Research Committee Newsletter
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edited by Udo Ganslosser*

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RESEARCH IN ZOOS: HOW TO START, HOW TO AVOID THE MOST COMMON MISTAKES!

Udo Gansloßer

1. Introduction

The situation of research projects in zoos quite often is characterized by several seemingly formidable obstacles. Some of them can be overcome by proper planning and hypothesis – driven approaches for often there are solutions due to recent developments in methodology. Many colleagues in and outside of the zoo community are not aware of these developments, which quite often leads to unnecessary friction and often embarrassing experiences. The present paper intents to address only two rather general aspects of proper planning in zoo-related projects i.a. hypothesis-finding and statistics. The reason for this is that many zoo projects specifically show deficiencies in these areas, and also that many colleagues outside the zoo research community tend to criticise zoo research specifically on the basis of these aspects. It is not my intention to address the specific planning aspects of specific areas (e.g. genetics, endocrinology, behaviour). These can be more easily obtained from laboratory textbooks, and from the methods sections of relevant papers.

Recently, BIAZA's Research Committee has started to publish a number of Zoo Research Guidelines on their website, and it is strongly recommended to refer to these in addition.

2. Hypothesis-finding and conceptualization

Zoo biology as a whole is a branch of conservation biology, an area that intends to integrate as many aspects of biological sciences and beyond. The underlying theme as in all biology, is adaptation and an understanding of adaptive processes as well as constraints upon these, can lead to better planning and execution of all types of zoo and conservation work (Hodges et all, 1995, Kaumanns & Gansloßer 1995). This approach, however, has to be specified in individual projects in order to avoid a fault that U. Reyer once called the 'little do we know about-approach' ('Wenig ist bekannt über-Ansatz') because many papers still draw their major justification by stating, in the introduction that this or that phenomenon has not yet been described, or quantified. It is a necessary precondition for scientific work to describe phenomena in an exact, objective and if possible quantitative way. But pure description, be it of anatomical structures, behavioural movements or DNA sequences, is not yet science!

Biological sciences aim at a better understanding of the phenomena of living organisms within the framework of a scientific approach. This means that general principles of scientific thinking and theory formation (e.g. Occam's principles of parsimony) have to be followed. However, in dealing with biological phenomena, we have to consider two additional characteristics that are specific for biological systems, namely the fact that biological systems are organised in a hierarchical way, often with synergistic interactions resulting in the whole being more than the sum of its parts and the historical dimension of all biological phenomena. In order to address these complexities in a testable and thus scientifically sound as well as well-focused way, Nico Tinbergen (1963) suggested the categorisation of biological research questions into four areas, each of which representing a different angle of approach, and being complementary to the others. Tinbergen stressed that only by addressing all four and finding answers to all four can be claiming to understand a biological phenomenon.

The famous four questions are:

- phylogenetic history: where does this phenomenon come from in evolutionary time, how about the situation in ancestral or related species. This phylogenetic approach has clearly profited from methodological improvements of the comparative method in recent years, including its application in behavioural ecology (Harvey & Pagel, 1991).
- evolutionary function: what is the fitness benefit of a given trait, how does it relate to overall reproductive success of its bearer, in comparison to other conspecifics of the same generation?
  This is an area where zoo research can help a lot to develop and conduct life history-related research projects by analysing stud book data and other institutional records.
- physiological function: how does this trait work in terms of hormonal and neural control, external stimuli, biochemical, biomechanical and other mechanism, what is the influence of climate change on the process of living organisms etc. Again, zoo animals, being often kept and bred outside their natural range, could serve as models to develop hypothesis on the influence of climate change on all sorts of bodily functions etc.
- ontogenetic development: how does a given trait development in the individual path from zygote to post-reproductive senibility? Developmental biology in general has long since overcome the old

nature-nurture dichotomy and by studying the closely related interactions between genome, extragenomic traditions and current external conditions (which all can be more closely controlled or at least documented in zoos) again zoo animals can be regarded as models for an understanding of developmental aspects in a broader context.

Once a phenomenon worth studying has been identified, be it from preliminary observations or literature it is important first to decide from which of the four angles the research project should be conducted - and then stay rigorously by within this angle. A mixing of causal and functional arguments is frequently encountered in the interpretation of descriptive but also sometimes analytical studies. An example: When asking about the benefit of infanticide for a male lion killing his predecessor's offspring, it is not allowed to argue that this is a consequence of stress after forceful take-over of a new pride, because the question relates to Tinbergen's second, the answer to the third category.

Careful observations and analysis of existing literature, as Innis (2006) has clearly demonstrated in her thesis on the value of bibliometry for zoo research, can lead to precisely formulated hypothesises and, based on these, specific predictions. It is important to check, during this stage, whether one's predictions are actually precise and unequivocal enough to be testable under the given conditions. Then, variables have to be defined, and again, it is necessary to clearly outline which are the independent and which are the dependant ones. Do visitor numbers influence the animals' activities, or do active animals attract more visitors? At this stage at the latest, it is urgent to consider statistical procedures, because specific tests often require a certain data structure.

After defining all variables, and carefully formulating, sampling and recording rules (what sort of data do we collect how) these should be written down and circulated to all people involved, including keepers, curators, vets etc. And they should be told that, if they have any objections to the way the project is to be conducted now, and only now, is the time to speak up or be forever silent (and do what the project requires). Many university colleagues are frustrated by the fact that zoo management accepts a research project that is later torpedoed by the lower levels, and many keepers are frustrated because they are never asked before student or researcher starts with data collection!

In planning zoo research projects WAZA has formulated and published Ethical Guidelines (Anon. 2005). As long as these are followed, there is no limit to what sort of research is being planned in zoo.

3. Statistics

Zoo and conservation biology research often suffer from a lot of statistical difficulties, leading to data sets that are "dirty", chaotic and "muddled".

Traditional statisticians often use this as a pretext to deny our research its scientific soundness. In general, the most-often voiced objections concern sample sizes data niveau or the unclear relations of several sets of dependent and independent variables. However, there are solutions to each of these statistical obstacles. The first generally accepted solution is to rely on non-parametric statistics. Zoo data (but also field data on rare animals) only rarely meet the preconditions of large sample sizes (> 15), normally distributed data, and clearly defined measurements on interval data niveau. If they do, traditional statistics can easily be applied.

Small sample sizes, however, need other approaches. Randomisation tests that generate their p-value from the data set itself instead of an assumed theoretical distribution are very powerful tools for small samples, comparing animals before and after treatment, comparing members of both sexes, etc. Single-case and small-case studies can be designed in an ABA/ABACA, etc. format, subjecting the same individuals to baseline and treatment and in "severe cases" of small samples (i. e. ≤ 5), results can be compared later by application of agglutination tests.

Another common problem in zoo (but also in field) studies of rare species is the fact that several dependent variables have one common underlying cause. This can be addressed by G-tests or their derivatives and tests for autocorrelation before using more than one data point per animal.

Finally, in designing multi-centred studies that compare data from several zoos, e. g. studbook participants, the application of multivariate means is recommended.

Several caveats however, still have to be voiced, in order to avoid common statistical pitfalls. One is the problem of pseudo replication and, related to it the pooling error.

Measuring the same animal repeatedly in the same situations does not increase n, it only may increase exactness of the measurement.

And before combining data from different subsets strictly speaking, they have to be tested for statistical differences. Only data subsets that do not reject the null hypothesis of no statistical difference are allowed

to be pooled. Other possibilities for statistically overcoming the pooling error exist, such as nested ANOVAs, but again require statistical competence and planning.

Another common mistake, even in analyses from high-quality labs, is a disregard of the problems of multiple tests. As soon as your data are subjected to more than one test, e.g. to answer several research questions, the results p-values have to be corrected, e. g. by application of Bonferroni procedure or post-hoc tests have to be used which include such a correction themselves.

4. Conclusions

Milinsky (1997) has outlined "seven deadly sins" in the study of behaviour. However, just as with Tinbergen's questions, these are not restricted to behavioural research and are quite often found in other zoo and conservation biology studies as well. In short, these seven sins are

- injustified conclusion from non-experimental i. e. correlational data
- pseudo replication by using data that are not independent
- time and sequence efforts in treatments, e. g. by disturbing the animals more and more often (or habituating them more and more!) during the course of the project
- observer bias
- animals not suitably accustomed to test procedures
- use of unsuitable controls
- attempts to "prove" the null hypothesis, specifically with small samples. Not detecting a difference is not the same as demonstrating that no difference exists!

Finally, one last remark: This paper only covers aspects of research design and procedure. It does not address the prejudice about zoo animals behaving abnormally because of an artificial environment. This is a criticism directed at zoos in general, which has been addressed in other contexts at least regarding behavioural studies (e. g. Carlstead 1996, Engel 1999).

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SCHOLARLY COMMUNICATION AND KNOWLEDGE MANAGEMENT IN AMERICAN ZOOS.

Julia Innes (2006) thesisGraduate School of Computer and Information Sciences, Nova Southeastern University.

1. Begin research mentoring programs for keepers, curators, and outside researchers.

(The mentoring of keepers is currently happening only on an ad hoc basis and is viewed as counter-productive or even threatening by many curators. Keeper involvement in research requires buy-in from top zoo administrators, but support from curators is also crucial.)

2. (E)AZA publicly acknowledge that successful zoo research is necessarily based on a passion for animals, in addition to scientific principles.

(Explicitly acknowledging the existence of the rapport between human custodians and their charges, rather than taking it for granted (at best) or denying its existence (at worst), is the sign of a humane and positive approach to the management of zoo animals. It also signals to zoo detractors that zoos' overriding preoccupation is the facilitation of human and animal co-existence, rather than scientific advancement for its own sake.)

3. Use bibliometrics as an inexpensive, easy to obtain measure to track the state of formal zoo knowledge.

(The caveat is that the scholarly literature reflects only a tiny percentage of zoos' knowledge base and remains subject to future revision (i.e., the published record is permanent but published findings may become obsolete).)

4. Become more aware of the value of existing tacit knowledge within zoos, and begin to use it to create new strategic knowledge.

(Rewarding cooperative gestures, mentoring activities and teamwork on employee evaluations would help to combat information hoarding and interprofessional conflicts (Von Krogh, Ichijo, & Nonaka, 2000, pp. 62-63). A more comprehensive evaluation of employees' contributions would identify previously unrecognized research enablers and shift the emphasis from research productivity (as measured by the Web of Science or the (E)AZA annual publications list) to the retention and intergenerational transfer of knowledge.)

5. (E)AZA community to take a strategic approach to the archiving and dissemination of its literature.

(Zoo administrators and (E)AZA need to decide whether they desire a higher level of outside recognition for zoo research, and, if so, develop a systematic approach to improving its inclusion and reception in the broader scientific community. As with any marketing campaign, they need to learn more about their current and potential audiences, and adjust their communications style to fit those audiences. Tailoring articles for high-ranked journals and offering tutoring services for authors whose manuscripts are refused by Zoo Biology are two ways to increase exposure to zoo research. What is currently lacking is a self-supporting publication culture within the zoo community that can train future peer-reviewed authors.

Finding or creating new distribution channels for both scholarly and grey literature is a third way to increase distribution of zoo research results. Keepers and curators, in particular, lack appropriate mechanisms for capturing their knowledge in a retrievable, peer-reviewed format. The increasing number of zoo researchers with advanced degrees has created a pool of future mentors, editors, and leaders who have exposure to both the scientific and zoo cultures. Animal Keepers Forum and International Zoo Yearbook struggle to obtain quality research material, but with a larger pool of potential authors, their role in disseminating grey literature could be expanded. As part of the focus on dissemination, writing courses, editorial assistance (interns), mentors, and grants specifically targeting publication and knowledge transfer would assist keeper and curatorial staff to publish more and better quality papers. Methodology is also a weak area. Even seasoned zoo researchers struggle with small population sizes, limited equipment and resources, and lack of control over both human and animal schedules. A workshop, joint course with a local postsecondary institution,

and mentoring are just some ways in which methodological skills could be transferred. A third skill set that is needed is how to publish in a scholarly publication.)

6. Train 'translators' who can navigate between the various forms of tacit and explicit knowledge, find commonalities, and facilitate the transfer and creation of new knowledge.

(These could come from different backgrounds, such as scientifically trained individuals willing to become the voice of those unable to "speak science," editors specialized in scientific writing, keepers with behavioral science training, etc. Adopting a standard vocabulary across institutions would also speed up interactions and reduce misunderstandings, while retaining those highly motivated researchers who take the initiative to contact zoos would keep outside mentors and their knowledge in the system longer.)

7. Provide greater administrative support to curatorial staff, who form a crucial link between keepers and researchers.

(Their interactions with researchers send a signal to keeper staff about the role of research within the organization. Given the resources and leadership, curators could play three separate roles in knowledge transmission: a) they could channel data effectively to researchers for peer-reviewed publication; b) they could capture their own observations in the literature and through conference presentations; and c) they could mentor keepers as part of a broader knowledge sharing initiative that would hopefully lead to increased keeper participation in the publication and presentation of zoo research.)

Bibliometrics can play a role in this cycle by providing a barometer of what the wider world cares to know about captive animals.

Lack of time and professional insecurity, rather than lack of money or enthusiasm, seem to be the greatest barriers to the dissemination process. Both can be resolved through positive leadership and clear signals to non-research staff to share what they know, in ways that are comfortable to them.

An annual publication list is vital for tracking the development of zoo research because it is one of the more comprehensive sources of non peer-reviewed zoo literature available. Could (E)AZA entice member institutions to submit all staff publications (not just peer-reviewed articles)? A more complete picture of information transfer would emerge, and mentors and assistors could be more easily identified. The inclusion of other sources of grey literature (Animal Keepers' Forum, husbandry magazines, other non-reviewed publications) would lead to a more meaningful measurement of the true extent of zoo-related literature. Through this list, (E)AZA could also play a role in removing some of the stigma attached to grey literature, both within and outside the zoo community. Non peer-reviewed information is better than none at all, and could lead to a formal research project if it fills an important need.

Do researchers at larger zoos tend to work amongst themselves or do they participate proportionally in inter-institutional research?

Which institutions lead in inter-institutional research, especially that published in peer-reviewed journals?

Are those institutions that perform the most research also those that communicate the research results most effectively?

Ideally, a citation analysis of the literature should be conducted in five yearly intervals to ascertain if the tendencies uncovered in Julie's study are maintained, and if zoo-based research is maturing into a separate discipline. A study of interprofessional relations (keepers-curators, curators-vets, etc.) is desirable to determine how existing staff resources could be be

ork together for an improved world in an atmosphere of mutual respect and positive criticism.

1 Announcements and Miscellanea

Rodent and other Viruses

My research group has established in the previous years a network "Rodent-borne pathogens" in Germany. Our main research efforts are focussed on rodent and shrew-transmitted hantaviruses. In addition, we have investigated rodents and shrews for novel herpesviruses. Moreover, in this network we are looking for additional viral and bacterial zoonotic pathogens.

Herpesviruses are very closely associated to their hosts, i.e. in each mammalian species might be only one (or a few closely related) beta- and gammaherpesviruses. This phenomenon could be explained by a virus-host co-evolution. We would be very much interested to prove if this is true also for herpesviruses of the representatives of the Afrotheria that earlier belong to the order Insectivora and from those which are still belonged to the Insectivora/Eulipotyphla. For these investigations we would need blood, spleen and lymph nodes from these animals. For our hantavirus investigations it would be very interesting to study various representatives of the novel order Eulipotyphla (shrews and others) from Europe, but is also from other parts of the world (e.g. Africa). In Africa also little known about hantaviruses in rodents -- therefore also rodents from Africa would be very interesting for us. For these investigations we would need blood, lung, spleen and lymph node tissues (for a combined search for hanta- and herpesviruses).

PD Dr. Rainer G. Ulrich

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From EAZA Office

During the 6th IZW Conference that was held in Berlin from 7-10 October 2007 a short lunch-meeting took place to further discuss the cooperation between EAZA and IZW regarding both the IZW conference and the EAZA Research Conference (hosted by Poznan Zoo and Poznan University). Attached you will find the notes from this brief meeting for your information. For further information

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A Global Invasive Species Database has been established by the IUCN Invasive Species SG.
www.issg.org/database
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Dear Colleagues,

Here in Antwerp Zoo we have recently stumbled onto a legislation issue regarding the use of zoo animals for research purposes. In my opinion this is an issue that would be worth discussing within the EAZA research committee initially.

