were stimulated by this feeding method, which utilises the cats' behavioural repertoire to a fuller extent. The cats seemed to 'enjoy' feather plucking and performed this behaviour extensively, not necessarily in connection with meat consumption. Some carried feathers into their sleeping quarters. Only on enrichment days some cats showed the full "stalk-rush-kill" sequence and occasionally 'cached' the carcass. It can also be assumed that bone crunching may improve dental health.

Habituation to new items is often a problem in long-term enrichment programmes for zoo carnivores. There was no difference in behavioural response on the three turkey feed days, habituation is therefore not to be expected when using turkey carcasses once or twice a month. Further studies are necessary to establish how quickly animals get habituated to a given enrichment and to decide on the frequency of applying it.

In addition to improved animal welfare, the turkey feeds also serve other core aims of a modern zoo. Showing active and natural behaving animals adds to visitor enjoyment and clearly contributes to conservation education.

As a result of this study, fully feathered, whole turkeys are fed once per month to all the cats at Chester Zoo as part of the normal feeding regime.

In order to communicate the findings to other zoos, the authors are currently working on a larger publication containing more detailed information about the benefits of feeding whole carcasses to zoo felids.

In November 2002, The Federation of Zoological Gardens of Great Britain and Ireland awarded Chester Zoo with an award in recognition of "Significant Advances in Husbandry and Welfare" for the turkey feed enrichment project.

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## Management practices and their effect on the behaviour of Asian elephants (*Elephas maximus*) at Chester Zoo, measured over 24hr time periods

*Dr. Stephanie Wehnelt, Research Officer, Chester Zoo, North of England Zoological Society, UK*

*Emma Worsley (BSc) and Dr. Colleen Schaffner, University College Chester, UK*

### Introduction

The management strategies for Asian elephants are highly varied within the zoo community. Also, within the same zoo, husbandry regimes may vary on a daily basis depending on many external factors such as weather, social variations in the group, training plan, health care etc. Elephants are one of the most charismatic species at a zoo. However, their value in conservation education and visitor enjoyment can be reduced by the tendency of these animals to stereotype and to be over inactive, both of which have also been discussed in their function as welfare indicators. In their effort to continually improve elephant welfare, zoos are currently discussing the effect of different husbandry regimes on elephant welfare due to restricted breeding success and behavioural problems found in the zoo population. This study is the first of a series of investigations that aim to elucidate how variations in certain husbandry procedures at Chester Zoo can affect elephant behaviour. Observations were carried out during the day as well as at night in order to establish a reliable picture of the elephants' 24hr behaviour.

### Methods

At the time of this project, Chester Zoo housed 10 Asian elephants, including five adult females and one 3yr old female that were the focus of the study. The males, a 10yr old bull, a 6yr old male and two infants, were only considered when interacting with the females. Due to the presence of newborn youngsters, the elephants did not have access to the large sand island, but to a 228m<sup>2</sup> outside pen. The breeding bull and the adolescent male are kept in separate pens to the females at night. When not in musth, the breeding bull is kept together with the rest of the herd during the day. The elephants are chained in the morning while they receive necessary foot and skin care. Feeds are carried out throughout the day ranging from little treats during the morning routine over scatter feeds to a main feed late afternoon. Environmental enrichment consisted of the provision of branches, small logs and scatter feeds.

During the day, behaviour was recorded by direct observations carrying out scan sampling every 15min. In addition to the behaviour, the following factors were also noted: time on chains, presence of keepers, presence of bull, duration and nature of environmental enrichment activities, access to outside pen. From the time the keepers left until the morning when the keepers returned, an infrared camera was used to film the behaviour of the elephants with a time-lapse VCR. The data was analysed by noting down the behaviour shown by each elephant every 15min.

Two-factor repeated measures analysis of variances (ANOVAs) were used to examine the effect of the independent variables on behaviour. Interactions were tested for significance by investigating the simple effects using Cichetti's correction for Tukey's HSD. The relationship between time spent on chains and stereotypic behaviour was tested using linear regression analysis.

### Results

#### **Enrichment (none versus less than 1hr)**

There was a strong trend, but no statistical significance (n.s.) that the presence of enrichment for more than 1hr a day decreased stereotyping during the day (from 16% to 12%). Enrichment significantly reduced stereotyping at night (from 15% to 7%). Enrichment significantly increased the time spent with feeding and foraging. The enrichment used did not increase investigative behaviour. The presence of enrichment decreased the time spent resting during the day (n.s.) compared to when no enrichment was present. However, enrichment increased the time spent resting at night.

### ***Access to outside vs. no access***

Elephants foraged and fed significantly less during the day when not allowed outside. Elephants stereotyped slightly more when having access to the restricted outside area compared to the inside area only (n.s.). They tended to rest less when having access to the outside (n.s.). Access to the outside pen did not effect night-time behaviour.

### ***Day-time versus night-time behaviour***

Overall, the amount of time spent stereotyping did not differ significantly between night and day.

Generally, the elephants were active for large parts of the night, but this varied greatly between the individuals. Resting time at night ranged from just over 1hr to 8hrs, the latter being unusually long for elephants.

At night, the matriarch lied down only after all the others had lied down, with the exception of one cow, which never lies down.

### ***Bull present versus absent***

The cows tended to show less stereotyping in the presence of the bull (n.s.). In presence of Chang, the cows spent significantly less time with foraging and feeding and slightly less time with resting (n.s.) during the day. At night-time, however, the cows rested for a larger proportion of time when the bull had been present during the day (n.s.).

Social interactions increased significantly when the bull was present.

### ***Effects of chaining***

The varying lengths of time that the elephants spent on chains did not significantly influence stereotypic behaviour.

## **Conclusions and recommendations**

The presence of environmental enrichment for more than 1hr and the presence of a bull seem to have a positive effect on the cows, reducing stereotyping and increasing activity. Therefore, husbandry routines should aim at providing enrichment throughout the day. Also, mixing the bull with the group should be aimed at as often as possible.

The only enrichment used during the study were food based, stationary devices that were quickly discovered and depleted by the animals. Enrichment that increases active searching behaviour needs to be developed. In addition, enrichment devices that allow feeding and foraging at night would be beneficial to meet nocturnal activity patterns.

Indoor foraging should be made available for days when access to outside areas can not be given. Reasons why the elephants of this study stereotyped more outside than indoors need to be investigated and measures that counteract this need to be found. At the time of this study, only a restricted outside area was available, which could have triggered stereotyping.

Longer chaining did not result in more stereotyping. However, the maximum difference in chaining time during this study was only 20min. To learn more about the effect that chaining time has on the animals, this factor has to be varied to a greater extent.

This project was the first in a series of investigations on how variations in husbandry procedures effect elephants. Chester Zoo is currently awaiting the results of a project comparing stress hormone levels under different husbandry conditions. In order to understand how different elephant husbandry and management strategies influence behaviour and breeding of this species, more detailed experimental investigations are required and cross-collection comparisons are necessary.

Overall, the results of this study support Chester Zoo's management strategy of providing enrichment throughout the day and mixing the bull with the group as often as possible. Additional enrichment

activities for day and night time are currently looked into. The elephants regained access to the entire outdoor paddock shortly after this study was completed.

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### **Environmental Enrichment by bringing in occupational food at the Malayan tapirs (*Tapirus indicus*) of Nuremberg Tiergarten**

*Susanne Zenzinger, Zool. Inst. I Erlangen (contact via U. Gansloßer)*

Until now, tapirs have largely been left out of consideration regarding specific enrichment programmes. Presently, there are far less studies of this topic about the Asian Malayan tapir (*Tapirus indicus*) than about his American relative, the Lowland tapir (*Tapirus terrestris*). Therefore, it was the aim of this study to examine the consequences of environmental enrichment on the feeding and resting behaviour of Malayan tapirs. Furthermore, the enrichment objects used were to be examined concerning their suitability as occupational food. For this purpose, three successive experiments were carried out with the Malayan tapir group (1.2) of Nuremberg Tiergarten within an observation period lasting from July 1<sup>st</sup> to October 2<sup>nd</sup> 2002. These consisted of hanging up food branches and stuffed jute sacks as well as bringing in spiked hay-bales. The observations exclusively took place at the outdoor enclosure. The observed individuals were father, mother and calf.