Our Antwerp research staff is working on a joint biomechanics research project with the University of Antwerp and the Free University of Amsterdam studying the functional morphology of muscles in humans and great apes (for a recent publication see: Scholz, Melanie N., Kristiaan D'Août, Maarten F. Bobbert, Peter Aerts (2006) Vertical jumping performance of bonobo (Pan paniscus) suggests superior muscle properties. Proc. Roy. Soc. Lond. Biological Sciences, 273: 2177-2184).

Part of the research is analysing the properties of live muscle fibres, but those are usually hard to come by. However, every once in a while we do get the unique opportunity to sample tiny amounts of life muscle fibres for `in vivo' experimental analyses of those fibres, for example when the Bonobo Mwindu in Apenheul was euthanized last January, a team from Amsterdam was ready at hand to collect a sample of muscle tissue right after the bonobo had died. In this particular instance we were required to wait until the animal's death was confirmed by the vet in charge to take the sample, since Dutch legislation does not allow taking tissue samples from living animals, no matter how tiny the sample is.

As a side project to the Europe-wide sampling of blood from zoo chimpanzees for subspecies determination using DNA (you must have heard about that project) we suggested to have tiny samples from some of the chimps' thigh muscles taken by out vet for the biomechanics project, while they were anaesthetised anyhow for the blood sampling. However, with Dutch regulation in mind we tried to figure out in advance what Belgian legislation says about taking samples from live animals. Basically, we found out that there is actually European legislation on this and that under no circumstances tissue samples may be taken invasively from live animals for research purposes, unless these animals are considered laboratory animals and that the whole procedure has been authorised by several national ethics and animal welfare committees. This is an especially difficult and long winding procedure for great ape species. As a matter of fact, even sampling of blood for non-veterinary purposes can be considered as unnecessary suffering for the animal and hence as unlawful if these samples are to be used for scientific purposes.

In all fairness, I agree that it is good to have such strict legislation on issues like these for zoo animals (or any animal), but it can be rather inconvenient if it does concern a rather harmless and painless procedure like taking a muscle sample or even a blood sample while the animal is anaesthetised anyhow. But such decisions about whether or not a procedure is appropriate or whether the animal is suffering or not, is not ours to make apparently.

One way of solving this would be to apply for authorisation from the right committees for taking samples like these. However, apart from the time-consuming effort you would have to put in, under European legislation authorisation would - technically speaking - make our zoo-animals laboratory animals, and that is something we would definitely want to avoid as a zoo for public opinion reasons and for our position as zoos and conservation organisations.

In the end we decided not to take the muscle samples at all but simply stick to the sampling of blood for the genetic determination of the subspecies. However, officially we would also need authorisation for doing this, since although it is indispensable for making proper population management decisions, it is in fact a non-veterinary procedure. But clearly this is a very difficult example, and this is neither the right time nor place to elaborate on this.

Anyhow, I thought I should share this particular case with you and see whether it is useful to take some time during one of our future EAZA research meetings to discuss matters like this, especially if we're going to stimulate zoos to do more scientific research. I do realize that taking samples like these from zoo animals only happens very rarely; this is in fact the very first time ever in the CRC's long history that we've come across something like this, but still, especially with regard to the sampling of blood that is going on in the chimp EEP, it's maybe worth giving it some thought in one of our EAZA research committee meetings.

Best regards

Zjef Pereboom

Head of the Centre for Research and Conservation Royal Zoological Society of Antwerp Research coordinator Animal Behaviour and Welfare

Red List 2007

The *2007 IUCN Red List of Threatened Species* was released yesterday. If you visit the web site (www.iucnredlist.org) and still see the 2006 Red List, please refresh your screen (either through pressing Control and F5 on your keyboards, or through the View and Refresh options on your toolbar).

The web site now has a new look, bringing it more in line with the main IUCN web site and, well frankly making a change from the same old look we have had for the last seven years. We welcome any comments you may have on the new look (whether positive or constructively critical).

We have also introduced a few new functions on the site. These include:

- A new Plant Growth Forms search option on the search page to allow easy searches for trees, cycads, herbs, etc.

- The default country/region/marine area search option is set to exclude uncertain occurrences, introduced species and vagrants; but we have added options to allowing users to include these taxa if they wish.

- Users can now search specifically for species that are currently under petition, or assessments that are now considered "out of date" (meaning the assessment is now more than ten years old and is due for reassessment).

There are still some items to be updated on the site (e.g., the export function is not yet back in place), but these will be resolved soon.

Caroline Pollock, Programme OfficerRed List Unit, IUCN Species Programme Tel: +44 (0)1223 277966, Fax: +44 (0)1223 277845, E-mail: caroline.pollock@ssc-uk.org Web site: www.iucnredlist.org

Field Guide: Wild Canids of the World

http://www.flickr.com/groups/canidguide/ (so far 239 photos of 27 species of wild canids)

This is a new tool that can be used to gather and display photos of wild canids. Flickr.com is a free* web-based photo-sharing site that has many, many members (270,000+ in 2005). It is organized in a way that makes it very easy to establish "groups" and share photos in "group pools" and structure the photo pools in informative ways.

I was inspired by the remarkable Flickr group: Field Guide: Birds of the World (http://www.flickr.com/groups/birdguide/), and have in many ways tried to model the Canid Field Guide Group after the Bird group. The Bird group is trying to obtain photos of every species of wild bird in the world (around 9,000 species)! So far, they have over 41,000 photographs of over 3,800 species contributed by 4,000+ members! The bird group has very lively discussion forums and has spawned various regional field guides.

FAQs:

- the photos are available to VIEW by the public for free, there is no need to "join" Flickr
- Flickr now speaks eight languages: English, French, German, Italian, Korean, Portuguese, Spanish and Traditional Chinese.
- Photos in the group can be searched by species using any of the three indices I created. Clicking on one of these indices will bring up thumbnails of all the photos in the group pool of that species. This will vary by species from 1 for the Tibetan fox to 100+ for the red fox. The indices are:
- Species listed alphabetically by English common name (http://www.flickr.com/groups/349770@N21/discuss/72157600027433912/)
- Species listed by scientific name (http://www.flickr.com/groups/349770@N21/discuss/72157600032790666/)

- Species listed by region (http://www.flickr.com/groups/349770@N21/discuss/72157600027680909/)
- To add a photo to the Canid Guide, you need to be a member of Flickr.com. The standard membership is FREE, and lasts indefinitely. This standard membership allows you to join or even form groups and post quite a few pictures/month.
- The photo always remains in the user's personal account and the photographer is still free to delete the photo or remove it from the group at any time. All that gets sent to the group is a link back to the photo.
- The copyright of the photo is controlled by the photographer/person who posted the photo. The photographer can set a variety of rights from reserving all rights, allowing for educational uses, to allowing for any use.
- Most photos are displayed at various sizes, the largest size usually being 800x600 pixels (which looks quite nice on a computer screen). To view this large size, you have to click on the thumbnail, and then chose the "All sizes" magnifying glass icon.)
- Searching the Flickr group has advantages over doing a web-wide search on Google or some other search engine both for the quality of the images and the typically larger size of the images on Flickr
- The group supports member-initiated discussion threads on topics of interest.

Species for which we still need photos: I have corralled up the easy species; no need for more photos of red foxes from London suburbs!

Jim Scarff

IUCN Canid Specialist Group webmaster

Remark by the editor: As you can see, this possibility is open to other groups (e.g. TAG's) to establish their own site. This could be an excellent tool, please make use of it!

IBREAM

Institute for Breeding Rare and Endangered African Mammals

Introduction

The Institute for Breeding Rare and Endangered African Mammals (IBREAM) was made a UK based Charity in November 2006, due to the important work the charity conducts into the conservation of some of the world's most threatened species.

Professor Bob Millar is principle Director of IBREAM, in addition to his role as Director of IBREAM, Professor Millar is also Unit Director of the MRC Human Reproductive Sciences Unit. Based in Edinburgh, in the United Kingdom, the HRSU is the UK's leading institution, undertaking research into reproductive health.

IBREAM itself is a truly international institute, with representatives based all over the world. In 2007 the need was also identified for a European based laboratory, in order to raise public awareness of the valuable work undertaken by the charity. The Royal Zoological Society of Scotland. At present the two charities are investigating the possibility of developing the European base for IBREAM at Edinburgh Zoo. The base would be a working laboratory, where reproductive research using reproductive technologies (such as collection & cryopreservation of gametes) for target species could be developed and carried out.

Problem defined

Africa has the richest and most diverse mammalian species, many of which are currently endangered. The loss of these animals will be a considerable impoverishment to the continent and to the planet.

There is an urgent need to introduce measures to maintain and increase the current population numbers and gene pools of threatened species.

Natural breeding of threatened species in protected environments is successful for a number of species such as the white rhinoceros. A complementary approach is to employ sophisticated Assisted Reproductive

Technologies (ART), such as sperm and egg banking, artificial insemination (AI), and in vitro fertilisation (IVF) as emergency & supportive interventions.

These approaches have the added advantages of facilitating transport & introduction of diverse additional genetic material, and to store sperm, eggs and embryos for utilisation in the event of calamitous declines in populations due to disease and natural disasters. The approach has already been successfully employed to breed panda, elephant, black-footed ferret, and cheetah. On the other hand, certain environments are threatened by overpopulation of specific species.

We proposed, therefore, to establish an Institute to breed rare and endangered species of African mammals by gaining knowledge of their basic reproductive biology and using ART as a complimentary initiative to programmes such as captive breeding, re-stocking, habitat reestablishment and infectious disease control. Knowledge of the basic reproductive biology will also position IBREAM to develop contraceptive measures where needed.

Thus, our Mission is:

To contribute to the conservation of African mammals through:

- The improved understanding of basic reproduction of chosen target species
- The development of assisted reproductive and contraceptive technologies
- Genetic analysis and preservation of gametes
- Integration of these initiatives with other conservation endeavours
- Education, outreach and capacity building

For further information contact

Project Coordinator, Dr Monique Paris, Ph.D.Department of Equine Sciences, Faculty of Veterinary Medicine, University of Utrecht, Building (Rm 1.140), Yalelaan 114, 3584CM, Utrecht, Postbus 80153, 3508TD, Utrecht, The NetherlandsTel: +31 (030) 2531331 (if no answer 2531350), Fax: +31 (030) 2537970, m.paris@uu.nl

Website: www.ibream.org

Displaying Research?

I am currently a student in Master II of Museology of Science in France's National Museum of Natural History and for my Master report, I am working about " Is it interesting to show research to zoo visitors and how to show it ? ". In consequence, I attempt to inventory and to contact zoological parks which display information about research.

If you are interested, I would be grateful if you would contact me.

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2.1 BIAZA Research Newsletter, Jan. 2007

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Feature Article

NUTRITIONAL ADEQUACY OF GORILLA DIETS IN EEP FACILITIES

ANNA WESTBURY, K.A. DOERNATH AGUIRRE ALVAREZ AND ELLEN S. DIERENFELD, ST LOUIS ZOO

Introduction

Gorillas have been kept in zoos since the late 19th Century (Vevers 1976) but their husbandry is troublesome and the first captive birth was not until 1956 at Columbus Zoo, Ohio (Cousins, 1990). There has been an International Gorilla Studbook since the 1970s and a comprehensive SSP husbandry manual since 1997 (Ogden and Wharton 1997) including a chapter on nutrition based on a survey of SSP gorilla holding facilities (Popovich and Dierenfeld 1997). Wild gorillas eat a wide range of plant matter, are seasonally frugivorous, herbaceous and folivorous (Remis 1997, 2003) selecting approximately 100 different fruit species (e.g. Popovich and Dierenfeld 1997; Remis 1997) but also leaves, bark, stems, seeds and pith, resulting in a relatively high-fibre, low-fat diet (Popovich and Dierenfeld 1997). Gorillas obtain most of their protein from leaves and shoots, and most of their energy from highfibre food items such as stems (Watts 1996; Popovich and Dierenfeld 1997). Health and behavioural problems in captivity can be linked to poor diets (Popovich and Dierenfeld 1997) including obesity, cardiovascular disease (McGuire *et al* 1989; Cousins 1979) and ulcerative colitis (Scott and Kremer 1975). This study aimed to determine the adequacy of diets currently fed to gorillas in 62 EEP facilities.

Materials and methods

Details of the gorilla diet were requested from all 62 EEP zoos listed in the International Gorilla Studbook (Hilsberg and Bender 2005). Responses were obtained from 20 zoos but 10 were rejected as unusable due to poor quality information. The data from 10 zoos were usable giving information on 17 individual diets which were entered into Zootrition. In addition, five-day dietary intake studies were carried out at two EEP zoos to compare given and consumed diets. Data are presented on a Dry Matter basis and only data generated by Zootrition using over 80% of dietary constituents was used in calculations.

Results

Broadly across the 10 EEP zoos gorilla diets were high in fruit and animal products compared with the SSP recommendations (Table 1)

	Mean from Survey	SSP Suggested
Fruits (%)	18.95	10.00
Vegetables (%)	45.13	40.00
Greens/browse (%)	23.66	25.00
Pellets (%)	2.42	23.00
Cereal/grains/nuts (%)	3.25	2.00
Animal products (%)	6.58	0.00
Supplements (%)	0.01	

Table 1. Dietary components in surveyed gorilla dietscompared to SSP recommended values (Popovich and Dierenfeld 1997).

Dietary intake studies in two zoos indicated that the gorillas consumed 93% and 100% of the diet offered suggesting that analysis based on offered diets is a reasonably accurate estimation of actual diet. Nutrient concentrations of the diets were highly variable across zoos and many did not meet the recommended concentrations for several nutrients (Table 2).

Nutrient	Units	Recommended	Mean	SD	Max	Min
Energy (Male)	Kcal/d	6000	4967.02	2348.56	9540.15	2988.61
Energy (Female)	Kcal/d	4430	2762.55	715.48	3964.79	1935.1
ADF	%	23.7-52	5.67	7.69	26.64	1.44
NDF	%	33.6-73.2	9.02	13.61	46.19	1.61
Total Dietary Fibre	%	31.5	10.26	51.92	20.87	3.55
Crude Fat	%		6.97	4.60	14.63	1.92
Linoleic Acid	g/d	14.5	23.82	24.68	96.95	3.75
Linolenic Acid	g/d	1.35	2.71	1.11	5.45	1.36
Crude Protein	%		12.60	2.39	15.74	8.19
Folacin	mg/d	0.4	3.13	1.33	5.36	0.65
Niacin	mg/d	15	53.49	28.99	130.43	21.57
Pantothenic Acid	mg/d	5	25.18	10.61	46.5	6.73
Riboflavin	mg/d	1.2	7.97	6.33	24.6	2.62
Thiamin	mg/d	1.15	7.01	2.47	12.67	3.22
Vitamin A	µg/d	800	1273571.50	1452719.40	6531677.5	112902.98
Vitamin B 12	µg/d	2.4	10.41	10.09	28.43	0
Vitamin B 6	mg/d	1.3	9.99	4.43	20.97	4.01
Vitamin C	mg/d	82.5	1398.06	495.55	2052.94	139.8
Vitamin E	mg/d	15	48.92	29.32	121	0
Calcium	g/d	1.15	1.60	3.10	12.45	0.14
Copper	mg/d	0.90	14.47	13.67	53.93	3.18
Iodine	mg/d	0.15	0.15	0.13	0.35	0
Iron	mg/d	13	107.78	90.94	329.77	19.02
Magnesium	g/d	0.37	0.51	0.92	3.6	0.04
Manganese	mg/d	2.05	40.09	32.23	117.94	8.31
Phosphorus	g/d	0.7	1.22	2.01	7.75	0.16
Selenium	mg/d	0.055	0.16	0.14	0.68	0.05
Sodium	%	0.25-0.65	0.21	0.12	4.15	0.13
Zinc	mg/d	9.5	45.21	28.46	112.93	13.13

Table 2. Mean, SD, maximum and minimum values for nutrients in gorilla diets of 10 EEP zoos and recommended values (converted from Allen and Oftedal 1996; Popovich et al 1997; National Research Council 2003).

Conclusions

1. Calculated calorie intake for adult male (150 kg) and female (100 kg) gorillas averaged 5000 kcal and 2800 kcal, respectively, approximately 1.5 X basal metabolic rate as determined by generic energetics equations for mammals. This is less than the recommended guidelines which, therefore, appear to overestimate energy needs.