The results point to a preference for the food branches followed by the hay-bales and finally the jute sacks, with the jute sacks being hardly taken by the male tapir at all. By bringing in hay-bales, the calf's overall duration of ingestion could be prolonged. The results show a tendency according to which the calf spent more time with food-orientated behaviour than its father and finally its mother. For the male animal, exploratory behaviour was stimulated by bringing in the jute sacks. For the females, such behaviour was observed after bringing in the hay-bales. Inactivity could not be reduced with any of the animals. For the female animal, there was a tendency to rest longer than the calf followed by the male. For the latter, an increased attentiveness towards its surroundings was observed during the hay-bales experiment. An outlasting effect could be observed for the male tapir at the food branches lying on the floor.

The observed changes in the behaviour of the animals probably cannot be exclusively put down to enrichment by the respective occupational object. Above all, climatic variations could have had a considerable influence on the results. Furthermore, it has to be assumed that the calf had an enriching effect on its parents. Therefore, at the end of the study, suggestions for further studies about Malayan tapirs are made.

### **Studies on the social structure of the white rhinoceros (*Ceratotherium simum simum*) in the safaripark Beekse Bergen**

*Stephanie Vespermann, Beekse Bergen (contact via U. Gansloßer)*

This study takes a look at the social structure of the white rhinoceros (*Ceratotherium simum simum*) in the safaripark Beekse Bergen. It deals mainly with the behaviour of the female rhinos among each other and their reaction towards the bull. Furthermore, the behaviour of the dam and her reaction towards the remaining members of the herd were examined. The observations took place in May 2001, in which the animals were observed for altogether 120 hours.

First of all an actogram was created with the point-in-time-method. The different activities (“eating”, “standing”, “lying”, “locomotion”, “grooming”) were recorded by taking a sample every five minutes from 10 a.m. until 4 p.m.. The scan method was used for testing the behaviour of the females among each other. For this reason a two-minute-scan was recorded for each animal, in which the seven cows were observed in a rotating change. The scan was carried out for fourteen days, four hours a day: from 11 a.m. until 12 a.m. and from 1 p.m. until 4 p.m.. The all-occurrences-method was used to record all types of behaviour and contacts of the bull or the dam.

The actogram indicates that the females invest nearly twice as much time in “eating” than the male (females: 70,2 %; male: 37,5 %). But focusing on activities like “locomotion” (females: 13,1 %; male: 41,7 %) and “standing” (females: 9,5 %; male: 20,85 %) the male features values, which are twice as high than those of the females.

The results of the scans show that five of seven females can be assigned to different subgroups, a dyad and a triad. The remaining two cows aren’t permanently integrated in one of these groups, but change in between them.

The females show clear differences in their behaviour towards the bull: While the older cows rather avoid or have agonistic interactions with the bull, the younger females often search contact with the male. Vice versa the bull also prefers the presence of the younger females.

The dam and her calf spend most of the time alone with each other. When the dam contacts other females, then the older cows and her daughters are preferred.

The bull is accepted well by the females. However the alliance-/cooperation behaviour of the cows negatively affects propagation. The success of breeding could be possibly be increased by a change of the group composition.

## The Effect of changes in food presentation on behaviour of Reindeer (*Rangifer tarandus*) in Nürnberg Zoo

*Stephanie Otte, Univ. of Heidelberg (contact via U. Gansloßer)*

The aim of this work was to study the effects of changed feeding conditions on the behaviour of reindeers (*Rangifer tarandus* Linné, 1758).

Therefore, in a group of 13, respectively 11 reindeers in the zoo of Nuremberg in two different experimental steps, first the distribution of food was altered by putting up additional troughs, and secondly the quality was improved by a supplementary feeding of the lichen *Cladonia rangiferina*. Moreover, the animals were also observed under their usual standard conditions before, between and after these two experimental situations.

According to HOFMANN (1989), this species is an intermediate feeder, which feeds on a mixed diet that changes seasonally. The social organization is regulated by a hierarchy. Hence, I thought, that varying the distribution of food would have no effects either on social relationships and aggressive behaviour or on the individual distances between the animals. On the other hand, the frequency of movements was thought to rise in this situation.

An improvement of food quality should increase activities and rates of social behaviour in general.

Indeed, social relationships and aggressive behaviour did not alter in frequency when food distribution was varied. However, the animals fled more often during the second standard condition. Presumably, this was caused by the dominant buck’s antler loss at this time.

The individual distances really differed between the phases, but the amount of movements did not. Such results were not expected. Possibly, they were caused by the way the food was distributed and

by the way the animals behaved immediately after a feeding. With regard to the distances, the antler loss could have played an additional role.

While the lichen was given, at least in the morning, the animals were most active. The general social behaviour also tended to be most frequent by this time. „Calm“ activities (chewing the cud and resting) tendentiously increased in the last standard condition. The lichen's taste and a sudden rise in temperature were seen as potential reasons for this.

## Behaviour of Takin at Nürnberg Zoo

*Linda Müller (contact via U. Gansloßer)*

From the 5<sup>th</sup> may to the 30<sup>th</sup> of november 2002 the takin-group of the zoo in Nuremberg were watched by a student of the Wolfgang-Borchert-Gymnasium Langenzenn for a thesis.

This animal group consists of seven animals, two of them are males, five are females.

At first five hypotheses were stated:

5. Within the takin-group of the zoo in Nuremberg there are relations of dominance, with are characterized by an asymmetric distribution of social-positive and –negative interactions.
6. These relations of dominance can be ordered to a linear hierarchie, in which Lisa dominates above all other female group-members.
7. The young cattle Lea dominates also over many group-members, which means that it receives more social-positive than social-negative interactions of the others.
8. The dams show less social-negative than –positive interaktions facing their young cattles than facing the others.
9. The animals which dominate over many members approach frequently to Lea than the others.

Afterwards the student made an ethogramm and an actogramm by using the instantaneous-and-scan-sampling method, so that she can see in which part of the day the observation is senseble. To evaluate the hypotheses there were also made a sociogramm which was also used for Landau's index for linearity.

The first hypothese can be verified, because the index of Landau results 1, which means that the dominance is linear. The second hypothese is true, too. Lisa dominates over all the other group-members. The next question, if the young cattle dominates also over many group-members isn't right. Lea has a very low rank. She receives many social-negative interactions except from her mother.

The last two hypotheses can also be verified.



## Developmental stability and welfare assessment of the Indian Blackbuck (*Antilope cervicapra*)

*Dr. Joanna Lawton, University Of Huddersfield*

*Dr. Lottie Hosie, University College Chester, UK*

*Dr. Stephanie Wehnelt, Chester Zoo, North of England Zoological Society, UK*

### Introduction

The concept that an animal regulates its internal state to reduce costs and improve efficiency has been noted within the field of animal welfare. The effects of stress and excessive expenditure due to sub-optimal conditions may be noted by investigating the regulatory abilities of animals, often known as developmental stability. Male Indian blackbucks of different social status were used to assess the use of developmental stability as an indicator of environmental suitability. Observation of male blackbuck under different environmental conditions allowed the investigation of individual abilities to cope with the zoo environment and comparing it to evolutionary designed performance criteria. An animal's ability to cope is considered to be its ability to maintain normal regulation of bodily and mental stability and may be regarded in terms of the fitness costs involved in their regulation.

### Methods

Developmental stability, although it cannot be measured directly, may provide information on the quality of the environment in which an animal has developed. Phenotypic measures were taken and analysed in a series of post hoc tests to assess the response to varied environmental costs.

Adult males were selected from three study groups: Chester Zoo, Knowsley Safari Park and Whipsnade Wild Animal Park. Enclosure characteristics, social-structure and management differed between the groups. Obvious differences occurred between the environments in enclosure structures, external influences, social organisation and management regimes. It was therefore assumed that the cost functions varied between enclosures, although no attempt was made to measure these environmental differences. The researcher had no control in manipulating these conditions and therefore the environment was monitored rather than experimentally measured. Common to all groups was the presence of dominant and sub-dominant males forming a notable hierarchy system. Dominant males could be clearly distinguished from sub-dominant males by the overall black colouration of their coats. Sub-dominants were tan in colour with some darkening to part of the coat. No change in colouration was observed throughout the study periods suggesting that social status did not alter in the groups.

Two phenotypic characteristics, fluctuating asymmetry (FA as an indicator of developmental stability) and behavioural responses, were measured in all the individual subjects. It was assumed that the measurements taken expressed the decision rules chosen by the individuals in their immediate environments. Although detailed knowledge of the environments stresses were unknown, it was considered that known perturbations of various scales presented varying stresses/costs to the animals as previous studies had shown changes in behavioural responses, and FA had been observed to increase in novel, and harsh environments.