2. Dietary fibre content was considerably lower, and fat content higher, than those recommended based on natural foods eaten by wild gorillas, as well as guidelines suggested in the SSP Gorilla Husbandry Manual. Low fibre and high fat could both contribute to obesity, high cholesterol and cardiovascular disease. Cousins (1979) notes that cardiac arrest, associated with a poor diet and lack of exercise, is an important cause of adult gorilla deaths in captivity, particularly if fats are derived from animal sources, such as cheese as in some of the zoos. Therefore the reasons for including animal products in captive gorilla diets require careful review.

3. Calculated dietary levels of (particularly) water-soluble vitamins and trace minerals were excessive compared to estimated requirements for gorillas, whereas macromineral concentrations were only just adequate. These could be improved by increasing the proportion of pellets in the diets which is very low compered to the recommended amounts. Alternatively a clear assessment of the need for specific products used for supplementing diets is suggested to ensure optimal balance of vitamins and minerals.

4. Information on actual weight, body condition and health parameters together with detailed diet assessments is recommended for optimising gorilla diets.

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Research Snippets

2006 BIAZA Research Award Winner

GENETICS OF THE SCIMITAR-HORNED ORYX

A. IYENGAR[1], T. GILBERT[1,2], T. WOODFINE[2] AND N. MCLEAN[1],
[1]University of Southampton and [2]Marwell Conservation

Once widespread and abundant across the Saharan region, the scimitar-horned oryx is now extinct in the wild. However, from a founder population of around 40 animals, there are now several thousand in captivity. Moreover, a dozen former range states have declared their interest in returning the oryx to its former habitat and prospects for reintroduction are good. Releases in fenced areas of Tunisia, Morocco and Senegal have shown encouraging results over relatively short periods of time, but all with limited founders from captive stock. Theoretically, long term success of true reintroduction will be in part dependent on the ability of the species to adapt to natural conditions without overt human intervention. Hence, selection of appropriate genetic stock to diversify existing semi-free ranging populations and fulfill broader reintroduction goals is essential, while sound management of captive populations as a backup remains critical.

Records show that the global gene pool of scimitar-horned oryx is almost entirely represented in the European (EEP) and North American (SSP) captive populations. However, with missing or questionable data in the International Studbook, the relationship between these populations and a limited number of oryx of unknown origin elsewhere in the world requires further understanding. We explored the patterns of genetic diversity across European, North American, and other selected captive groups of oryx using microsatellite markers and mitochondrial DNA control region sequencing. This provided recommendations for captive breeding and reintroduction. Together with available data on closely related species, we were also able to report on the structure and evolution of the mitochondrial DNA control region in oryx. As a result specific recommendations for global captive management and selection of animals for reintroduction have been made, with immediate consequences for the SSP and a plan to ship oryx to Tunisia in 2007. Two publications in scientific journals have resulted from this work.

See: Iyengar A, Diniz FM, Gilbert T, Woodfine T, Knowles J & Mclean N 2006. Mol. Phylo. Evol. 40: 305 - 314.

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2006 BIAZA Research Award Commendation

THE JUMP-YIP DISPLAY AND RESPONSE BEHAVIOUR IN A CAPTIVE COLONY OF BLACK-TAILED PRAIRIE DOGS, *CYNOMYS* LUCOVICIANUS

SUE DOW, BRISTOL ZOO GARDENS AND CHARLOTTE DAY,
Bristol University

Black-tailed prairie dogs, *Cynomys ludovicianus*, show high rates of a behaviour pattern consisting of an upwards leap in conjunction with a two-syllable vocalisation, the "jump-yip" display. This behaviour is often contagious in eliciting further displays from individuals of home and adjacent coterie territories, although some displays do not elicit a response. This study aimed to identify reasons for this observed difference in jump-yip response elicitation by initiating callers.

Seventeen parameters of jump-yip calls were analysed from recordings of a captive zoo colony of black-tailed prairie dogs. No structural differences were found between calls that elicit a response and those which do not. Black-tailed prairie dogs were shown to respond to the vocal component of the display in isolation from the visual component in a playback experiment. They respond significantly less frequently to calls given within a short latency of a previous initiating jump-yip than to calls made after a longer latency. This supports a function of the jump-yip call as part of a system of co-ordinated vigilance within groups. A behavioural refractory period could optimise the benefits from such a system by minimising the loss of

time available for non-vigilance-related behaviours. Timing did not account for all observed response differences suggesting that further factors may be important determinants of response elicitation.

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2006 BIAZA Research Award Commendation

CONSERVATION TOOLS FOR DETERMINING GENETIC RELATEDNESS IN GROUP MANAGED SPECIES.

PAUL PEARCE-KELLY, RAJ AMIN AND JINLIANG WANG,
Zoological Society of London

Currently available genetic tracking and analysis software tools are reliant upon individually based pedigree information to calculate kinship among individuals. Of the nine recognised categories of species management levels only one pertains to non-group managed species. The other eight categories include the vast majority of species. As ever more species require conservation breeding assistance (e.g. the large number of amphibians facing global species declines) the group-management approach is inevitably becoming the most practical option – even for many traditionally individual-based programmes. Therefore, there is pressing need to develop group-oriented genetic management solutions for the development of the global *Zoological Information Management System* (ZIMS) and its associated (currently individual based) demographic and genetic analysis tool PM2000.

A ZSL research team has been working in collaboration with EAZA, EADISC, ISIS and CBSG to address the most technically demanding aspect of this work. This research work has succeeded in developing the mathematical genetic model which has been validated using real species programme data (the EEP Partula snail programme). A demonstration software tool has also been developed to assist the practical implementation of the model and associated management algorithms. This in turn has led to the development (by the same research team) of a genetic relatedness visualisation tool which for the first time provides population managers with the relevant information in a clear and concise manner. This research provides a major breakthrough in the conservation of group managed species from invertebrates through to mammals.

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2006 BIAZA Research Award Commendation

THE RESPONSE OF GREY DUIKERS (*SYLVICAPRA GRIMMIA*) TO CONSPECIFIC FAECAL DEPOSITS: POSSIBLE TERRITORIAL IMPLICATIONS

NICKY LUNT AND TONGAI CHIRADZA, MARWELL ZIMBABWE TRUST AND AMY PLOWMAN,
Paignton Zoo Environmental Park

Duikers are becoming increasingly threatened, primarily due to hunting for bushmeat. In Zimbabwe, recent economic decline has led to very significant increases in bushmeat hunting and trade; possibly even to the extent to cause local extinction of the usually abundant grey duiker (N.Lunt unpubl. data). Duikers are very poorly studied and more information is needed to develop effective monitoring systems and conservation plans. Territorial behaviour is particularly important as estimates of territory size and degree of overlap are often used to determine density of individuals. Dambari is the headquarters of the Marwell Zimbabwe Trust and holds a large collection of small antelope including many grey duiker. It provides an ideal situation to test hypotheses about these small, secretive animals in semi-natural conditions. Grey duikers (Cephalophini: *Sylvicapra grimmia*) are territorial antelope that use olfactory means to demarcate territorial boundaries. The role of faeces in territorial behaviour was investigated using semi-captive antelope at Dambari Field Station, Zimbabwe. The strength of response to introduced faecal deposits of various ages from unfamiliar conspecifics of both sexes and three age classes was measured using a repeated measures design. Latrine sites, faecal pile dry mass and defecation rates did not alter with introduction of unfamiliar

faecal piles, and fresh mass of introduced faeces did not affect response magnitude. Dung of intermediate age elicited the greatest response, and animals responded most intensely to the dung of animals in their prime. Adult male and female response frequency was not statistically different, although males responded to fresher dung than did females and only adult males scent-marked near introduced deposits. Adults showed greater interest in introductions than juveniles. It is concluded that faecal piles act as both olfactory and visual signals, and that the differences between sexes in the types and magnitude of response are related to territorial behaviour.

IMPROVING ZOO ENCLOSURES MAY MAKE VISITORS CARE LESS

AMY PLOWMAN, WHITLEY WILDLIFE CONSERVATION TRUST

Conservation education is a major role of zoos but there is little evidence that this is benefited by new, and often very expensive, zoo exhibits. Thus, a visitor survey was conducted to evaluate the effects of the new Monkey Heights exhibit, opened at Paignton Zoo in 2005. Visitors to the old monkey house and to the new exhibit were questioned on their feelings towards monkeys, their perception of the monkeys' welfare, their concern for conservation of monkeys and their natural habitats and their willingness to undertake certain conservation actions. The vast majority of visitors to both exhibits had positive feelings about monkeys and there was no significant difference between the exhibits in this respect. Not surprisingly, significantly more visitors to the new exhibit believed the monkeys to have high standards of welfare then visitors to the old exhibit; e.g. in Monkey Heights 32% strongly agreed the monkeys looked 'happy' compared with 3% in the old exhibit ($\chi^2[3] = 23.22$, $p<0.001$). However, visitors to Monkey Heights were less concerned about monkey conservation and less likely to undertake conservation action than visitors to the old exhibit; e.g. in the old house 81% of visitors strongly agreed that it was important for monkeys to survive in the wild, compared with 48% in the new exhibit ($\chi^2[1] = 18.35$, $p<0.001$), and 24% of visitors in the old exhibit said they were very likely to avoid buying non-sustainable tropical timber

compared with 8% in the new exhibit ($\chi^2[3] = 15.53$, $p<0.01$). It seems that improving zoo animal welfare (or at least the perception of it) may have detrimental affects on zoos' ability to encourage visitors to care about and take action for animal conservation.

Further info on both the above: Amy Plowman, Paignton Zoo. Tel: 01803 697514, amy.plowman@paigntonzoo.org.uk

VISITOR AWARENESS OF NATIVE SPECIES WITHIN PAIGNTON ZOO

KATHERINE THOMAS AND DAVE PRICE,
University of Plymouth and Natasha de Vere, Whitley Wildlife Conservation Trust

Zoos are one of the main locations where people in the UK are able to come into contact with exotic animals. However, they may also provide opportunities for visitors to encounter native species. At Paignton Zoo Environmental Park, South Devon an interview-based questionnaire showed that less than 50% of visitors were aware of the Clennon Gorge nature trail, sited within the Zoo. Knowledge was largely influenced by the distance travelled to the zoo and the number of previous visits that had been made. The majority of visitors gave time constraints as the main reason for not visiting the nature trail. Along the nature trail the number of native bird species seen by visitors correlated with the interest rating of visitors, the length of time the visitor had been at the zoo, and the rank of the species on the BTO bird watch count. No relationship was found between the gender and group structure of visitors and the amount of information wanted about native species. However, a difference was found in relation to visitor age. Approximately two-thirds of visitors said they would like to see more information on native species. The preferred location of this information differed in relation to visitor age, gender and whether or not they were members of Paignton Zoo. With the exception of visitors aged 56+, information posted around the zoo was the preferred option holding approximately 35% of the vote. The study indicates that more could be done to educate visitors about native species that exist within and around the zoo. Enhanced knowledge may be needed of the location of native species within the zoo and the nature of their interactions with exotic species to do this

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CONTENTS

Feature Article

THE ROLE OF BIAZA MEMBERS IN THE CONSERVATION OF CRITICALLY ENDANGERED PRIMATES

HOLLY BARNES MENVSCI.
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Introduction

To date 625 different species and subspecies of nonhuman primate have been discovered (Mittermeier, *et al.,* 2005) and through field research and improved genetic techniques new species are still being described. While the number of extant primate species grows the World's primate populations are shrinking. At present it is estimated that 26% of nonhuman primates are in immediate danger of extinction (Mittermeier, *et al.,* 2005). In 2004 the World Conservation Union (IUCN) classified 56 primate species (8.96% of known species) as critically endangered. The world's zoos hold thousands of different species and more than 600 million people visit them each year (WAZA, 2005). With such a massive potential to influence people, zoos are an obvious source of conservation education and in recent years education has become a major focus of zoo work. In its position as an educator, a zoo is well placed to promote conservation projects and raise money to fund them. British zoos are regarded as some of the best zoos in the world and consequently have both an opportunity and a responsibility to make a major contribution to conservation efforts.

Methodology

A complete list of critically endangered primates was obtained from the IUCN Red List (IUCN, 2004) and a list of full BIAZA members was obtained from BIAZA (BIAZA, 2005). BIAZA members keeping primates were then contacted with a questionnaire which had been approved by the BIAZA Primate TAG and Research Group. This covered all aspects of conservation breeding, education, research, fundraising and involvement in *in situ* projects related to critically endangered primates. Responses were combined with data from other sources, such as the International Species Inventory System (ISIS) (ISIS, 2006). Every effort was made to ensure that the data used in this study was as complete and current as possible but, due to natural fluctuations in population size and changes in zoo collections, the data used cannot be considered to be exact, all data was correct as of 1st January 2006.

Results

On the 1st January 2006 BIAZA had 68 full members, 45 of which kept primates (30 of which responded to the questionnaire), 28 of which kept critically endangered primates. Only 14 (of 56, i.e. 25%) critically endangered primate taxa were represented in BIAZA zoos. The total BIAZA populations of these taxa varied considerably ranging from two (*Hapalemur simus, Propithecus verreauxi coronatus* and *Trachypithecus vetulus nestor*) to 81 individuals (*Varecia variegata rubra*).

Jersey Zoo (Durrell Wildlife Conservation Trust) plays a key role in the keeping of the BIAZA zoo critically endangered primate populations as it keeps a considerable proportion of the Alaotran gentle lemurs, *Hapalemur griseus alaotrensis,* pied tamarins, *Saguinus bicolor* and black lion tamarins, *Leontopithecus chrysopygus*. However, other BIAZA members keep the entire BIAZA population of some critically endangered primates these include Twycross, Belfast, Linton and Edinburgh Zoos.

Conservation Breeding

Seven of the 27 European Studbooks (ESBs) and 11 of the 44 European Endangered Species Programmes (EEPs) for primates were coordinated by BIAZA or BIAZA members (two for critically endangered primates). As BIAZA zoos make up 11.41% of EAZA members they are very highly represented in the coordination of studbooks.

Education and Research

Of the 30 zoos which replied to the questionnaire, 20 had designated education centres and 23 employed staff specifically for educational purposes. In recent years zoo-based education programmes have re-focused to target adult visitors as well as younger children but school children remain their primary audience with participating zoos reporting visits from between 500 and 61,766 school children per year as part of organised school visits. Research was a growing field with two of the participating zoos running their own research departments with dedicated research staff. The most common means by which BIAZA member zoos participate in research is through allowing students or visiting researchers to study their animal collections, 18 participating zoos reported doing this. However, some zoos such as Jersey Zoo (Durrell Wildlife Conservation Trust) also fund field research scientists' work. Of the 28 BIAZA zoos which keep critically endangered primates, 15 were active in education and research initiatives involving those taxa.

Fundraising

EAZA campaigns were the biggest single cause of fundraising activities amongst EAZA members within BIAZA. Past campaigns have raised hundreds of thousands of pounds so it can be assumed that the EAZA Madagascar Campaign 2006-2007 will be as successful. Many zoos stated that they always supported the annual EAZA campaign so it seems likely that many Madagascan conservation projects will benefit from the funds raised. These projects will involve lemurs and as 11 lemur species and subspecies are critically endangered this campaign will have a considerable beneficial effect on critically endangered primates. As well as participating in annual EAZA Campaigns many BIAZA members also contribute funds to primate groups such as Cercopan, AEECL and the Madagascar Fauna Group.

In Situ Project Involvement

A survey carried out by BIAZA in 2001 showed that in the previous three years members had supported 177 field conservation projects in 62 countries, contributing over ten million pounds. Members also contributed to these projects with husbandry and management skills, equipment and by developing local education programmes (BIAZA, 2005). It is clear that at present the most common way in which BIAZA member zoos participate in *in situ* conservation initiatives is through financial means. However, some zoos are active in *in situ* conservation, the Durrell Wildlife Conservation Trust, based at Jersey Zoo is currently actively working in the field with four critically endangered primate species.

Conclusions

The most important conclusion which can be drawn is that BIAZA zoos appear to be very active in the conservation of critically endangered primates. They hold a considerable proportion of the total captive population of critically endangered primate species and coordinate more EAZA breeding programmes for primates than would be expected for such a small number of zoos. BIAZA zoos also appear to be out-performing other zoos of equal or larger sizes in fundraising initiatives.