Differences between dominant and sub-dominant male trait sizes and trait asymmetry were compared using Mann-Whitney U tests. Any correlations between trait size and asymmetry were found using Spearman's rho, one-tailed tests. A Friedman's two-way analysis of variance was used to determine any differences between like-status males in different environments. Analysis of variance tests were used to confirm the Friedman's test on subdominant males and to compare the mean-square values of the variance between and within the samples. Finally, associations between morphological and behavioural stabilities were analysed using Spearman's rho, one tailed tests comparing trait fluctuating asymmetry (developmental stability) and percentage change in 'total' and 'category' behaviours (behavioural stability). These tests were performed on pooled data of the males (dominant + subdominant) as well as on like-status males only.

## Results and Discussion

The series of post hoc experiments investigating morphological and behavioural stability provided results that reflect the decision rules and individual variation within male blackbuck. The rules and responses observed are considered to illustrate the priorities and performance criteria of the males within and between groups. It is assumed that selection favours those individuals that show higher levels of stability and as such those traits showing symmetry (less deviation) are considered to be priorities and more essential to the animal's well being. This is used to assess the performance criteria and flexibility of responses to particular environmental circumstances.

For an individual to adapt, information from all phases of the life cycle must be incorporated at several biological levels from genetic to ecological. Analysis of individual abilities as reflected by their dominance status, suggests that some individuals can cope with the costs of fluctuations and stresses in their environments better than others. Dominant males through their genetic disposition and learned experiences achieve and maintain an optimum phenotype that through stabilising pressures is selected within the population, indicating that in these males there is less of a mismatch between original and imposed performance criteria. The ability to tolerate changes need to be considered in zoo breeding programmes and relocations where assessment of susceptibility to perturbations would help determine which individuals can cope with the transportation and novel circumstances. Results have shown that individual phenotypic traits such as morphological traits and behavioural responses do not respond equally to environmental conditions. FA as a reflection of developmental stability and overall individual quality may provide a useful tool in animal welfare management. The results of this study support others, where it is suggested that researchers should examine those traits that are less developmentally stable and possibly under directional selection pressures such as sexual ornaments. Further efficiency in the examination of habitat suitability and individual welfare issues may be gained by detailed analysis of lower status individuals that appear more susceptible to environmental stresses, than their more stable, stress tolerant domineers. The observed decision rules of the male blackbuck help us to understand the animal's costs and priorities of living in a zoo environment. Morphological responses to perturbations indicate which traits the animal perceives to be important and allocates the necessary resources accordingly. It is only through appropriate responses and prioritisation being made within the behavioural repertoire that the animal can gain the necessary resources to meet the costs of good body condition and developmental stability.

A detailed ecological understanding of the environments in which animals are kept is necessary to evaluate the relationship between stresses (costs) and animal welfare. Observation of the decision rules employed in these situations gives us some insight into the animal's priorities as reflected in the flexibility of phenotypic characters.

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## Endocrine correlates of dominance and reproductive success in male great apes

*Ekaterina Vorobieva, Michael Heistermann, J. Keith Hodges, Department of Reproductive Biology, German Primate Centre, Göttingen, Germany*

As part of our project on endocrine correlates of dominance and reproductive success in male great apes, we investigated the relationship between androgen status, dominance rank and associated behaviours in intact male chimpanzees. Seven adult males, housed in the chimpanzee groups of Amersfoort (n=3) and Arnhem zoos (n=4) were studied for periods of 2.5 and 3.5 months, respectively. Behavioural observations (295 h in Amersfoort, 432 h in Arnhem) were focussed on agonistic and sexual behaviour, which was recorded using the method of all-occurrences sampling.

Observations were combined with regular collection of urine samples for non-invasive assessment of a male's testosterone (T) concentration. Our data show that in both groups of chimpanzees urinary T levels differed significantly between males. The overall relationship between T and male rank, however, was not clear, although in the majority of dyads the more dominant male showed significantly higher T concentrations. While T was unrelated to rates of initiation of aggression, a significant negative relationship was found between T and the frequency of strong aggression received. There was no significant relationship between urinary T concentrations and the frequency of male copulatory behaviour. Studies are now underway to elucidate how a male's dominance rank and his endocrine state are related to reproductive success.

### **Behavioural and non-invasive endocrine measures of stress and reproductive status in male gorillas (*Gorilla g. gorilla*) living in all male (bachelor) groups and heterosexual groups**

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The project aims to provide data on the effect of housing conditions on the behaviour and physiology of male lowland gorillas living in all male bands and family groups. Observations on social and sexual behaviour and collection of urine samples for analysis of testosterone (T) and cortisol (C) as indicators of testicular and adrenal function were carried out for periods of 2-4 months on a total of 15 male gorillas living at Loro Parcque, Tenerife/Spain and Paignton Zoo, UK (all male groups) and at Krefeld and Cologne Zoo (family groups), Germany. Urine samples for complementary cross-sectional analysis of endocrine status were collected from additional male gorillas (age range: 8-34 years) from 20 European zoos. Preliminary analysis of the data show that males in the two group types differ in terms of their relative proportions of affiliative/agonistic behaviour, with males in all male groups showing a higher proportion of agonistic interactions, although this appears to be age- and rank-dependent. Moreover, males in all male groups spent more time sitting alone. Despite behavioural differences, males of both group types, however, did not differ in their urinary concentrations of T and C. Although behavioural data analysis has to be completed, these initial results show that housing conditions affect the social behaviour of male gorillas and moreover suggest that maintenance of males in all male groups leads to a more tenseful living.

### **Endocrine and behavioural correlates of musth in captive African elephants (*Loxodonta africana*)**

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The study aims to provide data for a better understanding of the phenomenon of musth in captive African elephants, its physiological correlates and its relationship with behavioural patterns. During the last two years, longitudinal collection of behavioural data (using check sheets and a questionnaire filled out by the zoos) and faecal samples for assessment of testicular and adrenal function from 17 adult bulls in 14 zoos in Europe and USA has been completed. In addition, a radiometabolism study was carried out on one bull to examine the metabolism and excretion of testosterone and cortisol and characterize the major androgen and glucocorticoid metabolites excreted into urine and faeces. The

information generated from this study was used for the establishment and validation of non-invasive methodologies for monitoring testicular and adrenal function in African elephant bulls by urinary and faecal hormone analysis. Application of these techniques in part of the study animals confirmed that musth in captive bull elephants is associated with markedly elevated androgen levels, but also showed that it is not accompanied by elevated glucocorticoid concentrations, suggesting that musth does not represent a physiological stress. Analysis of behavioural data, which will start soon, will show how these endocrine characteristics of musth are related to specific behavioural patterns and what other factors might be involved in the behavioural and physiological manifestation of this interesting phenomenon. The project forms part of the Cabarceno Elephant Research Project (CERP) and is partly carried out in co-operation with the Samburu Elephant Research Project (Save the Elephants).

## **Zoo Research goes wild: Monitoring reproductive physiology and stress levels in free-ranging female African elephants**

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Non-invasive methods to monitor reproductive status in female African elephants have been established and validated in captive animals in collaboration with several European zoos. Reliable application of these methods in the field, however, requires the recognition of individual elephants and the feasibility of collecting samples on a regular basis. Both of these are possible in the elephant population of Samburu and Buffalo Springs National Reserves in northern Kenya which includes 767 identified animals and has been scientifically studied since 1997. In 2001 two projects incorporating fecal hormone analysis and behavioural observation were initiated:

### **I. Assessment of reproductive status and stress level in free-ranging African elephants**

This study combines longitudinal monitoring of reproductive behaviour and fecal hormone analysis in relation to breeding success in adult females of different social status in elephant families that are either residents of the reserves or migrants according to season. In addition to the correlation between hormones and behaviour with respect to reproduction, results will provide information on the amount of stress posed on residents versus migrants. It is also hoped to establish thresholds for hormone levels in order to develop rapid diagnostics for the use in the field.

### **II. Onset of reproductive function in young female African elephants**

This study is directly linked to the project carried out on young African elephant females in European zoos (see EAZA Research Committee Newsletter, 8<sup>th</sup> Issue, 2002). The objectives are to determine the age at which elephants in the wild start to show ovarian cycles and to define environmental and social factors that might have an effect on the onset of reproductive function. The results from the field can be directly compared with those from captivity in order to examine potential differences between these elephants and to find possibilities to improve the breeding success of the African elephant in Europe.

Since both of these studies represent a perfect link from zoo research to research in the wild, European zoos and safari parks keeping African elephants can use the opportunity to participate in this in-situ project by providing financial support for the laboratory part.

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## Correlation of signs of musth and male sexual activity with female reproductive status in Asian elephants

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The reproductive status of the four Asian elephant cows in Leipzig Zoo has been monitored continuously via weekly urinary progestagen analysis since 1995. The method has been used to reliably predict estrus in all four cyclic animals, as well as to diagnose and monitor pregnancy in one of the three younger females. At the same time the young bull achieved dominance over the females and proved his breeding potential by successfully siring a male offspring. Regular observation of male sexual behaviour by the elephant keepers revealed that the bull frequently showed temporal gland secretion, comparable to that recorded during musth, at the time a female was due to come into estrus. A higher level of aggression or urine dribbling, however, was not necessarily noted in the bull. In order to examine the relation between musth symptoms, male sexual behaviour and female reproductive status, a longitudinal study was initiated which compares daily keeper records over the past seven years to the reproductive physiology in the four females as monitored by urinary hormone analysis. This will also include an analysis of estrus synchrony in the cows and the timing of occurrence of masturbation in the bull.

## Nutritional requirements of the African giant forest hog, (*Hylochoerus meinertzhageni* Thomas) at the Queen Elizabeth National Park, Uganda

*Dipl.-Biol. Katja Viehl, Univ. Hannover, Dissertation*

In order to conserve a species, its ecology must be known. In this study, the nutritional requirements of the African giant forest hog, *Hylochoerus meinertzhageni* (Thomas), were investigated. For this purpose, giant forest hogs were studied at three sites in the Queen Elizabeth National Park (QENP) in south Uganda 1997 to 1999.

Giant forest hogs occur in a wide range of habitats. In the QENP they were found in almost all habitats, ranging from woodland to swamp and open savannah. The three study sites were situated in a mosaic of bush land and savannah, where the forest hogs had permanent access to fresh water.

With more than 100 food plants identified during the course of the study, the forest hog is proved to be far less specialised than previously assumed. Although preferring soft and fresh plants or plant parts, it is very flexible in the choice of its food plants.

Although, an analysis of food plants and faeces did not indicate any lack of nutrients and macro- or microelements, some forest hogs showed deficiency symptoms during the dry season. However, during 1997 and 1998 ecological conditions were particularly extreme because of the impact of the El-Nino phenomenon. Usually Uganda's south west receives at least some rain even during the dry season, and therefore the region does not normally dry out completely as it was the case during this study.

The size of the forest hog's home ranges of no more than 3 km<sup>2</sup> also indicates that the resources contained within a small area were sufficient and distributed relatively evenly. In other areas where giant forest hogs have been studied, they were using home ranges of up to 20 km<sup>2</sup>. The average density of the forest hogs in QENP was approximately ten animals per km<sup>2</sup>, which is indeed well below the maximum density of up to 31 animals per km<sup>2</sup> found elsewhere.

The giant forest hogs of QENP spend approximately 60% of their time feeding, which is comparable with forest hogs elsewhere. In contrast to forest hogs elsewhere, the QENP forest hogs do not use

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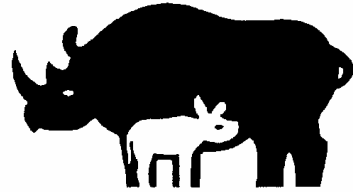
animal paths to travel to wallows, resting or sleeping bushes. The fact that they even rest in wallows that are open on all sides indicates that they feel safe. However, forest hog carcasses, obviously killed by predators, have been found during the study. Potential predators include lions and leopards, and, in the case of infants, hyenas and possibly pythons.

The studied groups behaved towards other herbivores in an offensive way. They even chased away waterbuck from shady resting places in order to rest there themselves. They are dominant over warthogs. Only big groups of buffaloes and elephants can force them retreat.

The study shows that the forest hogs in the three study sites are able to fulfil their nutritional requirements by covering short distances within a small home range. Therefore it can be concluded that the study site contains favourable habitats.

Keywords: giant forest hog, *Hylochoerus meinertzhageni*, feeding ecology, food analysis, home range, energy budget, feeding competition





## 8 Book Reviews

### **Animal Genomics (ed. by B. Chowdhary), Karger, 366pp, €113,50**

This is a very extensive volume which covers all aspects of genome mapping and DNA sequencing in vertebrates. There are 57 chapters, with lots of different animals, not only domesticated ones. Thus within bovids we find the chapters on bison and Bubalus, in the section on horses we also find Przewalski's horse and zebras, and the canid section there is also Nyctereutes and Alopex. We also read about marsupial chromosome evolution, and in the section on fowl, there are also turkeys. Finally, the rainbow trout cDNA is sequenced.

The volume thus is very informative, and well illustrated including colour pictures of fluorescence-techniques in a high print quality. On the final 7pp there are abstracts from the 13<sup>th</sup> North American Colloquium on animal Cytogenetics and Gene Mapping, including some zoo-related topics e.g. by Marlies Houck, Kurt Benirschke and Oliver Ryder.

### **Atlas of Biodiversity**

#### **B. Groombridge and M.D. Jenkins**

compiled a brief but comprehensive volume on **"Earth's Living Resources in the 21st Century"** - thus the subtitle. 340 pp, mostly with colour pictures/ graphics, lots of tables, publ. 2002 by UNEP and the Univ. of California, at £ 37.95 is very good value. The book takes us through biosphere, the phyla and phylogeny of living organisms, human resource ecology and the most important ecosystems. Its starting point, as the subtitle suggests, in each case is the amount of primary production and carries on through characteristic vegetation structure to animals, with a special mentioning of threatened species. Because the arrangement is by ecosystems, not continents, it is easy to compare e.g. dry forests of South America and Madagascar, and this certainly is of great help for exhibit and collection planning. This volume thus is to be recommended for

anybody who, at a quick glance, wants to get an overview of major ecosystems and their development and conservation. Certain minor criticisms, e.g. the extensive emphasis on molecular clock data in the section on phylogeny, leading to 100000 years of domestic dog history, can be overlooked.

**Richard Mackay's Atlas of Endangered Species** (Earth Scan, London 2002, (128 pp, ~ 15 £) is a good addition, because in this booklet, both ecosystems and important taxa are covered, both in a similar arrangement: each ecosystem or taxon (e.g. rodents) has a double page, with a world map illustrating the distribution, in the case of taxon chapters including some information on where most of the threatened species live, and some additional text, graphs and pictures. In addition to standard ecosystems, "fragile areas" (e.g. Antarctic), hotspots, and other conservation related regions are treated similarly. The final part is tables, on a country- by- country- basis, of protected ecosystems, species diversity and threatened species. If you ever need to know how many threatened species of what taxon Chad has, and how many square km of tropical forest, how many percent of these are protected etc.- look into this booklet!

Getting even more specific, for just one ecosystem, **Sara Oldfield's "Rainforest"** publ. by New Holland, London, 2002, 159 pp, in an almost coffee- table format, with lots of colour pictures, covers the presence and (often bleak!) future of rainforests, as well as some of their inhabitants (including people), on a country- by- country basis. This book has no tables (though a lot of numbers, on areas, species etc., are in the written text) and no graphics, just superb pictures. But it can illustrate what we are about to lose, and help plan efforts in our exhibits to make visitors aware!

## Marine Biodiversity

The companion to Groombridge and Jenkins is **M.D. Spalding, C. Ravilious and E.P. Green's World Atlas of Coral Reefs**, 2001, also publ. by UNEP and The Univ. of California Press, 424 pp, also £ 37.99. The volume also, like the companion, is full of graphs, tables and pictures (mostly > 1 per page) and it takes us through all the tropical seas, for each region with detailed maps, where to find what sort of reef, what protection in what size we have, and also general data on economy, population etc. of the surrounding countries. Ever want to know how many reefs and protected areas Brunei has- look at the maps and tables in this book! The text in each chapter is easy to read and competent, and helps to understand the specific problems per area, also to non- marine biologists. The bibliography is per continent/ ocean region, but it includes not only books but also map references and other specific data.

Two more volumes in coral reefs and adjacent biota have been compiled and published by AIMS (Australian Institute of Marine Science, at Townsville).

### **F. Talbot & C. Wilkinson: Coral Reefs, Mangroves and Seagrasses: A**

Sourcebook for Managers, AIMS, Townsville, 2001, 193 pp, £ 14.50).

### **C. Wilkinson: Status of Coral Reefs of the World: 2000**, 361 pp, £ 14.50).

Both volumes describe, with lots of drawings, pictures (mostly colour!), and background information in boxes, the problems, potential solutions, and distribution of these fragile and charismatic marine ecosystems. Again very useful sources for a comparative treatment of tropical marine biology.