A number of zoos stand out in their work with critically endangered primates, the most outstanding being Jersey

Zoo (Durrell Wildlife Conservation Trust). Jersey Zoo not only coordinates the only two EEPs for critically endangered primates run by BIAZA zoos, it is also one of three zoos keeping the highest number of critically endangered primate species in BIAZA and keeps almost four times the number of individual

critically endangered primates of any other BIAZA member zoo. It is also one of the most active BIAZA zoos in the fields of education and research, fundraising and *in situ* conservation efforts. Jersey Zoo is a relatively small zoo with an income limited by its island location; as such it would be expected to play only a small role in large conservation efforts. Conversely Jersey Zoo sets an example that all other zoos can follow should they choose to develop their conservation initiatives with critically endangered primates.

Chester Zoo, Edinburgh Zoo, Belfast Zoo and Shaldon Wildlife Trust all stand out as institutions concerned with the conservation of critically endangered primates, being in the five BIAZA zoos holding the highest number of critically endangered primate species. Colchester Zoo stands out as having a particularly diverse range of education initiatives involving critically endangered primates. The Zoological Society of London (London Zoo and Whipsnade Zoo) and Colchester Zoo stand out as being particularly active in fundraising for critically endangered primates.

While BIAZA zoos can be seen to be actively conserving critically endangered primate species, it must be remembered that only 14 of the 56 different species and subspecies of critically endangered primate are present in BIAZA zoos. In order for BIAZA zoos to help conserve the species which do not occur in captivity (37 species and subspecies worldwide) they must implement or contribute to field conservation initiatives targeting habitat conservation or aiming to reduce hunting pressure and other human-induced threats. BIAZA zoos are in a good position to contribute to field initiatives with their considerable experience with a variety of primate species and an audience willing to participate in fundraising activities walking through their gates everyday.

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Research Snippets

A KEY FOR IDENTIFYING MAMMAL HAIRS FROM HAIR TRAP SURVEYS IN THE UDZUNGWA MOUNTAINS, TANZANIA.

PHILLIPA BROWN[1,2] AND ANDREW BOWKETT[2],
[1]University of Plymouth, [2]Paignton Zoo Environmental Park

The Udzungwa Mountains are part of the Eastern Arc range in Tanzania, a global biodiversity hotspot with high levels of endemism and endangered fauna. This includes a rich, but very poorly studied forest antelope community, including the endangered Abbott's duiker (*Cephalophus spadix)*. Researchers from Paignton Zoo are trying to establish reliable methods to monitor forest antelope populations and during 2005 tested the use of hair traps. These were set up in the Mwanihana Forest in the Udzungwa Mountains to catch hair from terrestrial mammals walking past the traps.

This project aimed to identify the hairs caught in the traps to species level. The first step was to establish a key to the hairs of mammalian species of the Udzungwa Mountains using known hair samples obtained from the Bulawayo Natural History Museum, Zimbabwe. A total of 37 species have so far been identified and characterised based on cuticular scale patterns of hairs, but other features of hair morphology

are also useful. The limitations of the key were examined; the main limitation being that small differences in cuticular scale patterns are sometimes used as diagnostic criteria to enable identification to species level.

The success of hair trapping is compared to camera trapping results from the same area to investigate the method's potential for estimating relative population abundance. For those species caught by both hair traps and camera traps there is a strong positive correlation between the number of hairs and the number of images ($r_s = 0.825$, $p = 0.002$). Both the hair samples and the camera images provided evidence for the rare Abbott's duiker, a flagship species for the Eastern Arc Mountains.

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PUBLIC PERCEPTIONS OF ZOOS: CONSERVATION OR ENTERTAINMENT

STUART COLLIER
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Education and conservation are defined roles of the modern zoo. This study investigated whether the message of conservation was being received by zoo visitors and members of the public not visiting a zoo, or whether zoos were still perceived as establishments primarily for entertainment. Questionnaires were used to determine the motivation for visiting zoos, and the perceived role of zoos by actual zoo visitors at Paignton Zoo and Newquay Zoo and by members of the general public in Plymouth city centre (all in the south west of England). Questions also investigated the effectiveness of education at UK zoos and whether or not zoos were getting across the message of conservation.

No significant difference ($P<0.05$) was found between the two samples in relation to the perceived main role of zoos and the motivation for visiting: conservation was considered to be the main role of zoos by both groups, but 72.4% of zoo visitors and 75.3% of the general public stated that entertainment was the main motivation behind visiting zoos. Both groups considered information at enclosures to be the most effective tool in educating people about conservation. A large majority of zoo visitors (80.6%) and 44.7% of the public stated that they were educated about conservation during their last visit to a UK zoo. Information about the zoo's conservation activities was considered to be an important or very important aspect of a zoo visit by 74.7% of zoo visitors and 61.2% of the public. This study highlights the importance of conservation education at zoos and the potential for zoos to further spread the message of conservation through education.

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DEVELOPMENT OF A RELIABLE NON-INVASIVE METHOD TO MONITOR SKIN, COAT OR PLUMAGE CONDITION

DIANA MATTHEWS, DIANA RODRIGUEZ AND JOHN EDDISON
University of Plymouth

Colour is suggested to be a reliable indicator of health status in animals. External colouration in animals is due to the expression of pigments many of which are exclusively obtained from the diet and only healthy individuals are capable of metabolizing and expressing them in a way of external colouration. Since the expression of colour is condition dependent, the monitoring of colour change in animals could be a determinant of the health and welfare status of animals.

This study investigated a method to quantify changes in colour of animal skin, coat or plumage over time, using digital imagery as a non-invasive means of data collection and coloured boards for calibration purposes to adjust for differing ambient light conditions. Photographs were processed using Adobe Photoshop 8.0 to obtain a score of red, green and blue (R:G:B) in each part of the individual. After mathematical adjustments to account for ambient changes apparent in images of the coloured boards, a statistical analysis showing the fluctuation of colour throughout time was performed to determine whether the colour fluctuations were significant. Eleven animals, housed at Paignton Zoo Environmental Park, were monitored over a period of 12 weeks; Papuan wreathed hornbill (*Aceros plicatus*), wrinkled hornbill (*Aceros corrugatus*), ostrich (*Struthio camelus*), red crowned crane (*Grus japonensis*), crested wood partridge (*Rollulus roulroul*), mandrill (*Papio sphinx*), Diana monkey (*Cercopithecus diana diana*), red river hog (*Potamochoerus porcus*), tapir (*Tapirus terrestris*), basilisk (*Basiliscus plumifrons*), and reticulated gila monster (*Heloderma suspectum suspectum*). It was found that there was a significant change in colour over time observed for the crown of the red crowned crane. This may be related to enhanced foraging efforts of

the bird as it was providing for its newly hatched offspring. Significant changes in colour were also observed in the bill casque of the Papuan wreathed hornbill suggesting changes in UV reflectance as the region examined was cream coloured and bony in appearance. There were also significant colour changes in the basilisk possibly due to it undergoing its shedding process. None of the other species showed significant colour variation over time.

The technique was deemed reliable and has potential as a non-invasive measure of colour intensity. However further investigation and trials are recommended to prefect the technique and determine whether calibration of ambient lighting with coloured boards is accurate enough to enable the technique to be useful as a welfare indicator.

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POST-MORTEM AND PATHOLOGY ANALYSES OF CAPTIVE ZOO WATERFOWL AND OTHER NONPASSERINE AVIAN SPECIES, AND FUTURE HUSBANDRY RECOMMENDATIONS.

ELIZABETH ROUSSOU AND HAYLEY RANDLE, UNIVERSITY OF PLYMOUTH

To determine differences in the cause and rate of death between 92 individual birds of 27 distinct species belonging to the orders Columbiformes, Passeriformes, Anseriformes, Ciconiiformes and Galliformes within Paignton Zoo Environmental Park, the pathology and post-mortem records (dating from 2000-2005) of all selected individuals were assessed. Environmental parameters, the content and design of each enclosure previously occupied by the animals and the general history of each individual prior to death were also evaluated. The results revealed that the main causes of death were chlamydosis, caused by the bacterial pathogen *Chlamydophilia psittaci*, trauma, and parasitism by *Ascaridia* species and herpesvirus. In 14% of all cases, the cause of death was unknown. Female mortality incidents (46%) were higher than male (37%). Red turtle doves (*Streptopelia tranquebarica*) and speckled pigeons (*Columba guinea*) were the species most affected by bacterial and viral pathogens. The highest death rate was noted in a netted enclosure, Brookside aviary (68%). Evaluation of environmental factors and other captive parameters were not analysed due to a lack of data. Future research, within a captive setting, in order togain knowledge of inter and intra-species pathogen occurrence and methods of disease transmission would bebeneficial and the knowledge gained could be incorporated into future husbandry routines.

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Feature Article

THE MEASUREMENT OF VISITOR DENSITY AND ITS EFFECT ON VISITOR BEHAVIOUR IN ZOO EXHIBITS

ANDREW MOSS, DAVID FRANCIS AND MAGGIE ESSON
North of England Zoological Society, Chester Zoo

Introduction

Bitgood (1992) raised the intriguing notion that visitor density could have a dual effect - 'people tend to approach an area containing other people, unless it is too congested in which case a crowd may have a repelling effect'. In other words, at relatively low levels, visitor density at an exhibit element can attract other visitors. But at high levels density can actually repel visitors away from the exhibit element, even though the element may be extremely appealing. In the case of zoo exhibits, the most likely locations for overcrowding are viewing areas for animals - especially those species that have a high popularity, such as big cats, primates and elephants (see Bitgood et al., 1988, Ward et al., 1998 or Balmford et al.,1996 for relative popularity of different animal taxa). Studies conducted at Chester Zoo suggest that this phenomenon does occur; the challenge for researchers is to quantify it. If visitor density is an important variable in defining visitor behaviour, it could have an impact on exhibit design as well as visitor satisfaction. Do visitors prefer larger or smaller, more discreet viewing areas? Is it possible that popular viewing areas can become so crowded that visitors are actively repelled?

There have been numerous studies on how visitor density affects animal behaviour (see Hosey, 2000 for a review), but surprisingly little research has been undertaken into how visitor density affects visitor behaviour in zoos. Marcellini and Jenssen (1988) found that at the National Zoo's Reptile House (Washington DC) time spent looking at exhibits was significantly negatively correlated with density. Derwin and Piper (1988) found that at the African Rock Kopje exhibit (San Diego Zoo) most people did not look into all six windows during the high-density times but viewed only two or three. When the crowds were less dense, people tended to look into all six windows. In contrast Phillpot (1996) found that time spent in the Gaherty Reptile Breeding Centre (Durrell Wildlife Conservation Trust, Jersey) did not vary significantly with increasing visitor density.

The methodology for measuring visitor density is itself a contested issue. Davey (2006) has shown that density can fluctuate significantly during the course of a single, relatively short visit, and that consequently, density is a difficult variable to measure accurately. Here, using the example of a Belanger's tree shrew (Tupaia belangeri) viewing area, itself part of the larger 'Elephants of the Asian Forest' indoor exhibit at Chester Zoo, we try to show that methodologies can be developed to measure visitor density and its effects in a more precise manner, that could be useful to zoo planners.

Methodology

A random sample of 240 visitor groups were unobtrusively tracked around the large 'Elephants of the Asian Forest' exhibit at Chester Zoo. The first visitor in the group to make a definite movement towards an exhibit element was then selected as the sole target for tracking. As part of a larger study data on many variables were collected including visitor dwell time at various exhibit elements (animal viewing areas, interpretation etc), time of day and group composition. Of specific relevance to this article, visitor density was recorded at the viewing window for Belanger's tree shrew (Tupaia belangeri) an integral species within the larger elephant exhibit. The Belanger's tree shrew viewing window is situated on the main path around the exhibit and features a large, single glass window, approximately 2.5m wide and 1.1m tall (situated 80 cm above the ground). The enclosure is attractively themed externally and is well planted and naturalistic inside. The pathway running past the window is approximately 3m wide, and consequently, every visitor has to pass this viewing area quite closely. During this study, this particular species was very active, and while small, could have been viewed easily by a stopping visitor. Visitors that merely glanced at the exhibit however, may not have been rewarded with a view.

Density was recorded to test whether visitors would make an initial decision to stop or not based on the number of visitors already at the viewing area. A density reading was made only if the animal was visible and as the tracked visitor approached the viewing window. Whether the visitor then stopped at the window

was recorded. Measurements were also made at the viewing window to determine how many visitors could fit comfortably within the defined space. This 'comfortable viewing' density (i.e. the number of visitors that are able to occupy the viewing area in a single row) was found to be a maximum of six adult visitors. After six visitors a second row would typically be formed. Chi-squared tests were used to statistically assess any differences in visitor behaviour depending on the density of visitors already at the window (0 visitors, 1-6 visitors, >6 visitors).

Results

Visitor behaviour showed a pattern similar to that suggested by Bitgood (1992) (fig.1). When visitor density was at zero, stopping rates made by visitors were lower than at any other time. At the 'comfortable viewing' density range stopping rates were at their highest point. As density increased beyond single row viewing stopping rate decreased, although not to the level seen at zero density. The difference between the three categories was highly significant ($\chi^2_{[2]} = 21.22$, $p < 0.001$).

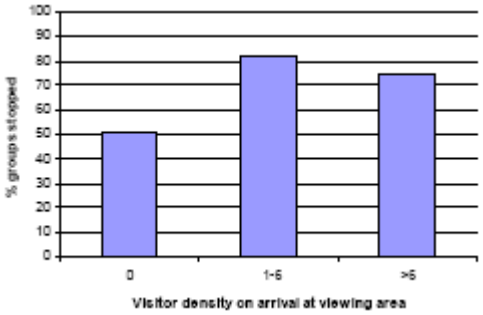

Fig. 1 Proportion of visitors that stopped at the Belanger's tree shrew exhibit in relation to visitor numbers already in situ (% stops at density 0 = 50.7 or 39 stops out of 77 groups; % stops at density 1-6 = 82 or 82 out of 100 groups; % stops at density >6 = 74.6 or 47 out of 63 groups).

To avoid any methodological assumptions that were made in the recording of single row or 'comfortable viewing' (i.e. variation in average number of visitors able to fit at a viewing area or whether single row viewing is an issue at all for visitors) the same data were analysed in two classes (fig.2). There was a highly significant difference between the stopping rates at zero density and any density above this ($\chi^2_{[1]} = 3.96$, $p < 0.01$).

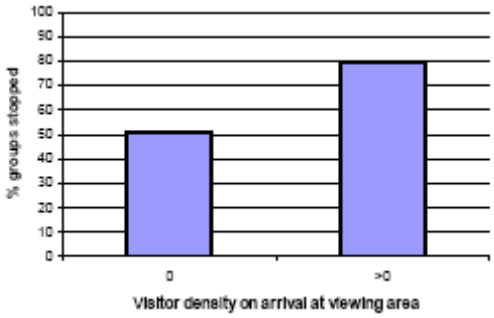

Fig.2 Proportion of visitors that stopped at the Belanger's tree shrew (Tupaia belangeri) exhibit in relation to visitor numbers already in situ (% stops at density 0 = 50.7 or 39 stops out of 77 groups; % stops at density >0 = 79.8 or 130 stops out 163 groups)

Discussion

The results suggest that the effect stated by Bitgood (1992) does occur at this particular viewing area. The tree shrew viewing area shows the same pattern of attraction under low densities but a slight repelling effect at high densities. Zero density however seems to be the least successful in attracting visitors. It is worth noting that zero density seems to have a larger effect on visitors' stopping choice than very high densities. This is perhaps because if no-one is viewing, others may believe that there is nothing worth stopping for. It is possible that at very high densities, some visitors will be repelled and will simply move on while others will wait their turn. The threshold that density pressure takes effect can be very different. This is dependent on the individual and their relationship to others viewing; for example, members of the same visitor group. It was felt useful to include a more simplified version of these data (fig.2) without any

allowance for single row viewing. Again we find that visitors were significantly more likely to stop if another visitor was already present at the viewing area. This is a clear further indication of the relationship between the attracting power of an exhibit and the visitors already in attendance.