## Encyclopedia of Evolution

**Evolutionary biology** is certainly the most exciting and dynamic branch of organismic biology today and it has the basis for all efforts

in conservation and management. Due to the truly interdisciplinary nature of this field, a lot of terminology, conceptual, methodological and taxonomic/ geographic, has to be mastered in order to understand the complexities of these, often very surprising and exciting, new developments. The two volumes **ed. by Mark Pagel** and a team of 8 editors, plus 9 advisors including the likes of R. Dawkins, J. Maynard Smith and E.O. Wilson have, in my opinion, successfully tried to compile the relevant information. In an encyclopedia, you expect, rightly so, an alphabetical arrangement. However, a comprehensive topical list allows to find, say, everything on life history theory because it also includes demography, and population dynamics. This topical list is 6 pp, and it helps to find each term or concept you want to know about. 1205 pp of course do not come cheap, 215 £ are certainly a considerable amount, but Oxford UP has to be commended for bringing all this together. The books are, in fact, also important sources for nearly all other areas, from genetics and cell biology to ecosystems. Thus, it is worth its sum!

## Polar Ecology

Several impressive and comprehensive publications covering aspects of polar ecology have been released recently:

**G.E. Fogg published: The Biology of Polar Habitats** (Oxford UP, Oxford etc., 263pp, £ 26.75).

This is a volume within the series "Biology of Habitats", which always describes physical and biological characteristics, adaptations of all possible groups of organisms, as well as human influences on a given ecosystem or biogeographic area. In this case, we find e.g. descriptions of the physiological, cell-biological, and behavioural problems of low light conditions, adaptations to cold (including anti- freeze), including such things as microorganisms in ice, and survival strategies. After these general chapters, glacial, periglacial, inland water, coastal and open- sea habitats and sea- ice are described with all their animals and their interactions.

**H. Shirihi, (ed.) with illustr. by B. Jarrett: *The Complete Guide to Antarctic Wildlife*.**

Princeton Univ. Press, Princeton/ Oxford, 2002, 510pp, £ This is a lavishly illustrated high- gloss volume, with breath- taking colour photographs, distribution maps, and colour drawings as near natural as I have rarely seen them before. Wherever possible (or necessary), all age-/ sex-/ individual differences are illustrated (e.g. up to 5 forms of dorsal fins for one species of whale), and each species is described with identification, distribution, movements, social behaviour, breeding biology, conservation and taxonomical problems. The book is introduced with about 50pp of introductory/synoptical remarks, and following the bird and mammal species accounts (> 300pp) we find regional descriptions, which even include Tasmanian, Chilean and Argentinian islands and “Gateways to the Antarctic”- seabird/ marine mammal populations on all Southern continents that migrate into the subantarctic/ antarctic zone. This is one of the finest local vertebrate fauna volumes I’ve recently seen!

***Polar Bears, Proceedings of the 13th Working Meeting of the Polar Bear SG, ed. by N.J. Lunn, S. Schliebe, E.W. Barn***, IUCN Publ. Dept. 2002, £ 15.-.

The regular meetings of the Polar Bear SG, as usual with guests representing several local community organizations/ bodies, always cover development and dynamics of polar bears in all 5 range countries, and suggest plans for management including sustainable use by hunting for local communities. In addition this publication has some research related contributions e.g. on den site selection, material denning, movements (interesting e.g., that males, contrary to other ursids, seem not to range farther than some female classes), and the Alaska Marine Mammal Tissue banking project.

**Wilderness**

**R.A. Mittermeier et al (eds)**, 575pp, Chicago UP, \$ 75.-, 2003

This is, in many ways, the companion volume to the same (but smaller) team of authors’/ editors’ previous “Hotspots” (which has been

reviewed here in 2002). It is again a coffee- table- sized and –weighted book, with almost 500 colour pictures, maps, tables, and lots more of statistical data distributed within the text. The book is organized as a sort of journey through 37 areas, from the equatorial rainforests to Arctic tundra and Antarctica, that fit the definition of the December 2002 Conservation International survey (at least 70% of original vegetation retained, at least 10000 km<sup>2</sup> in size, and <5 persons/ km<sup>2</sup> as inhabitants).

The book, following these criteria, is less concerned with biodiversity as with ecosystems, and it is a unique description of these. For each area, apart from a map, we get an ecological and geographic definition, biogeographical classification, major ecosystems, data on protected areas, biodiversity flagship species, humans (=indigenous) cultures, threats, and conservation efforts. Each chapter is written by one or more (sometimes more than a dozen) authors with first- hand expertise.

From the above- mentioned survey, 47% of earth’s surface (apart from marine areas) fits the definition, but only 7% of these wildernesses are protected. It can only be hoped that books like this find a lot of readers who then start to do something useful with this wealth of information!

**Erkrankungen der Amphibien (Diseases of amphibians) by Frank Mutschmann, Parey Verlag Berlin 1998**

hardback, 352 pp, 12 colour pictures and 87 black and white pictures or drawings, ISBN: 3-8263-3095-1, 29,95 Euro

This book gives a comprehensive survey of the present knowledge of the diseases of amphibians and it also provides the basics of ecology, biology, physiology and husbandry of amphibians. Therefore this book is not only directed towards vets but also towards amphibia owners or keepers.

The first part of this book contains introductory chapters of the ecology, taxonomy, reproduction, growth, physiology and pathology of amphibians. The second part of the book starts with a chapter about handling and clinical examination of

amphibians, inclusive a brief description of the use of x-ray and ultrasound. Short chapters about how to take samples and how to make laboratory diagnosis and the use and application methods of drugs are following. The next chapters are on anaesthesia, euthanasia, forced feeding and methods of identification. The next 200 pages describe the diseases of amphibians arranged in organic diseases, viral and bacterial diseases and a comprehensive chapter about parasites with many drawings. The book also includes a short chapter about nutrition with a special focus on vitamin deficiencies, unfortunately no requirements (estimated or based on own experiences) are given.

## Pheasants

**Paul A. Johnsgard's classic "The Pheasants of the World"**, in a 2<sup>nd</sup> edition of 1999, by Smithsonian Inst. Press, Wash. DC, 398pp, has been totally revised since its first edition. 50 colour plates, some of them lithographs, but mostly photographs, serve to give an impression of the variety in this taxon, and within the text there are many additional b/w illustrations of crests, wattles and other features, as well as typical postures in displaying. Needless to mention, of course, the distribution maps on species or subspecies level. All species accounts contain detailed measurements, identify characteristics both in the field and in the hand, and data on ecology, behaviour, reproduction, evolution, conservation, practically anything you would want to know.

## **Klinische Propädeutik der inneren Krankheiten und Hautkrankheiten der Haus- und Heimtiere by Walter Baumgartner (editor)**

5th edition, Parey Verlag Berlin 2002, paperback, 482 pp, 35 tables, 103 figures, no pictures, ISBN: 3-8263-3427-2, 44,95 Euro

This book is very useful for students of veterinary medicine. It describes clearly and in detail the clinical examination procedure for cats, dogs, pigs, goats, sheep, horses and in special chapters for birds and other little

companion animals like rodents and reptiles. The text is well structured, clearly understandable and well illustrated with several tables, figures and drawings. The 46 chapters address restraint methods, important aspects for the case history, examination procedures (visual examination, auscultation, percussion, palpation) for all organs and systems (skin, eye, circulatory respiratory and digestive system) including chemical examination methods for urine and blood. Examination procedure of the nervous system and application methods of drugs are also described. The index is comprehensive.

## **Lehrbuch der Schafkrankheiten by Heinrich Behrens, Martin Gauter, Theodor Hiepe**

4th edition, Parey Verlag Berlin 2001, hardback, 491 pp, Video-CD added, 89,95 Euro

In this fourth edition the book "Lehrbuch der Schafkrankheiten" by Behrens was united with the book "Schafkrankheiten" by Hiepe and revised by 14 different authors. The first large chapter (100pp) is about organic diseases with a special focus on reproductive disorders (50pp). For several topics tables and figures present clearly cardinal symptoms and differential diagnoses. The suggested medicinal treatment is often not licensed by the current German drug laws. The second chapter (40pp) covers ketosis and deficiency diseases. The text is well structured and clearly understandable. The third and largest chapter (130pp) describes infectious diseases and the fourth chapter (80pp) the parasites of sheep. The other five chapters address hereditary diseases (20pp), intoxication (30pp), surgery (20pp), abnormal behaviour (2pp) and hygienic conditions for sheep housing (10pp). The appendix (3pp) contains reference values of the rectal temperature, heart and respiratory rate and most blood values and describes a method for age determination by examining teeth. The index is comprehensive. The book includes more than one hundred black and white prints (mostly of good quality) and 47 colour prints. The added Video-CD is about the neurological investigative procedure and diseases of sheep.