Other visitors clearly have a large influence on the behaviour patterns of others. For zoo professionals, particularly those involved in exhibit design, these patterns could have far-reaching effects. If visitors are attracted and repelled by the presence of other visitors, then clearly the exhibit planning process should factor in these needs by avoiding 'pinch points' in exhibits, as well as making viewing areas sufficiently large to allow visitors to view animals in a less-pressured environment. However, the provision of larger, more open viewing areas and the possibility of increased visitor pressure could create animal welfare issues for some species. From a visitor studies perspective this study emphasises the importance of recording visitor density since this variable significantly affects the attracting power of exhibits.

It is acknowledged that there are limitations to this study. Only one viewing area was assessed and some assumptions have been made as to how visitors decide whether to stop or not at viewing areas. It is hoped that this study can act as a catalyst for further work, perhaps including a refinement of this methodology.

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Research Snippets

Winner of the best student/keeper oral presentation, BIAZA 9th Annual Research Symposium, ZSL Whipsnade

THE LEAF PREFERENCE OF A CAPTIVE COLONY OF LEAF-CUTTER ANTS (ATTA CEPHALOTES)

LIAM SHEPHEARD AND ALEXANDER KENT
Drusillas Park

Captive leaf-cutter ant (Atta cephalotes) colonies can be seen within many collections throughout the UK, despite this there has been very little ex situ research focusing on their behaviour. This study therefore aimed to expand our knowledge of the leaf preference of a captive colony of this species, with a view to enhancing their husbandry and management. The study focused on the provision of five plant species which were frequently utilised as leaf material for the colony with a view to discover which species is preferred. The results indicate a significant preference for spotted laurel (Aucuba japincia). Of the total leaf mass harvested 49.32% was from this species, double the quantity of the next most harvested species, Euonymus japonicus (25.05%). An unexpected result showed that there was a gradual increase in preference towards Elaeagnus ebbingei over the course of the study. This corresponds with the natural seasonal growth pattern of this species. A second aim of the study was to investigate whether there was any temporal variation in the ants' harvesting behaviour. The results showed no difference in activity between the day and night time period, except when harvesting for Aucuba japincia where the colony were significantly more active during the day ($\chi 2_{[1]} = 0.03$, $P<0.05$). This study suggests that there is a leaf preference forThis study suggests that there is a leaf leaf-cutter ants and that harvesting activity is more substantial during the day. This has implications for the management of the species in an ex situ environment and the plant species offered.

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Winner of the best student/keeper poster presentation, BIAZA 9th Annual Research Symposium, ZSL Whipsnade

FORAGING DEVICES INCREASE SPECIES-TYPICAL BEHAVIOURS IN ZOO-HOUSED PRIMATES

LOUISE LOCK, CHRISTINE MOINARD
University of Edinburgh, Jackie Hooley, Kris Hern, Rebecca Pink, Twycross Zoo

In the wild, primates have many choices and exhibit a wide repertoire of natural behaviours. In captivity most decisions are out of their control. If denied the opportunity to perform species-typical behaviours, psychological well-being can be compromised. This can result in high levels of inactivity and abnormal behaviours. A variety of environmental enrichment techniques can be used to make captive environments richer in stimulation and positively affect the welfare of captive primates.

Feeding enrichment is increasingly used to encourage species-typical behaviours. For this study two custom-made foraging devices were presented to two zoo-housed primate species, woolly monkeys (Lagothrix lagotricha) and chimpanzees (Pan troglodytes). The woolly monkey troop demonstrated significantly increased foraging behaviours when the provided with the devices. The chimpanzees showed a marked preference for the more complex device. The foraging devices increased species-typical behaviours and were used by most of the primates.

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IMPROVING LITERACY, NUMERACY AND COMMUNICATION SKILLS IN STUDENTS WITH LEARNING DIFFICULTIES USING ACTION RESEARCH AT BLACKPOOL ZOO

SARAH THOMAS
Blackpool Zoo

Since 2005 a local agricultural college has been in partnership with Blackpool Zoo providing weekly group work experience for a number of animal care students with learning difficulties. Due to their varying abilities many organisations can not provide placements as too much individual support is needed. In the first year the group included six female and five male students, aged 16-29, with varying physical and learning special needs.

As well as practical experience working in the collection it was decided that an intervention could be performed that required the students to improve their literacy, numeracy and communication skills whilst on the placement. The scheme was based on action research methodology using the zoo and its wide selection of species as a tool for learning. At the end of each term the students were asked to produce an A2 size poster and give a 5-10 minute presentation about a selected animal species in the zoo. They were given 2-3 sessions of preparation time. The first presentation was in a group of 3 individuals, then in pairs and the last one at the end of the academic year was given individually. Before each presentation the students were asked about their thoughts and feelings regarding the talk. This was documented and words coded into positive and negative responses. After the sessions they are also asked specific questions regarding their performance. Feedback and questions from other members of the group was also initiated and the comments and scores used as product evidence of assessment.

The key questions that have been asked during this research project are:

- Do group tasks improve social skills
- Does peer feedback improve individual performance
- Is confidence built through activities involving animals and verbal communication
- Are literacy skills improved through practical tasks based on animals

This action research project is qualitative in nature; the data are not subject to formulaic analysis and often make use of more open ended questions that allow expression of opinions and attitudes. Qualitative data collected comprised of open ended questions and the nature of data is words, images and categories that are then analysed to discover themes, patterns and holistic features. With these kinds of studies there has to

be a clear focus to the project but there is usually a minimum pre-structuring and a high degree of flexibility. Researchers do not claim to find the final answer to a question, but do claim to improve and change practice through the development of an educator.

Blackpool Zoo, as other collections, has a large number of groups with a variety of learning difficulties. Due to the cyclic nature of the action research project it has allowed the collection to improve its provision of teaching methodology for a number of disability groups. The students' perspective of their achievable goals regarding literacy, numeracy and communication has been altered. The college was so amazed by the improvement of the group that it has renewed the contract with the zoo for a further two years, which means substantial amounts of funding will be guaranteed for this project.

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SHOULD ZOO FOOD BE CHOPPED?

KIRI GREEN, LAURA TAYLOR
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In many zoos the food, particularly fruit and vegetables, provided for a range of animals is chopped into small pieces even though the animals are capable of processing much larger food items. Chopping food takes up keeper time and the chopped edges increase the risk of bacterial contamination and food spoilage. Leaving food whole may increase food processing time and allow the animals to express more natural foraging and feeding behaviour. Among the reasons given for chopping food are that: it enables all individuals in a group of animals to obtain enough food and a variety of food items, it prevents wastage caused by animals taking one bite and then discarding the rest of a large item, it enables a wider scatter feed to encourage foraging behaviour and prevent aggression during feeding. None of these reasons have been extensively tested so this research aimed to investigate the possible advantages of chopping food.

The research was conducted on a group of Sulawesi crested black macaques (3.5.3) at Paignton Zoo and Brazilian tapirs at Paignton Zoo, Newquay Zoo and Bristol Zoo. Paignton and Bristol tapir groups consisted of an adult pair and their latest infant (both 4 months old) and at Newquay it was a mother and her infant (6 months old) and all tapir individuals were studied. For the macaques three adult female subjects were selected on the basis of their known dominance status: the most dominant female, the most subordinate female and a female of intermediate status. The usual fruit and vegetable feed provided to each group was offered in four conditions: chopped and clumped, chopped and scattered, whole and clumped and whole and scattered, such that the total amount of food was the same on each day. The average piece size and total weight of each fruit or vegetable type was recorded each day and any food uneaten each day was weighed. Each study subject was observed individually during feeding time and the number and type of each food item eaten recorded along with any aggression and the total time spent feeding. Each subject was also observed for two 30 minute sessions at other times throughout the day and their behaviour recorded using instantaneous sampling every minute. The data were analysed using randomisation tests equivalent to two-way ANOVAs to determine the effects of food item size and presentation method on total weight of food consumed, diversity of food items consumed, total feeding time, aggression during feeding, behaviour throughout the day and total food wasted.

For the macaques food size and presentation did not significantly affect any of the variables measured when looking at the whole group. However when just looking at the most subordinate individual she was able to obtain significantly more food (randomisation test, $P = 0.008$) when it was left whole rather than chopped, but scattering or clumping the food made no difference. For the tapirs the only statistically significant difference was found at Paignton Zoo where the chopped/clumped condition resulted in significantly less foraging behaviour throughout the day than the whole/clumped condition (randomisaton test, $P = 0.013$) with both scattered conditions (whole and chopped) being intermediate.

These results indicate that the suggested advantages of chopping food (more equal access to food and less aggression in groups, greater foraging time if scattered, less wastage) are not actually evident. In fact the only significant results indicate that leaving food whole may be better in that it enables subordinate animals to obtain more and may promote foraging time. Therefore, for animals that are capable of processing it, food should be left whole to avoid the increase risk of contamination and save keeper time.

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AQUARIUM CONSERVATION RESEARCH TRAINING

JANET UTTLEY
Blue Planet Aquarium

Blue Planet Aquarium based in Cheshire together with their sister site, Deep Sea World in Scotland, are increasing their working relationship with the Marine Conservation Society to ensure that visitors to both sites are made aware of the work undertaken in support of the Marine Bill, which includes the important Marine Reserves campaign. The campaign provided a focus for a Gala Evening held recently at Blue Planet Aquarium linked to Ocean Awareness Weekend. Enticing local businesses and key tourism contacts to not only dig deep and donate money, but also to widen their knowledge of the important elements of the Bill and what their business and personal actions can do to support it.

On the night Dr Jean-Luc Solandt, Biodiversity Policy Officer from the Marine Conservation Society set the scene with a thought provoking speech on the need for the Bill and highlighting that what is natural in the sea has entirely altered due to human influences. He went on to say that the advent of SCUBA has enabled us to really understand what has been lost. As both sites run Discover SCUBA and Dive Night sessions it was something encouraging for staff members themselves to hear.

Using the backdrop of the Aqua Theatre enabled the keynote speaker, BBC Coast presenter Miranda Krestovnikoff to give an insight into her own work not only as a presenter but as a passionate advocate of marine conservation. “Many people talk the talk but so few actually do something about it” said Park Director Andy Hygate. “As an attraction with a wide and varied audience, both in age and ability, it is our aim to educate and inform in a manner that easily understood.” He went on to say “Through our BlueWatch group our activities both on site, through hosting special events and off site via beach cleans and local ranger activities, are set to grow.” Deep Sea World are following a similar pattern with focus on Basking Sharks and a specially formulated course entitled ‘Seasearch Fish Identification’.

Breaking news: Deep Sea World in Scotland has just confirmed that its female Angel Shark is pregnant. This is a first for this species in a captive environment. It represents an important step in the understanding of this increasingly rare shark species whose natural habitat is found within European waters.

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Feature Article

SUSTAINABILITY IN THE BRITISH ZOOLOGICAL COLLECTIONS SECTOR

SOPHIE OLIVER
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Introduction

This project explores the range of sustainability activities carried out by BIAZA member zoological parks and aquariums ('zoos'), compares activities and approaches and makes recommendations for the sector. Sustainable development is 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. Sustainable development requires balancing social and ecological factors alongside economic needs, in a Triple Bottom Line approach. To follow this approach, zoos need to be economically viable, as well as being socially responsible (fulfilling people's cultural, material and spiritual needs) and being ecologically sensitive (protecting and enhancing natural ecosystems). In recent decades, zoos have positioned themselves as centres for conservation, where species survival and holistic conservation are the main concerns. Zoos articulate the desire to inspire people to care for wildlife and to conserve the environment through their missions. Zoos are therefore obliged to participate and promote environmental sustainability. BIAZA member zoos attract over 18 million visitors a year and appeal to a wide cross-section of society. With their widespread popularity and trusted position in the community, zoos are also well-placed to demonstrate and encourage social sustainability

Method

Primary data from 52 BIAZA-member zoos were collected through surveys and interviews with selected personnel. Questions were prepared in three sections to ascertain zoo profiles, their level of engagement in sustainability practices, and the different approaches employed to implement sustainability objectives. In addition annual reports for seven BIAZA zoos were examined for their sustainability content.

Results

Policies in place: Social policies relating to employees existed in almost 90% of zoos and had been in place for many years, but few zoos had policies relating to visitors and the wider community. Environmental policies existed in two-thirds of zoos, and usually they had been in place for at least three years. Economic policies, such as sustainable procurement, were less common and existed in on third of zoos, and most had been in place for under a year. A higher proportion of local authority zoos had policies in place than charity or privately owned zoos

($\chi^2_{[1]}$=12.91, df 2, p=0.002) suggesting a stronger tendency for local authority zoos to work within a policy framework to achieve sustainability goals.

Sustainability reporting: Only the most recent annual reports (2005 and 2006) included any reference to sustainability issues and none featured specific targets or performance-related achievements. Zoo annual reporting is still very much focused on the financial bottom line rather than a Triple Bottom Line.

Recognised environmental standard:A third of zoos were using an accredited environmental standard to make operational improvements to sites, most commonly ISO14001.

Designated personnel: Around half of zoos had a designated team or officer in place responsible to achieve sustainability objectives on site. Zoos with designated teams or officers were more likely to be using a sustainability standard ($\chi^2_{[1]}$=9.13, p<0.01), to be achieving cost savings through better environmental management ($\chi^2_{[1]}$ =12.94, p<0.001) and to be using renewable energy on site ($\chi^2_{[1]}$ =13.00, p<0.001).

Economic sustainability: Economic factors were most frequently considered when making purchasing decisions, with ecological and social factors less frequently considered (figure 1). Over 90% of zoos were reducing energy use, three quarters were reducing water use, half were reducing car travel, and 20% were reducing air travel. Two thirds of zoos were increasing public transport links to their site, such as through incentives for bus and bicycle visitors, and developing new routes with transport providers. A third of zoos used renewable energy, either bought from a supplier or generated on site, such asthrough wood-fuel burners, solar panels, wind turbines and seawater underfloor heating. Around 15% of zoos were offsetting carbon emthrough wood-fuel burners, solar panels, wind turbines and seawater underfloor heating. Around 15% of zoos were offsetting carbon emissions, some zoos were counting tree planting on site as an offsetting measure.

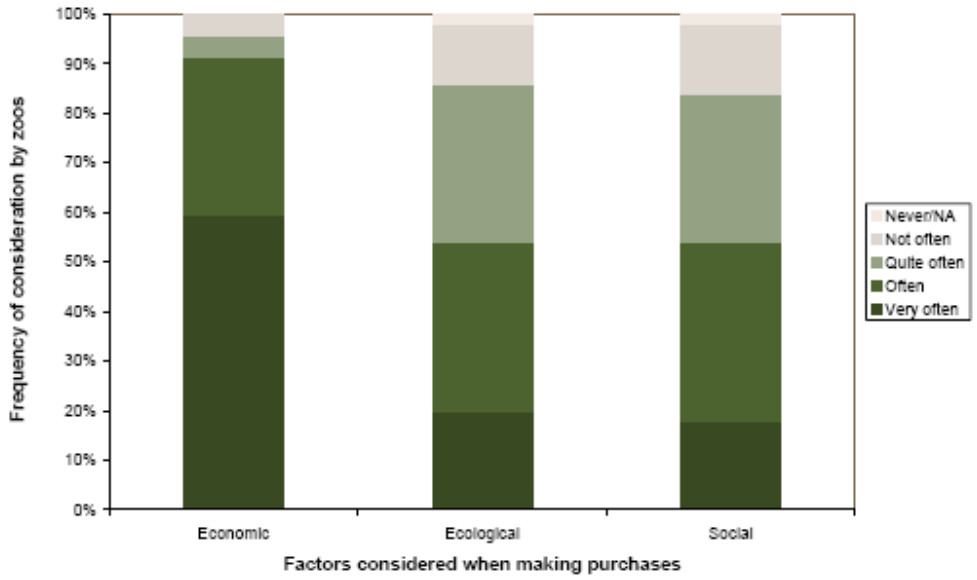

Fig. 1 How often factors are considered when purchasing decisions

Social sustainability: Three quarters of zoos sought to involve local communities in their decisions – such as through external advisory groups. Zoos communicated sustainability matters most frequently to staff and visitors, but least frequently to the general public or to partners and sponsors (figure 2). All zoos used local goods and materials, and over 80% of zoos made ethical purchases, such as buying Fair Trade products to sell in their shops and cafes. No zoos said they had a site-wide policy on purchasing ethical products.