**Lehrbuch der Schweinekrankheiten by Karl-Heinz Waldmann, Michael Wendt (editors)**

3th edition, Parey Verlag Berlin 2001, hardback, 604 pp, 216 colour and 57 black and white prints, ISBN: 3-8263-3373-X, 89,95 Euro

This edition is a reprint of the second edition with an update on the suggested medicinal treatment by the current drug law. After an introductory chapter the second chapter address the influence of housing conditions on the animals health. The next two chapters are about anaesthesia, restraint methods and application methods. Over 500 pages very comprehensive and good illustrated descriptions of the diseases of the skin, blood, muscles and the respiratory, central nervous, cardiovascular, digestive, urinary and reproduction system etc. follow. The chapters are well structured e.g. in congenital disorders, viral and bacterial infections, parasites, nutritional and husbandry disorders. They contains the aetiology, clinical manifestations, diagnosis, differential diagnosis, therapy, prophylaxis and literature references. In consequence, a highly useful and very recommendable collection for vets.

**Dolphins, Whales and Porpoises**

2002-2010 Conservation Action Plan, compiled by R.R. Reeves, Smith, E.A. Crespo and G.N. di Sciara, 139pp, IUCN 2003-08-11 is another document in the “new” i.e. more comprehensive, biology – oriented series of Action Plans. Chapters with overviews of threats, possible solutions to cetacean conservation problems, recommended research and education actions make up all but 22pp of the plan, which means that almost 80% of the contents cover generalized items. 30pp of references alone are another strong point of the document. Of course, there are still many species listed DD or NE, but this is not a short coming of the current plan – we simply don’t know enough.

**Sperm Whales**

**Hal Whitehead**, certainly one of the most experienced field researchers on these

creatures, has written a 431pp book, Chicago UP, 2003, £ 21.-

The book is an extensive review of the author’s long and successful research into behaviour and ecology of Sperm whales, and its main emphasis is on social complexity and culture in a marine environment. For this he also has collated data from geography, functional morphology, and includes many historical records, descriptions and anecdotes. Following his argument, the spermacete organ evolved for long- range echolocation and was then, later used for communication including mating calls. The social system of Sperm whales has a lot of resemblance to the elephants’, with matriline, roving males, long infant/ juvenile care, and ecological/ food- based sexual segregation. Even though none of us probably will ever have these animals in their collection, they make for good educational stories, and thus the book certainly is a very valuable source of information.

**Lion Tamarins**

**D.G.Kleiman & A.B. Rylands**, eds Smithsonian Inst. Press, Wash. DC, 2002, 422pp, \$ 45.-. The 4 species of lion tamarins are not only flagship species for their endangered rainforest habitat, one of the true hotspot areas of the world. They, at least several species, also have served as model species of developing cooperative, and scientifically based, breeding and re-introduction programmes. Thus, a comprehensive account of biology, ecology, conservation measures and problems for this genus is far more than a case study, and of far broader interest than purely for primatologists. Lion tamarin research and conservation have always been joint efforts in- and ex- situ, and all the chapters, including mating system and group dynamics, infant care, communication, or the “practical” ones such as pre- release training, include experimental or lab data as well as field data. Discussion of results and conceptual approaches mostly includes comparative aspects of other callitrichids/callimiconids as well. Finally, last but not least, the lion tamarins make good stories for all kinds of visitor information, and for this purpose the book also provides a lot of background.

## All the Cats in the World

**Mel & Fiona Sunquist** have written a very helpful and impressive compilation of data on a species- by- species basis: *Wild Cats of the World*, Chicago UP, Chicago/ London, 2002, 452pp, 358 of which are dedicated to the species accounts. For the rest, there are chapters on “What is a cat”, taxonomy, recent advances in field research, relocation, conservation, and among others, appendices with Red List Criteria, reproductive and communicatory data in comparative tables, etc. Each species chapter has a b/w picture, a distribution map, and text on history, appearance, distribution, ecology & behaviour (including reproduction and development), and conservation/ status. Tables, with measurements, prey species, and other information often accompany the species chapters, and each chapter has its own bibliography. In addition to the b/w pictures, 49 colour plates, often from natural habitats, serve to illustrate in more detail the various coat patterns as well as typical movements and postures.

## Wolves and Dogs

Two, rather different but both very instructive volumes by leading authorities have been published by Chicago Univ. Press:

***Wolves, ed. By David Mech and Luigi Boitani***, 2003, 448pp, appr Euro 50,-

Is a state of- the art combination of 13 chapters plus introduction and conclusions, written by > 20 Authors, each a leading authority covering all aspects from molecular genetics and taxonomy to the role of wolves in ecosystems, and their relationship to humans. Recovery, conservation and restoration of wolf populations take a prominent part, and data from captive populations are integrated into nearly all the chapters on behaviour, physiology, body functions etc. Thus the volume is not only a must for anyone keeping wolves and doing education with them. It can also, in many parts, serve to demonstrate the importance of research in zoos and other captive situations both for understanding the fundamental biology of a species and for interpreting and evaluating data from the wild.

One chapter specifically deals with Red wolf and its recovery plans, and this is one of the points where wolves can be used very easily for conservation messages. In addition to the text, the book contains numerous illustrations b/w pictures, tables, and almost 40 superb colour pictures.

***Dogs, by Raymond & Lorna Coppinger*** already publ. 2002, 352 pp, appr Euro 16,- in pbk

Has a very special thesis underlying it: Dogs, as the Coppingers state were not passively domesticated by early people from wolves. They became scavengers, commensals in human settlements, and through generations of adaptation to this new environment in close contact with our ancestors, they “domesticated” themselves, lost their pack structure, became semi- solitary, lost most of their hierarchical behaviour etc. Only much later did people then realize that they could come to a mutualistic relationship by cooperating with dogs, and the result were the different household pets, again come much later. To support this line of reasoning, data on ontogeny behaviour, motor patterns, and anatomy of different breeds are brought together with observations on village dogs and historical accounts. The authors certainly have a point in emphasizing that not everything a dog does is directly understandable as a form of wolf behaviour. But nevertheless the wolf is undoubtedly the ancestor, they are still the same species, and in light of the enormous ecological and behavioural plasticity and variation we find in *C. lupus* it would probably be possible to find corresponding traits in some wolf population somewhere, for almost anything a dog naturally does. And many of the behaviour descriptions still fit both! The concluding chapters certainly have value in themselves, for raising provocative thoughts about the role of dogs in today, human societies, and how to develop a truly mutualistic relationship.



## Evolutionary Aspects of Primate Life Histories

Again though different angles a group of volumes cover evolution of primate life history traits:

**A. MacLamon & C. Ross (eds.): *Evolution of Non-Maternal Care in Primates*.** Karger, Basel 2000, Euro 28,-, 11 pp. Is a collection of papers, both from proximate and ultimate angles, on allomaternal care. The first chapter reviews the phenomenon from a general avian and mammalian perspective, the following ones cover callitrichids (in 2 chapters), tarsiers, cercopithecines, anthropoids (one each) and theoretical aspects. Some specific topics, e.g. the influence of coat colour, and game-theoretical models, as well as data on paternal/allopaternal behaviour are included.

**M. E. Peirera & L.A. Fairbanks (eds.): *Juvenile Primates*.** Chicago Univ. Press, 2002, 428 pp, appr Euro 30,- pbk and

**P.M. Kappeler & M.E. Peirera (eds) *Primate Life Histories and Socioecology*,** Chicago Univ. Press, 2003, 416 pp, appr Euro 30

Are companion volumes covering ecological and ultimate reasons for the ontogenetic development and reproductive strategies of primates. "Juvenile primates" does not look at the influences of rearing conditions, socialisation or endocrine situations on that (in primates always rather long) time span between weaning and full maturity. The book explores this developmental stage in all types of primates, also non-gregarious ones, including our own species. The first 3 chapters review existence, evolution and characters of juvenality. Following these reviews the rest of the chapters is arranged into topical sections: one on taxonomic groups in comparative overviews, one on development of skills for latter use, one on conflict resolution and dominance and one in human childhood.

Understanding the ultimate reason for certain ontogenetic stages and traits is very important for a proper husbandry and rearing protocol because, if do not know why a certain trait is important, we run the risk of neglecting the

proximate conditions necessary for its proper development.

Later in life, trade-offs between certain traits, be they growth, reproduction or predator avoidance still shape an individual's life and in a high degree of phenotypical plasticity. This is where the second volume comes in. We shure find an astonishing array of behavioural, morphological/ morphometric and ecological data, all put together into a picture of mutual influences and dependances. That life history, hence phylogenetic influence and not only ecology, influences social systems, is the central theme in the book. The reasoning in this volume certainly is creative and novel, and is worth applying to other taxa as well.