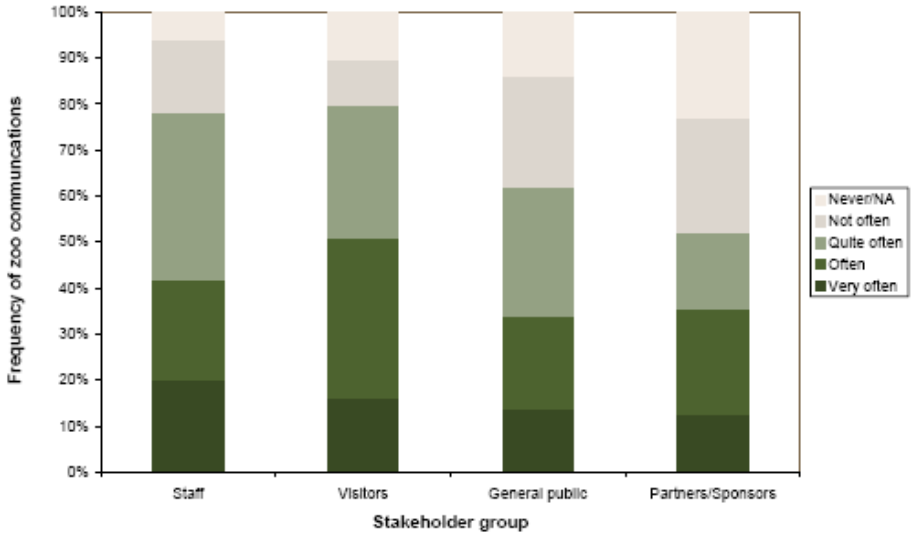

Fig. 2 Frequency of communicating 'sustainability' to stakeholders

Ecological sustainability:A small number of zoos had calculated their Ecological Footprint and others had collected similar data as part of their Environmental Management System. One zoo was developing a zoo-specific Ecological Footprinting tool that could be used by the sector as a whole. Over 90% of zoosmanaged their sites for local biodiversity, such as through creating new habitats, biodiversity monitoring, and control of invasive species. All but one zoo said they reused or recycled a number of materials on site, and three quarters said they had benefited from cost savings associated with this (figure 3). A quarter of zoos used sustainably sourced fish products, indicating that they were taking positive action on the issue of overfishing. Two thirds of zoos grew browse for their animals, demonstrating a self-sufficient approach to supplying browse. Overall charity zoos carried out a wider range of sustainability activities than private or local-authority owned zoos ($\chi^2_{[1]}=23.41$, $p<0.001$). Zoos with a smaller annual visitor numbers carried out a wider range of sustainability activities than larger zoos ($\chi^2_{[1]}=4.88$, $p<0.05$).

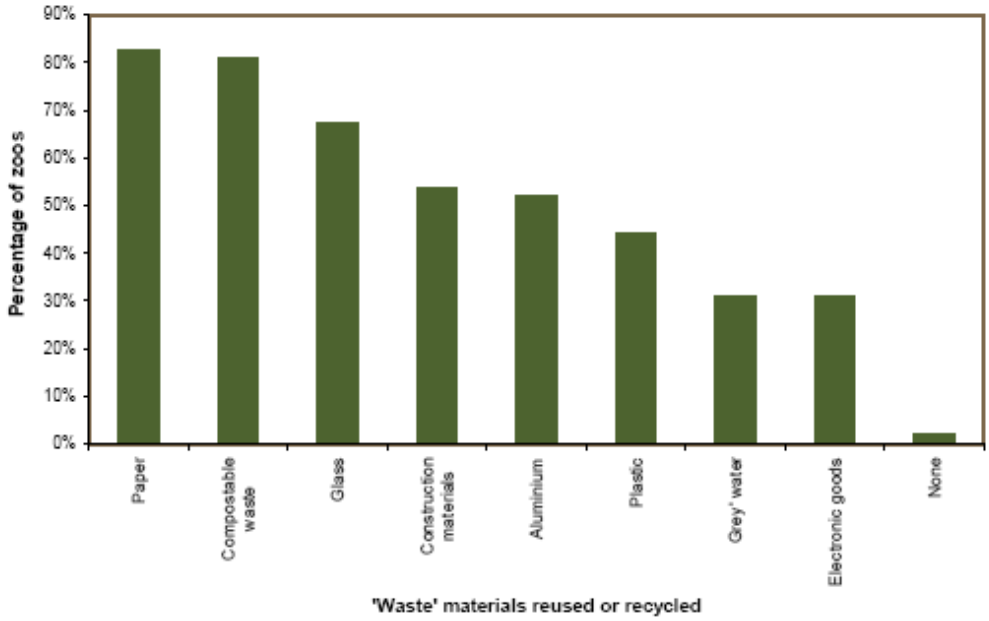

Fig. 3 Percentage of zoos reusing and recycling different materials

Implementing sustainability objectives:The most relevant factors for successfully implementing sustainability goals were identified as that sustainability related to zoo missions, that zoos were morally obliged to get involved and that there was strong commitment from top managers. The most relevant factors inhibiting the delivery of sustainability goals were the cost of implementation, that other work took priority, and that there was a lack of designated personnel.

It is recommended that zoos

1. Consider and balance economic, social and environmental sustainability factors in all organisational decisions.
2. Establish clear policies on sustainability matters to ensure the adoption of an organisation-wide approach.
3. Adopt a common approach to calculating Ecological Footprints and measure performance on an annual basis.
4. Work towards the accreditation of an Environmental Management System (e.g. ISO14001).
5. Develop clearly defined roles and teams to take forward the sustainability agenda within the organisation.
6. Display a consistent approach to sustainable and ethical procurement across the organisation.
7. Reduce carbon emissions as much as possible before engaging in offsetting activities.
8. Increase the involvement of local people and communicate sustainability best practice to visitors and the public.
9. Develop a formal Triple Bottom Line reporting framework to report on sustainability performance annually.
10. Work together with other zoos to make collective progress towards a more sustainable approach.

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Research Snippets

INFERENCES ON THE EVOLUTION OF BIPEDALISM IN EXTANT APES: AN OBSERVATIONAL STUDY OF CARRYING IN CAPTIVE BONOBOS (PAN PANISCUS)

JAMES HASSELL
Royal Veterinary College

Arguably the largest factor, after conscious state, that differentiates us as humans from our closest primate relatives, is that of adopting a habitual bipedal stance and gait for locomotion. Observations of captive bonobos (Pan paniscus) at Twycross Zoo offered the most realistic opportunity to collect data that allowed the comparison of several locomotor related variables, in an environment where behaviour was as natural as possible. The data collected was tabulated, and then statistically analysed and the results used to test several basic hypotheses on the role of carrying in the evolution of bipedality. A quadrupedal, knuckle-walking gait was found to be most associated with locomotive carrying, totalling 59% of the total incidences recorded. This gait was most frequently employed in the carrying of food during foraging behaviour. Unassisted tripedal and assisted bipedal gaits were the second most frequently seen (accounting for 30% of total incidences), with both being indicative of a terrestrial 'pushing' motion. In this, both forelimbs were used to move larger objects, such as boxes, around the enclosure during dominant display behaviour and excitement within the group. The observed preference for the pushing of heavy objects using assisted bipedal locomotion, indicates that in the captive environment this proves to be an energetically easier method than using both forelimbs to carry them with an unassisted bipedal, upright gait. Whether this is true of wild populations, where terrestrial substrates would differ enormously, will require further field studies to be concluded.

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DRIVER: IMPROVING ACCESS TO RESEARCH IN EUROPE

MARY ROBINSON
University of Nottingham

The current system of academic publication developed as a means to disseminate the findings of research. Unfortunately this system can hamper the very process it was set up to serve, with access to articles being limited by publishers to only those who can afford to subscribe. "Open Access literature is digital, online, free of charge" (Peter Suber, http://www.earlham.edu/~peters/fos/fosblog.html). Published material which is Open Access (OA) can be freely accessed by anyone in the world via an internet connection. This increases the readership of an article by making it available to many people whose institutions cannot afford a subscription. Evidence shows that making articles Open Access significantly increases citations to the article. The importance of Open Access is acknowledged by many research funding agencies within the UK, Europe and internationally. Many research funders now require that publications arising from their funding must be made available through Open Access. For a summary of research funders OA policies and mandates worldwide please see http://www.sherpa.ac.uk/juliet

Open Access repositories and Open Access journals are the two main options available for making your research publications Open Access. OA journals use a different business model to traditional journals. Everything else, including the peer review process, is the same as for traditional journals but the articles are freely available without a subscription. OA repositories are online digital archives where authors may deposit copies of their articles that they have published elsewhere. Permission to archive is subject to copyright, but the majority of journals allow some form of archiving. The RoMEO database lists the OA policies of over 300 journal publishers worldwide (http://www.sherpa.ac.uk/romeo.php).

Full-text articles held in repositories are available to anyone via various search services. In Europe the DRIVER project is co-ordinating and providing support for the development of a European network of repositories. DRIVER has developed the technical infrastructure to bring together articles and other materials held in repositories to improve the search and retrieval of these materials. The DRIVER infrastructure also facilitates the use of these materials by other service providers and research groups wishing to develop search

and other services specific to their needs. Further information on the DRIVER project and its implications for research in Europe is available from www.driver-support.eu or by email info@driver-support.eu.

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ENVIRONMENTAL ENRICHMENT FOR A MIXED-SPECIES NOCTURNAL MAMMAL EXHIBIT

FAY CLARK
Institute of Zoology and Vicky Melfi, Paignton Zoo Environmental Park

Environmental enrichment is considered to be an integral management tool in the modern zoo; however, application of enrichment rarely receives scientific validation and is often based on anecdotal reports of success in other species. A need has been recognized for zoos to approach the application of environmental enrichment in the context of a species or subject's natural history and individual history, in addition to the limitations which may be imposed by the exhibit and husbandry. A bias also persists in published peerreviewed environmental enrichment studies on large, conspicuous or charismatic mammals, and for this reason, mixed-species of nocturnal mammals have often been overlooked. Here, we studied if speciesspecific enrichment forms (2 sets of 3 different species specific enrichments were provided) were required to enrich species within a mixed-species exhibit of nocturnal mammals, or if genral enrichment forms (2 enrichments were provided) would 'suit all' species. All enrichments were presented 6 times in the nocturnal house at Paignton Zoo Environmental Park which was occupied by 1.1 Senegal bush babies (Galago senegalensis), 1.1 nine-banded armadillos (Dasypus novemcinctus) and 1.1 two-toed sloths (Choloepus didactylus).

No single enrichment resulted in positive behavioural responses (increased species-typical behaviour and behavioural diversity, or increased use of the exhibit areas) for all species. However, we identified a set of species-specific enrichment forms (buried food in a soil pit, gum arabic logs, and a hanging basket sphere filled with food) which resulted in positive behavioural responses for all species. One general enrichment (a CD recording of rainforest sounds) resulted in a high level of 'not-seen' behaviour for bush babies, which was interpreted as hiding, and decreased species-typical behaviour in all species. Armadillos appeared to show the most positive responses to enrichment overall, perhaps reflecting their generalist nature. All species contacted non-target enrichment forms, which had been designed for other species, without inter-species conflict, indicating that it is possible to use multiple enrichment forms in a mixed-species exhibit. We conclude that it is important to consider enrichment at both the species and exhibit level, and encourage further research in mixed-species exhibits of nocturnal mammals.

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CAN ENVIRONMENTAL ENRICHMENT AFFECT VISITOR STAY TIME?

JOANNA BISHOP, UNIVERSITY OF PLYMOUTH, SANNE TE STROETE, VAN HALL LARENSTEIN INSTITUTE, VICKY MELFI AND JULIAN CHAPMAN, PAIGNTON ZOO ENVIRONMENTAL PARK

Environmental enrichment (EE) has been successfully implemented in many studies to increase activity levels in zoo animals. Following the Visitor Attraction hypothesis, which predicts that visitors pay more attention to active animals, we would expect the provision of EE to increase visitor stay time at an exhibit. Increased visitor stay time could be beneficial as it is likely to increase the impact of zoo education (e.g. signage) and potentially encourage visitors to spend more during their visit to the zoo. In this study olfactory, manipulatory and food-related EEs, were provided to three species of carnivores at Paignton Zoo Environmental Park: 1.1 Sumatran tigers (Panthera tigris sumatrae), 1.3 meerkats (Suricata suricatta) and 1.1 maned wolves (Chrysocyon brachyurus). Each EE was presented on at least 3 days in a random schedule including at least 3 days with no EE. Instantaneous scan sampling of broad state behaviours was carried out at the same time each day immediately after the presentation of the EE. At the same time the stay length of at

least 10 visitors at the enclosure was also recorded.

The use of EE led to significantly increased behavioural diversity and activity levels in the meerkats but did not significantly affect tigers or maned wolves. Animal activity and visitor stay length was significantly positively correlated for the tigers and the meerkats, however there was no significant correlation between visitor stay length at the maned wolf enclosure and maned wolf activity. The presence of EE appeared to significantly increase visitor stay time at the tiger enclosure, but did not significantly affect visitor stay time at the meerkat or maned wolf enclosures.

The relationship between visitor stay time, animal activity and the presence of EE differs depending on species. Visitor stay length was greatest at the tiger enclosure and was positively correlated with tiger activity and the presence of EE. Although relatively inactive, big cats are attractive to visitors which suggests a subjective characteristic such as 'charisma' also plays a part in stay times at an exhibit. Meerkat activity was positively correlated with visitor stay length, but stay length was not correlated with EE. This is possibly because the meerkats were always relatively active even without EE. The maned wolves were very inactive and rarely seen, they did not use the enrichment and visitor stay time at this enclosure was always very short irrespective of the treatment condition. In conclusion, EE can increase the attractiveness of some species to visitors and thus increase their stay length but this trend is not observed in all species.

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3 Research by IBREAM Institute for Breeding Rare and Endangered African Mammals

Website: www.ibream.org

IBREAM has been established as a UK based Charity in November 2006

CONTENTS

MATING SYSTEM AND REPRODUCTIVE PHYSIOLOGY IN AFRICA'S MOST ENDANGERED CANID: THE ETHIOPIAN WOLF

PHD STUDENT: FREYA VAN KESTEREN, STARTED IN MAY 07.

BACKGROUND

Ethiopian wolves are cooperative breeding carnivores restricted to the Afroalpine highlands of Ethiopia. With less than 500 individuals surviving, they are Africa's rarest carnivore, and its most endangered Canid; threatened by loss of habitat and disease. Although solitary foragers, they live in close-knit, family packs of up to 15 adults, with a single dominant female reproducing annually. For nearly 20 years WildCRU scientists have been studying the species behavioural ecology in the Bale Mountains of southern Ethiopia. They have since progressed from detailed behavioural, to demographic, to genetic studies, refining our understanding of Ethiopian wolf population biology. Habitat availability constraints dispersal in these Afroalpine specialists, resulting in phylopatry and potential for incest. A synchronised breeding season, extra-pack copulations and multiple paternity provide putative mechanisms to reduce the risk of inbreeding. The understanding of the Ethiopian wolves' mating system remains incomplete, however, until a better insight of their reproductive physiology is available. Currently, little is known about its basic reproduction, and as such the capability to undertake and reproductive manipulation as part of metapopulation management is also very limited. With such small wild populations and no animals kept in captivity there is an urgent need to gain such knowledge. IBREAM has this expertise and recently forged an official collaboration with the scientist of IBREAM to study reproduction of these animals in their natural environment. Laboratory assays have been developed in recent years to measure reproductive hormones in faecal matter and these

assays have been successfully applied to a wide range of wild species, including carnivores. With these non-invasive methods hormonal information can be derived from carnivore faeces and a range of metabolites can be measured, including reproductive and stress hormone levels, allowing for reliable tools to assess reproductive status which will in turn allow the testing of hypothesis to determine decision making among female Ethiopian wolves.

The study proposed here will comprise of a basic non-invasive reproductive study to gain a better understanding of the reproductive biology of this species. In brief, we plan to regularly collect fecal samples of known individual female wolves throughout the year. In this way we will map the seasonal patterns of reproduction, and characterise hormonal levels of pregnant individuals. We will also seek to determine differences in physiological hormone levels between the dominant female and the other females in the pack and whether the dominant female suppresses the hormone levels of the less dominant females. In males, reproductive and stress hormone levels will also be analyzed to answer a similar question, and thus determine whether the dominant male suppresses reproductive hormone production in less dominant males. Additionally the will explore whether it is possible to determine sex from a fecal samples. This will provide a useful future tool for random sampling (without having identified the animal visually) of unknown individuals and will aid population studies.

What makes this study posible

The Ethiopian Wolf Conservation Program (EWCP) is a collaborative effort between the University of Oxford's WildCRU and the Ethiopian government. The EWCP is based in the Bale Mountains and led by WildCRU's Claudio Sillero-Zubiri. EWCP runs a small research station and has two field camps. It employs approximately 25 people, including academics and eight well trained field assistants. This infrastructure provides the necessary logistics for a successful reproductive project, including transport, animal identification and tracking, and sample storage. The graduate student will benefit by joint supervision from the collaboration between IBREAM and WildCRU, which brings together the experience of a long-term field study as well as scientists experienced in behavioural ecology and reproductive biology.

For more information please contact IBREAM's project Coordinator: m.paris@uu.nl

UNDERSTANDING THE HORMONAL REPRODUCTIVE EVENTS IN THE FEMALE PYGMY HIPPOPOTAMUS *(HEXAPROTODON LIBERIENSIS)*, AND AIMING TO UNDERSTAND THE BASIS OF THE SKEWED SEX RATIO

DEVELOPMENT OF A PHD PROJECT

Endangered Status

As West African forests are cleared, Pygmy hippos (*Hexaprotodon liberiensis*) lose their habitat and hunting pressure for bushmeat increases with the easier access. Pygmy Hippos are shy forest animals that live only in a 5,000 km² area of West Africa and reports from the field suggest that the quality and extent of this habitat continues to erode rapidly. At last count in 1994, fewer than 3,000 individuals remained, but given the declining quality and fragmentation of their habitat and subsequent hunting pressure their numbers today are surely lower. The Pygmy Hippo is now listed as Endangered by IUCN.

With such endangered status, maintaining a viable population in captivity is very important. However, the Pygmy Hippo produces 6 females to 4 male babies, which can make Zoo management complex. With the species being so shy, little knowledge has been gathered about their reproductive behaviour.

Importance of the proposed study:

The pygmy hippopotamus (*Choeropsis liberiensis*) is listed by IUCN as vulnerable, with 2000-3000 remaining individuals, but in Nigeria it is already critically endangered (IUCN Red list, 2006). Thus,

maintaining a viable population within zoological institutions is of uttermost importance. As a consequence of their cryptic behavior, there is little information about this species collected in the wild [1]. More specifically, a lack of reproductive knowledge currently compromises the breeding management of the pygmy hippopotamus in zoos. In captivity, a highly female-biased sex ratio at birth (59% female) has been reported for the pygmy hippopotamus, exceeding most other known distorted sex ratios in captive mammals [2]. Sex bias in offspring can occur at a number of different physiological levels during reproduction in male or female [3-5]. In the pygmy hippopotamus, a significant difference in sex ratios among different zoological gardens has been reported, and detailed analyses strongly suggests that high feeding intensity and 'hands-on' husbandry favors production of daughters [2]. The influence of diet on sex ratio has been reported in other species [6]. In addition, elevated stress hormones lead to a sex-biased reproductive investment in other vertebrate taxa [7-8]. We propose that elevated stress hormones may have similar effects in the pygmy hippopotamus. High mortality of juvenile pygmy hippo males results in a further female bias of 62.5%. Housing pygmy hippopotamus in groups is difficult. Hence, the general policy in captivity is to hold 1 breeding pair and offspring. This has created significant problems in housing surplus animals produced by the skewed sex ratio (European Studbook keeper, personal communication).

Part 1 of the project

The first part of the proposed study aims to gain basic understanding by monitoring female reproductive and stress hormones in animals of all sexually mature classes (juvenile, intermediate, and old-age females). Current information on reproduction is derived from studbook data, but hormonal characterization of the estrus cycle has been not yet been undertaken. We aim to measure fecal hormone metabolites (progestagen, estrogen, androgen, and corticosteroid), bodyweight, and gather detailed information on husbandry practices and diet. We will then analyze how these factors may correlate with important reproductive events such as the onset of puberty, and the sex of offspring. The common hippopotamus (*Hippopotamus amphibious*) is the larger cousin of the pygmy hippopotamus and has been studied in more detail. In this species, sexual maturity in wild females occurs at about 9 years [9-10]. In captivity, it may occur much earlier at 2.5 to 4 years of age [11-14], and an estrus cycle length of 35.3 + 1.3 days has been reported [14]. A recent study [15] suggests that body weight is an effective tool for indicating onset of puberty. In 2 females, estrus has been reported to occur 37 and 42 days after birth respectively [16]. Fecal progestagen analyses have further shown that although captive females may ovulate while nursing a youngster, lactational suppression of ovulation is common [14]. In the wild, calving intervals of 18 - 33 months were observed [9]. Wild females appear to be fertile up to 35 years of age [9-10]. In captive pygmy hippopotami, female sexual maturity generally occurs between 3 – 5 years of age [17]. However, 6 females have conceived at less than 3 years of age, indicating that puberty can begin earlier. In 2 of these cows, a second conception was achieved during lactation 40 - 46 days after birth (Zschokke and Steck, unpublished observations). The oldest captive female to produce viable young was 31 years (Steck, unpublished).

Experimental design of the study:

Fecal sample collection has already commenced twice weekly (for at least a 1 year period) from > 15 zoological institutions throughout Europe (including Kerkrade, Berlin, Aalborg, Zodiac Zoos (3 Institutions), Blijdorp, Burgers, Olmen, Bristol, Zürich, Blijdorp, Paris, Bristol, Sweden, and Edinburgh) and further zoological participation is being sought. Currently the pygmy hippo females compromise 2 pre-pubertal juveniles, 10 sexually mature (of which 3 are pregnant), and 3 possibly post-reproductive cows. Freshly produced samples are collected, and stored at -20°C until analysis. The first part of the project will characterize the estrus cycle. The hormonal patterns of the estrus cycle in the pygmy hippopotamus are on a regular basis determined by analysis of progestagen, and estrogen metabolites in fecal material. This work is done in close collaboration with Prof Schwarzenberger, Vienna who also provided assay reagents for recently performed studies in the common hippopotamus [15] and has experience in establishing fecal endocrine assays in a wide variety of wildlife species.

Initial results

At the EAZA Conference 2007, in Warsaw, the first results of the outlined study where presented. In summary, results show that estrogen surges can be determined on a regular basis, and are indicative of cycling. However, the progesterone metabolites tested so far don't specifically rise following the estrogen peaks. This suggests that either: a) the exact progesterone metabolite hasn't been found as yet, or b) that the Pygmy Hippopotamus can show characteristics of an induced ovulator, which would have significant consequences for ZOO management of this species. More data are needed to unravel the reproductive nature of this cryptic species.

IN SITU COMPONENR

IBREAM is currently evaluating whether an in situ reproductive study can also be started in Western Africa

For more information contact: m.paris@uu.nl

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CHARACTERIZATION OF BASIC REPRODUCTIVE PHYSIOLOGY IN THE AFRICAN WILD DOG (LYCAON PICTUS)

Status

The African Wild Dog (Lycaon pictus) is an African Mammal that is in serious decline throughout its range. Its status is now regarded as endangered and it appears on the IUCN Red List.

Aims

The aim of this project is to gain vital knowledge of both male and female reproductive biology using studies of captive African Wild Dogs. Using this information, we hope to achieve some indication of the best conservation strategy to help preserve this valuable, rare and endangered African mammal. This modus operandi could also be used in further work with other endangered canids such as the Ethiopian Wolf.

In order to achieve these aims, a research project is being conducted into the characterization of seasonal reproduction in females held in European Zoos (Edinburgh Zoo, Colchester Zoo, and West Midlands Safari Park). It will provide important information on sexual adaptation to the Northern hemisphere and climate in a species whose native origin is in the Southern hemisphere. More specifically, we aim to study reproductive patterns in females that are housed with and without the presence of males. At this stage, it is not known whether females housed without males will cycle. It is important to answer this question for both Zoo management and conservation purposes.

Our study aims to gain understanding of their reproduction in a more controlled environment at first instance (throughout European Zoo Institutions). Such knowledge is critical as this species breeds rapidly in captivity but inbreeding in the wild is a recognized problem. Knowledge we gain aims to solve management problems both in captivity and in the wild by developing measures to control or promote reproduction.

4 Research from Kolmarden Zoo

CONTENTS

ARE SEALS WILLING TO PAY FOR ARTIFICIAL KELP?

JENNY RUOTIMAA
Final thesis. International Master Programme Applied Biology 2007, Linköpings University Supervisor: Mats Amundin

Background

• Test motivation for obtaining a resource by making the animal pay a price for it.

• Price - time/energy when pushing a weighted entrance gate to a test arena.

•The maximum price paid - highest price an animal is willing to pay for a resource.

• Compare resource with value of ”comparator” - food.

Aim

Test how much grey seal Liivi is willing to pay for access to artificial kelp and live fish

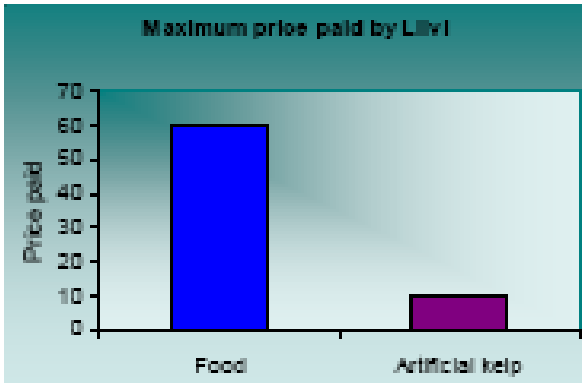
Method

A large net cage was used as the test arena. Food fish was used as the comparator. The grey seal (Halichoerus grypus) Liivi was the subject.

$$\frac{\text{Max. Price kelp}}{\text{Max. Price food}} = \text{\% willingness to pay for kelp}$$

Results

The maximum price paid for artificial kelp was 17% of the maximum price paid for food. Nothing was paid for access to live fish.



The maximum price the grey seal Liivi was willing to pay for food and artificial kelp, respectively

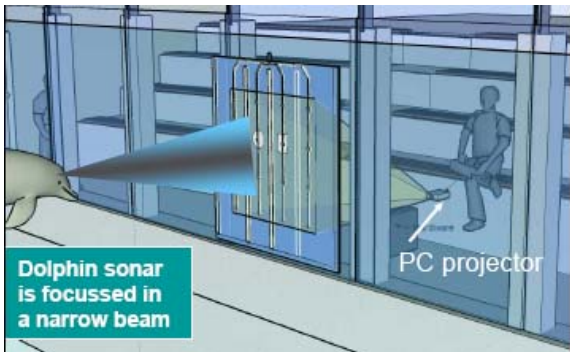
Conclusion

Liivi was willing to pay a small price for artificial kelp but none for live fish.

ELVIS – ECHOLOCATION, VISUALISATION AND INTERFACE SYSTEM

PHD PROJECT AT THE LUNDS TECHNICAL UNIVERSITY, SWEDEN
Masters thesis in the International Masters program in Applied Biology, Linköping University, Sweden

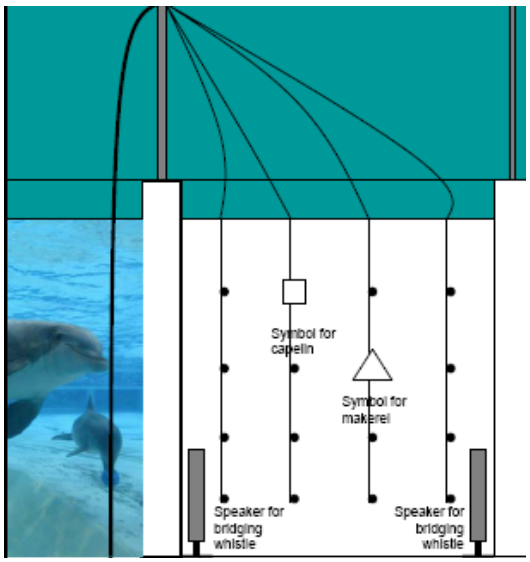
New tool for advanced studies of dolphin sonar, cognition, food preferencies and artistic capacities



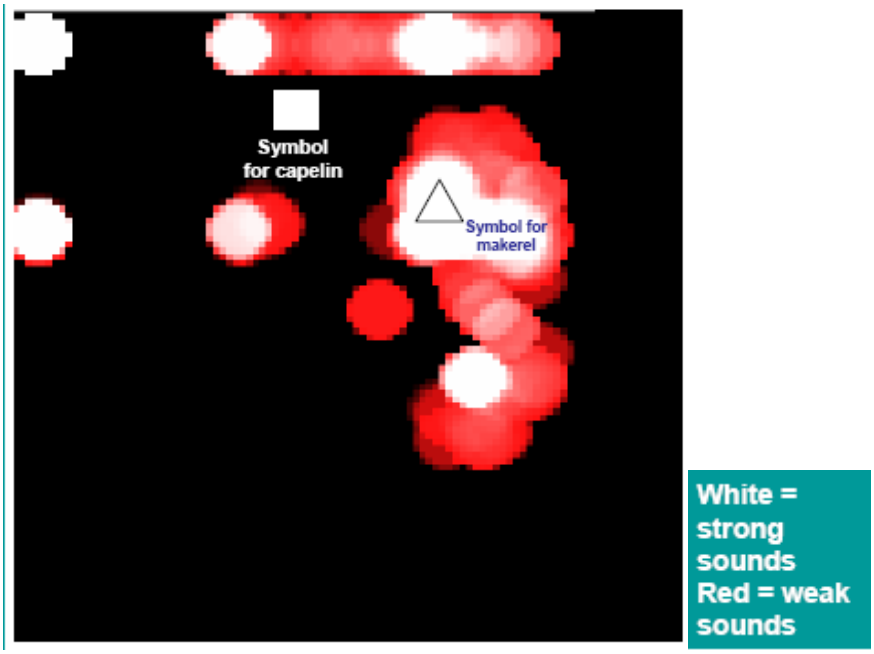
ELVIS consists of a semitransparent screen with 16 hydrophones measuring the inten-sities in the beam These values are converted to colour and light intensities on a PC screen.

The PC image is projected on the hydro-phone screen, using a PC beamer , which allows the dolphins to see their sonar beam

Acoustic ”touch screen” for dolphins



ELVIS is now used as an acoustic ”touch screen” for the dolphins in a study of their food pre-ferences. White symbols for different fish species are projected on the screen. A trainer sends a dolphin to the screen. If it aims the sonar beam at a symbol, it blinks and a bridging whistle is played through speakers at the screen. Then the dolphin returns to the trainer and gets the fish represented by the symbol.



The software allows the trace of the sonar beam axis to be followed while the dolphin makes its choice

Vicky (34), Ariel (11) and Luna (6) participated in the study.

Preliminar results:

- • They did not prefer any of the fish that were tested: makerel, capelin, herring or squid
- • When Luna was given a symbol for ”wrong”, she chose this as often as any of the fish symbols – indicates that she not yet has grasped the meaning of the symbols

Other applications:

- • The dolphin ”points” at the toy, projected on the screen, they want the trainers to give them
- • They ”paint” with their sonar beam, controlling the colour, intensity and brush width
- • The touch screen is configured as a ”synth”, allowing the dolphins to play tunes
- • Study of the ability of dolphins to find objects buried in coral Sand

Future of ELVIS:

- • 16 hydrophins is increased to 64 – improves resolution
- • Improved electronics allowing the frequency content of the sonar clicks to be analyzed, not only the sound pressure levels

TARGET DETECTION IN CORAL SAND BY BOTTLENOSE DOLPHIN (TURSINOPS TRUNCATES)

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Final thesis. International Master ProgrammeAppliedBiology2007
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Aim

Investigate if bottlenose dolphins can be trained to detect targets buried in coral sand, using their sonar, and if so, if they used any particular search strategy.