A remarkable detail in the vita of M. Pereira: He is a research associate of Lincoln Park Zoo, thus demonstrating once again the possibility for doing highclass research in a zoo research dept.

**P.R. Hof & C.V. Mobbs (eds.) *Aging in Non-human Primates*.** Karger, Basel, 2002, VIII + 240 pp, Euro 141.50, covers the other end, so to speak, and one that we, in the zoo world, often are confronted with. How do skeletons, teeth and brain structures change with age, what different/ nutritional requirements are to face, what cognitive capabilities remain etc. The strenght of the volume is its rather broad approach both in taxa (including great apes) and data sets (from zoos, field and laboratory conditions). It is with particular emphasis that Erwin et al, already in their first chapter, stress the importance of zoo and wildlife medicine, in primates, to establish bridges between clinical, human, veterinary and laboratory medicine!

## IUCN- Ungulate Documents

***Antelopes- Global Survey & Regional Action Plans- Part 4: North Africa, the Middle East, and Asia, ed by D.P. Mallon & S.C. Kingswood*,** IUCN Publ. Dept. 2001, 257pp, covers 37 countries from Morocco to Vietnam, and 25 species from 5 subfamilies, including the new uncertainly placed *Pseudoryx* and *Psuedonovibos*. There is an introduction, including a taxonomic justification for classification, and then a

country- by- country overview of ecosystems, species, and conservation (measures taken and proposed). Following these, status summaries and a Regional Action Plan provide short overviews. There is also a chapter on captive breeding, including recommendations for breeding programmes at different levels.

***Equids: Zebras, Asses & Horses, ed by P.D. Moehlman***, IUCN Publ. Dept. 2002, 186pp. This is again one of the “new”, and comprehensive, Action Plans including chapters on general biology of the taxon (taxonomy, genetics, reproductive biology, population dynamics, diseases concerns, and ecosystems modelling). The fact that feral equids in many aspects are similar to wild-living ones allows to draw conclusions from studies of their ecology and management, which greatly helps to understand the problems of the endangered wild populations. This is elegantly demonstrated in several chapters, and also makes this document an important review and seminal work for teaching equid biology in general.

#### **Some Small Mammals in German:**

***Christian Ehrlich: Kleinsäuger im Terrarium- Biologie- Haltung- Verhalten.*** NTV (Natur + Tierverlag) Münster 2003. This booklet, on 127 pp originally is directed towards the pet/ hobby keepers and breeders. However, it is a superb collection of data on husbandry, feeding, breeding and general biology also for anyone being able to read some German, and interested in small mammals for zoos. One of the strengths of the small volume is its lavish illustration- there is at least one colour picture per page, at least one per species, and lots in the general section dealing with feeding, terrarium design, health, climate etc.. Most species dealt with in the systematic part are rodents, but there are also insectivores, tenrecs, armadillos, marsupials, and one species each of micro- and megachiroptera as well as an elephant shrew.

#### **New volumes on aquatic mammals by IUNC Publ.**

***R. Reeves, B. Smith and T. Kasuya, Biology and Conservation of Freshwater Cetaceans in Asia,***

2000, 152 pp and

***H. Marsh, H. Penrose, C. Eres, J. Hugues: Dugong- Status report and Action Plans for Countries and Territories,*** UNEP Early Warning and Assessment Report Series 1, no date given but probably 2001; 162 pp. In the dugong document, status of the only strictly herbivorous, strictly marine mammal species is listed and threats discussed for about 37 countries/ geographical or political units. In most cases the editors think their numbers, mostly from anecdotal evidence, will be underestimates, but due to the species' low reproductive rate, fragile habitat and often isolated/ fragmented populations, there is nevertheless no cause for much complacency and in almost all places outside Australia the situation could become critical unexpectedly at short notice. But as dugongs have a high emotional appeal both to tourists and local people, protecting them should be possible if the actions suggested in the document can be implemented. The freshwater cetaceans in Asia suffer from more different types of threats. Consequently the document not only discusses all 3 species in separate chapters but also starts with 4 chapters on water development issues and has, in its 3<sup>rd</sup> section, 5 chapters on methodological topics. As more research currently is available on neotropical freshwater dolphins, these chapters mostly are on South American studies. The most dramatic story not only in this volume but possibly in conservation worldwide at present is the imminent extinction of *Lipotes vexillifer*, the Yangtze River dolphin. There are a few dozens, if at all, left, and almost nobody seems to notice. This is also a major fault of all cetacean conservation organizations, who really should have cared more about these freshwater species instead of, often purely emotion- and welfare, oriented campaigns for marine species still in their 10- 100000s!!

## Australian Wildlife

Several volumes wholly or partly dedicated to Australasian mammals have recently been published that hold lots of information for anybody planning exhibits, guiding visitors or managing marsupial collections: **T. L. Montague (ed): *The Brushtail Possum***, Manaaki Whenua Press, Lincoln, NZL, \$ 9.95, 292 pp, is written from a specifically New Zealand perspective which means possums there are, rightly so, regarded as pests. They do not only damage crops and trees, they carry bovine Tb and prey on endemic birds. But the book is not only a rap sheet of the possums' misdeeds, because, in order to provide a background for management decisions there is an extensive first section on biology, ecology and reproduction, and there are also discussions about biological (= non- lethal) control possibilities that we should keep in mind when trying to manage zoo populations in responsible ways. Each chapter has a summary, some have specific glossaries, and the book is not only directed at scientists as audience. It is probably the best single volume monograph in any marsupial species, and on one of the best- known.

**Ph. Gibbons & D. Lindenmayer: *Tree hollows and wildlife conservation in Australia***, CSIRO Publ. Dept. 2002, 211 pp, A\$ 59.95, can be ordered either from the publisher or, in Europe, from Eurospan, Covent Garden, UK Fx+44-20-73790609. Tree- hollows are one type of habitat is under constant threat even under the most responsible selective logging practices, because large trees often are the ones that carry holes, and for security or economic reasons are selected for cutting. In Australia, about 303 species, appr. 15 % of all vertebrates rely on tree hollows, and countless invertebrates will probably also do so. The book not only lists those species and discusses impact of tree hollow loss on their populations. It is a practically complete "biology of tree hollows" with evolutionary, ecosystems- dynamical as well as individual- tree- based processes, and also chapters on methodological issues (how to do inventories, how to provide substitutes by nestboxes, how manage this habitat...). Tree hollows would make a great, topic for an ecologically oriented

exhibit, also possible in smaller institutions; and why not select the 5<sup>th</sup> continent for this?

**David Lindenmayer** also is the author of a new volume in University Press of NSW' s series on natural history of Australian fauna: ***Gliders of Australia***, Sydney 2002, 160 pp, A\$ 34.95. There are 6 species of gliders from the tiny Feathertailed glider to the strictly folivorous Greater glider. The book is a comprehensive description of morphology, ecology, behaviour and conservation issues. Many illustrations in b/ w (pictures, graphics, tables) are included in the text, and a block of 19 superb colour plates, not only depicts all the species appearance but also shows them doing interesting things, such as a series of shots of a gliding and landing sugar glider. At present, two species of gliders are in the EAZA Marsupial Collection Plan recommendations, and anybody wanting to include them in their collections is strongly recommended to have this book on their shelves. The only minor criticism might be that in a rather slim volume, it might be better to have one bibliography, instead of one per chapter- especially when all the references are at the end of the book anyway!

A second new volume in related species, from the same series, is **Anne Kerle's *"Possums"***, also Uni NSW Press, Sydney, 2001, 128 pp, A\$ 37.95. In this book, Brushtails, ringtails and the Greater Glider are discussed. It might be considered an unnecessary duplication to find *Petauroides volans* twice- but it makes sense: taxonomically, the Greater glider is a pseudocheirid, ecologically it is a glider. Anne Kerle, of course, has many more species to cover, but again, in her book everything can be found in morpho- and ecophysiology, reproduction, behaviour and also relation to people. In addition to a block of colour plates, this volume is also illustrated with beautiful drawings by Veronica Saunders, and, again, numerous graphics, tables and b/ w pictures. Again, the bibliography is split into different chapters- obviously a common feature of the series.

## 9 Meetings and congress announcements

We realize that some of these are already in the past, but maybe the list can help you

### 5th International Symposium on Physiology, Behaviour and Conservations of Wildlife in Berlin, September 26th-29th, 2004

Dear colleague,

We are proud to announce that this year's EAZA plenary talk will be given by Prof. Dr. Ton Groothuis of the University of Groningen. He will talk about "Hormone mediated maternal effects".

Most of Prof. Groothuis' work focuses on the development of social behaviour, with an emphasis on the early influence of hormones and experience and their interaction. In particular he is interested in the question of how avian mothers influence androgen exposure in their offspring. In both lab and field experiments he manipulates early androgen exposure and analyses its effects on behaviour and physiology. Overall, maternal effects may be very important to understanding variation in behavioural development under different housing conditions. Such conditions very likely not only affect the mother,

but via her activities they may also induce intergenerational effects. We are very much looking forward to his talk.

As some of you may recall from past conferences, the German National Science Foundation will most likely make to us available a limited number of stipends to support attendance at the conference by scientists from eastern European countries. Most scientists from most eastern European countries are eligible for these stipends, provided that you are the presenting author, you submit an abstract and register for the conference. Going on past experience we are likely to receive more applications than we will have stipends, so we will have to select amongst applications. Your chances will be increased if you submit your abstract and registration details for attendance at the conference EARLY (first come, first serve...).

Hope you have a productive and enjoyable spring time (or autumn if you are in the southern part of the globe), on behalf of the organizing committee

Dr. Christian Voigt (IZW / [symposium@izw-berlin.de](mailto:symposium@izw-berlin.de) / [www.izw-berlin.de](http://www.izw-berlin.de))

### Elephant Symposium: Elephant Management & Owners Association and North West Parks & Tourism Board

To celebrate the 10<sup>th</sup> Anniversary of EMOA 13 – 17 September 2004 Bakgatla, Pilanesberg National Park, NW Province, South Africa

Since its inauguration EMOA has held 7 successful workshops on various topics related to elephant management. At the end of last year EMOA launched the process of a national elephant policy in conjunction with Government. EMOA has increasingly gained

in reputation, and, being the only elephant organisation within South Africa, endeavours to take the lead in issues pertaining to elephant management.

In the early years translocation of elephants was an important management tool and at the centre of interest. However, most established reserves, private or official, have reached their full elephant carrying capacity and are faced with a whole set of new problems. The most pressing issue is that of elephant overpopulation, and there are few options for management intervention. There are very few suitable reserves left to which elephants can be



translocated to; immuno-contraception seems viable only for small populations at this stage; and culling is only a last option due to public opinion, ethical considerations and costs involved in such an undertaking. Clearly new ways of managing elephant overpopulation need to be developed.

The symposium endeavours to bring together current research on all aspects of management of free ranging elephant populations and wild elephant populations restricted by fences, either private or official. These presentations will be the background for a workshop to discuss and develop innovative ideas on conservation of elephants within South Africa, and their management. Some exciting ideas have been put forward.

South Africa is the only country on the continent that allows private ownership of wildlife and has so many fences around its reserves. It is time that current conservation strategies be reviewed to accommodate a new generation of people.

### **Preliminary Agenda**

(Will be amended as presentations come in)

#### *Monday 13 September*

Arrival and Registration

17h00 Welcome cocktail around the pool at Bakgatla

#### *Tuesday 14 September*

Key Note address: Dr Holly Dublin  
(Chairperson African Elephant Specialist Group)

Presentations: (preliminary arbitrary order of the first confirmed talks. (Note: list will increase and change)

Rudi van Aarde: Nurturing metapopulation dynamics as an alternative conservation measure for elephants across southern Africa  
Ron Thompson: Culling as a necessary management tool

Space for Elephant Foundation: A vision of a biosphere in northern Maputoland

Gladman Buthelezi: The Swaziland-Pongola TFCA

Jozua Viljoen: Elephant impact on vegetation pre translocation

Markus Hofmeyr: Moving elephants to the Greater Limpopo TFCA

Ian Whyte: Current options for management of elephants

Jozua Viljoen: Baseline for faecal cortisol in free-ranging elephants

Neville Pitts: How not to kill an elephant: effects of scoline in elephants

16h00 Evening and night drive through park to Pilanesberg- Elephant-Back-Safari operation for interaction with trained elephants and sundowners & snacks

#### *Wednesday 15 September*

Presentations (preliminary; will be added to as papers come in)

Rob Slotow and his co-workers/students from University of Natal

Graham Kerely and his co-workers/students from University of Port Elizabeth

17h00 Game Drive and Bush Braai in Pilanesberg

#### *Thursday 16 September*

Workshop

16h00 ca end and free evening

#### *Friday 17 September*

Excursion to Marakele Game Reserve

We will be given a briefing by Marakele conservation officials on their management actions with elephants.

### **Workshop Session**

Are we able to ensure the conservation of elephants and biodiversity with our current approach?

The workshop is to develop possible “scenarios” for the future.

#### **What are scenarios?**

As per the IUCN publication “Protected Areas in 2003. Scenarios for an uncertain future.

Presented to the 5<sup>th</sup> World Congress on Protected Areas, Durban:

“Scenario planning highlights the major forces that may push the future in different directions, and creates stories that stimulate thinking of alternative possible futures. Good scenarios are plausible, internally consistent, and realistically include both perceived favourable and unfavourable elements.....Scenario planning can also involve a wide community of different stakeholders, thereby helping to reveal expectations and values held by these different groups...Predictions, forecasts, and projections help inform scenarios, which are simply stories designed to stimulate new ways of thinking about the future...”

By enabling managers to consider different possible futures, new risks and opportunities will become apparent and help lead to better decision making.

Protected area managers are faced by a world that is changing rapidly, and where opinions and values range widely. Scenario planning is an important tool for coping more effectively with risks and uncertainties faced by protected areas”.

#### **Goal of the workshop**

The most plausible scenario/s is/are to be taken forward to lay a foundation for developing a proposal for a possible strategy for

conservation in South Africa (or southern Africa?). Key issues need to be identified, such as research priorities regarding management of elephants, especially in confined areas; possible ways of coordinating research to guide and inform on a strategy and others.

#### **Topics**

Intervention management: Culling, translocation, hunting, sustainable utilisation, contraception; fences  
Conservation strategies: New ideas, mega parks, transfrontier parks, corridors; any other?

### **Mountain Tapir PHVA (Population and Habitat Viability Assessment) to be held in Colombia**

IUCN/SSC Tapir Specialist Group (TSG);  
IUCN/SSC Conservation Breeding Specialist Group; (CBSG); Colombian Tapir Network

Dear Friends,

During the Second International Tapir Symposium in Panama it was agreed that the best strategy to review and update the previous version of the IUCN/SSC Tapir Status Survey and Conservation Action Plan (1997) will be the conduction of PHVAs (Population and Habitat Viability Assessments) for each one of the four species of tapirs (involving their entire geographical ranges). We have already taken the first step towards that goal, given that we have already conducted the PHVA for Malay Tapirs last year in Malaysia.

The next one will be the Mountain Tapir PHVA which will be held in Colombia later this year, involving participants from all the range countries (Colombia, Ecuador and Peru). For the conduction of this workshop we will once again have the support from the

IUCN/SSC Conservation Breeding Specialist Group (CBSG). Right now, we are putting together a planning committee to work on the organization of the workshop. Our TSG members in Colombia are discussing the best date and venue for the meeting, and as soon as those details are decided we will start promoting the workshop and raising the necessary funds to conduct it.

If you know of any people and organizations in Colombia, Ecuador and Peru that should be considered as potential participants of this workshop, please let me know as soon as possible. Remember that for the success of a PHVA we must have all stakeholders present, including researchers, conservationists, representatives from NGOs and governmental agencies, members of the local communities, universities etc.

Thanks a lot!

Best from Brazil,

Patricia Medici

Chair, IUCN/SSC Tapir Specialist Group (TSG)



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**10<sup>th</sup> International Conference on Human-Animal Interactions, 6.-9-10.2004, Glasgow, Scotland**

„People and Animals: A Timeless Relationship“

Details online at: [www.glasgow2004ad.com](http://www.glasgow2004ad.com)

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**3<sup>rd</sup> IUCN World Conservation Congress, 17.-25.11.2004, Bangkok, Thailand**

Organised by the World Conservation Union – IUCN

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**The annual autumn symposium of The Mammal Society, 26.-27.11.2004, London**

“British mammal populations-50 years of change”

Meeting Rooms, London Zoo

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**6<sup>th</sup> International Conference on Dormice (Gliridae), 20.-24.9.2005, Siedlce (Poland)**

Organizing Committee: Wojciech Nowakowski\*, Michal Scinski\*\*, Anna Wereszczynska\*, Mirosław Rzepala\*\*\*, Ireneusz Kaluga\*\*\*

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\*\*\*Nature Society “Bocian”, ul. Jagiello 10, 08-110 Siedlce, Poland

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