Background

Bottlenose dolphins in the Bahamas detect and dig out fish buried in coral sand after searching the seabed while echolocating. The use of echolocation in this behavior, called "crater-feeding", is poorly understood, e.g. if the dolphinsextract useful information from the echoes from the buried fish/the hollow made by the fishorif they use some other cues. Perhaps visible breathing holes and/or faecal piles on the sand surface or sound made by the fish reveal its presence in the sand.With their sonar bottlenose dolphins are able to detect targets buried in sediment.However, detecting buried targets can be a great challenge. The detection capability depends on e.g. the bottom particles, the angle of incidence of the sonar signal, the source levels, interfering noise and reverberations (unwanted echoes scattered back from objects other then the target).

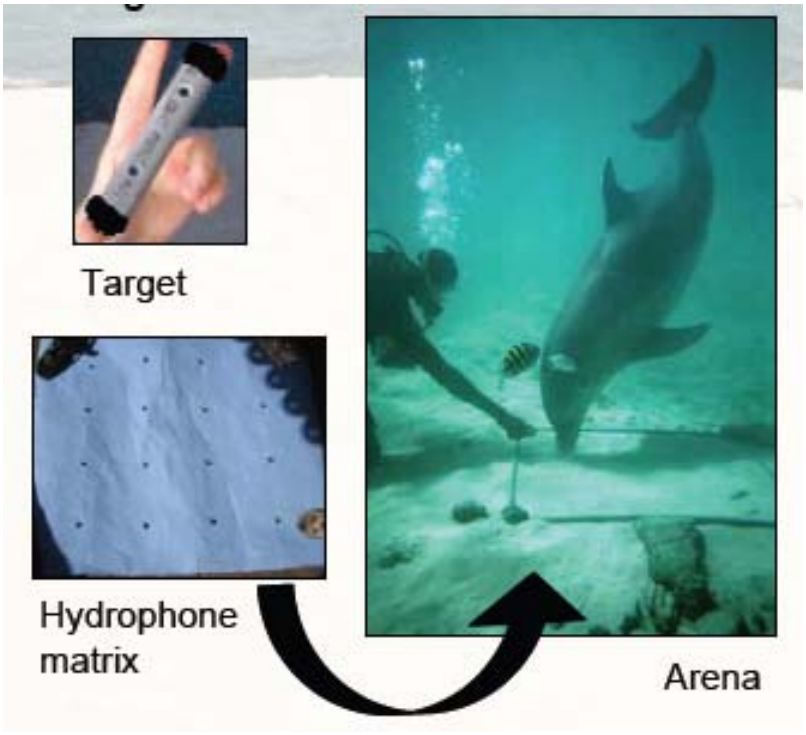
Material & methods

The studywasconductedat DolphinEncounters(DE), Nassau, Bahamas.

During7 days and 57 trials three dolphins were trained, using operant conditioning, to find and retrieve targets successively buried until invisible in a coral sand arena.

The ELVIS system

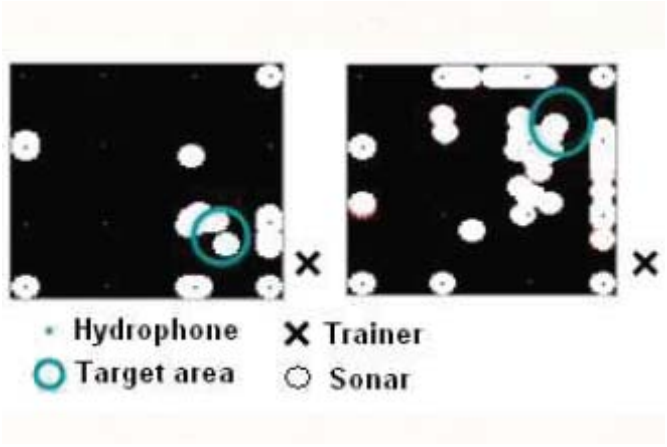
A 4×4 hydrophone matrix, measuring the sonar sounds, was buried under a thin layer of sand in the arena. It was connected to a PC and custom made software visualized the trace of the sonar beam axis while the dolphin searched for the targets.



Results

Targetdetection

The dolphinsreachedthe point where they retrieved completely buried targets they had seen being buried and pointed at. Either within a few seconds or after being once again directed by the trainer. They sometimes ploughed through the sand with their rostrum to find the target.



Typical sonar search pattern

When searching for partly/completely buried targets they echolocatedin a somewhat scattered way, in the direction where the trainer pointed, and often in the vicinity of the target right before/when picking it up.

Conclusions

- Despite echolocating, the dolphins did not seem to be able to use sonar as the primary cue when detecting partly and completely buried targets.
- However, these dolphins were new to this experience and only trained during a short period of time.•Further trials will explore the possibility that learning may enable them to extract useful information from their sonar echoes.
- This may shed some light on crater-feeding in the wild!

HARBOUR PORPOISES IN THE SOUTH OF SWEDEN?

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Aims

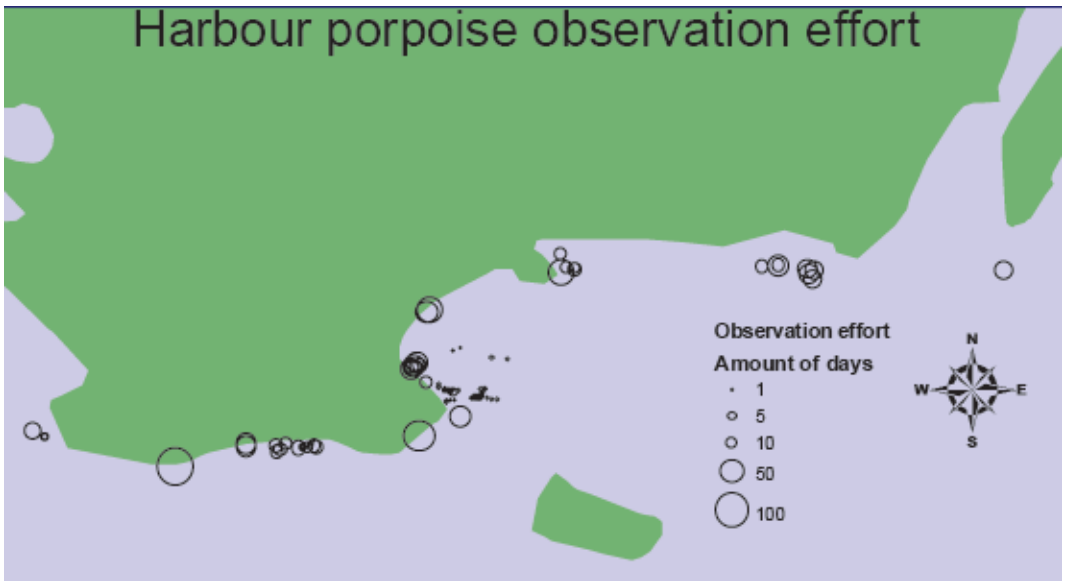
to investigate the presence of harbour porpoises,Phocoena phocoenaoff the southern coast of Sweden by meansof SAM (Static Acoustic Monitoring). This information can be veryuseful for future conservation efforts.

Equipment•

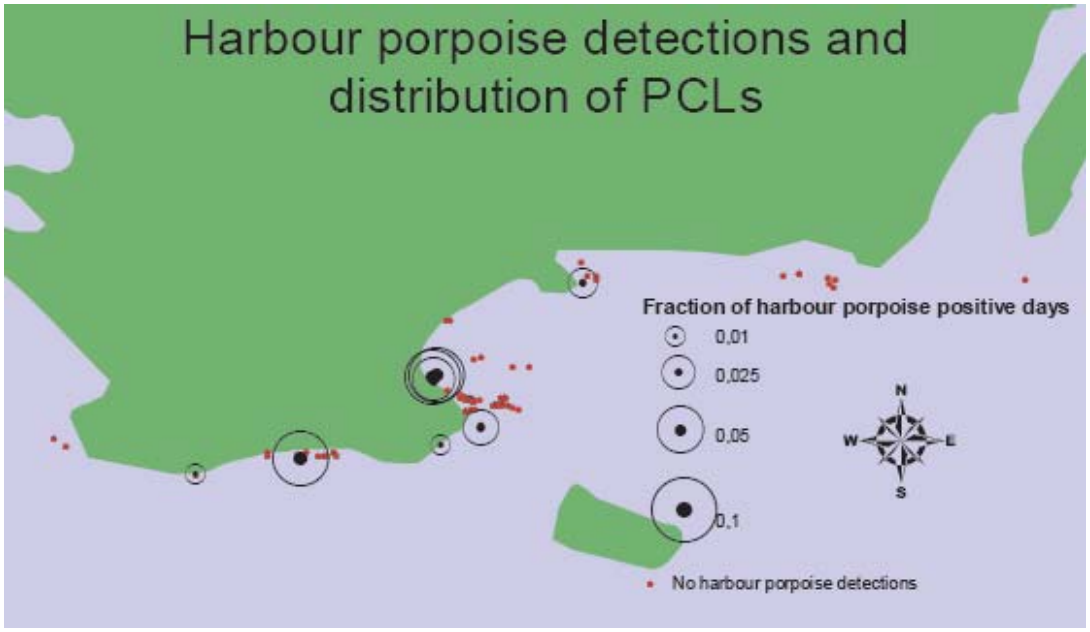
- Porpoise Click Logger –PCL•
- Submersible hydrophone unit
- Built in customizable filters
- 14 days battery time
- 8 Mb non volatile memory •Easy to use USB interface allows inventive logistics
- Built with sturdy acousticallyinert plastics

Setup

- 30 PCLs were placed off the southern coast of Sweden by localfishermen.
- Data was retrieved and subsequently e-mailed to a project mailserver by the fishermen for further analysis at a regularinterval of 14 days.
- Data analyzed in this thesis encompasses a period from 2006-07-07 to 2006-12-17 with the sum of days logged by eachPCL being 1164.
- On 8 days only were there a porpoise detection.
- Average number of days with harbour porpoise detections was0.3 percent of logged days for each location.



Map with the number of active logging days on each location.



Map with the amount of harbour porpoise positive days as a percentage of total active days. Red dots are positions with no harbour porpoises detected•

Conclusions

- •Harbour porpoise detections were very rare indicatingthat there is only a small population present.
- •The inventive logistics provided the opportunity to make the project large scale and cost efficient.
- •Further studies with focus on static deployment andeven distribution along the coast could give moredetailed insight on the status of the harbour porpoiseoff the coast of Sweden.

Acknowledgements

I would like to thank my supervisor Mats Amundin. I would also like to thank Ulrika Roos and Jacob Hagberg, my colleagues in this project. Thanks to Ed Ceurstemont from Aquatec group, Ida Carlénfrom Aquabiota Water Research, various staff at the Swedish boardof fisheries and all the fishermen for their kind cooperation.

A METHOD TO EVALUATE ENVIRONMENTAL ENRICHMENTS FOR ASIAN ELEPHANTS IN ZOOS

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Aim

To investigate if the max price paid concept can be used, and to find an operant test suitable for elephants, to measure the value of enrichments.

Introduction

Environmental enrichment (EE) is increasingly used to improve captive animals environment. That is good because most zoo animals have a poorer environment than wild ones. However, introducing EEs can be problematic, both practically and financially so before making it permanent it is useful to find out if an animal has any interest in it.

Maximum price paid is one measure that can be used to assess what an animal prefer. An operant test is set up where the animal has to perform a task to get access to a resource. Then a cost is imposed upon access until the animal stops "paying". This is seen as the highest price an animal is prepared to pay for a single visit to the resource. It is a straightforward measure that shows if an animal has any interest in a resource at all[2].

A comparator of known value to animals is needed to compare against the resources tested[3]. Food is of basic importance to animals[4] and is therefore very useful.

Materials and method

Two elephants, Saonoi and Bua from Kolmarden Animal Park, were used. Two weight machines were welded together, with a total weight magazine of 372 kg. Attached to the machines was a photo cell switch and when the weights were lifted that would release the resource of choice. Different objects were tested to find what the elephants wanted to use when pulling the weights.

Pfeiff's Feeder PE 360 was used to distribute pellets and sugar,. A hay net and a tarp, both filled with 5 kg hay, were also tested. To find the max price paid for hay three trials with the tarp were carried out with each elephant with a set weight increase schedule.

Results

A rope with a knot at the end suited the elephants best when pulling. The food dispenser did not work because the sound of it frightened them. The hay net did not release the hay properly but the tarp functioned without any problems.

This is the max the elephants paid for the hay for the different trials :

1. Bua → 245kg	Saonoi → 173kg
2. Bua → 372kg	Saonoi → 173kg
3. Bua → 227kg	Saonoi → 227kg

Discussion

The technical solutions for the operant test required a lot of trial and error. This is partly due to the fact that most of the research done before has been on smaller animals, e.g. hens and minks. Most of the studies also had different solutions on what kind of task the animals had to perform to get access to a resource.

Max price paid seemed to work when testing the willingness of the elephants to pull for hay. It should be possible to use this measure to test almost any kind of enrichment that could be valuable for elephants. However, further studies are needed with more resources tested before anything can be said for certain.

Conclusions

A method has been developed to evaluate enrichments for elephants. The max price paid concept was used and the max price for food was tested. This method can most likely be expanded to measure the relative value of other resources as well

Acknowledgments

Many thanks to my supervisor Mats Amundin and to the elephant keepers, Thomas Antmar and Andreas Levestam, for all their assistance. Mikael and Per Cederholm gave important help with the technical equipment. Richard Kirkden gave much appreciated methodological assistance and comments on the manuscript. Nautilus provided with the two weight machines. Finally I am grateful to Kolmarden Animal Park for letting me conduct my research in their park.

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THE PORPOISE CLICK LOGGER

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Aim:

To evaluate and validate the function of the PCL. This includes calibrations and field trials to test detection function and practicality.

The Project

The harbour porpoise is seriously threatened in the Baltic Sea, and if we want to keep them here actions are needed. The Swedish Board of Fisheries ("Fiskeriverket") has started a project to gain more knowledge about the porpoise in the Baltic. A part of this project is the new PCL or "Porpoise Click Logger". The PCL detects the clicks emitted from the porpoise, and through this we hope to find out where along the Swedish Baltic coast the porpoise can be found.

My thesis, "Evaluation of a new device for static acoustic monitoring of harbour porpoises in the wild", is a part in this project where I have tested the function of the PCL. This was done through a validation study in an area where porpoises are common, and a pilot project in the Baltic Sea in cooperation with fishermen. It is important to know for example the detection range and the detection proportion of the PCL before using it in the wild.

The porpoise

The harbour porpoise is a small whale common in northern seas. It is about 1.5 m long and weighs about 50 kg. The favourite food is different kinds of fish which it often hunts close to coasts, but also enjoys it in the open ocean.

The porpoise has become more and more rare during the last 50 years. The main reason for this is that so many are entangled in fish nets. Because the porpoise breaths air like you and me, this leads to a terrible death through drowning.

In the Baltic Sea, only a fraction now remains of the great numbers of porpoises that could earlier be found here.

The PLC

The PCL consists of the main unit and the hydrophone. The hydrophone is an underwater microphone, especially designed to detect the clicks from the porpoise. Our is moulded in black rubber.

Inside the main unit, there is a data chip. The data chip processes the sounds detected by the hydrophone, and determines if the sounds should be saved in the memory as porpoise clicks. The criterias are the length of the click, the time between two clicks and the amplitude and frequency composition of the click.

Conclusions

The PCL is overall comparable to similar devices. Technically andpractically it has worked well, it is hardy and easy to handle. However, the detection range could have been better and the varying hydrophone sensitivities is a problem.

Acknowledgements

Acknowledgements to my supervisor Mats Amundin, the PCL-team: Jacob Hagberg and Daniel Wennerberg, and fishermen taking part in the study.

POLAR BEAR URSUS MARITIMUS HEARING MEASURED WITH AUDITORY EVOKED POTENTIALS

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Summary

While there has been recent concern about the effects of sound on marine mammals, including polar bears, there are no data available measuring the hearing of any bear. The in-air hearing of three polar bears was measured using evoked auditory potentials obtained while tone pips were played to three individually anaesthetized bears at the Kolmården Djurpark. Hearing was tested in halfoctave steps from 1 to 22.5·kHz. Measurements were not obtainable at 1·kHz and best sensitivity was found in the range from 11.2–22.5·kHz. Considering the tone pips were short and background noise measurements were available, absolute measurements were estimated based on an assumed mammalian integration time of 300·ms. These data show sensitive hearing in the polar bear over a wide frequency range and should cause those concerned with the introduction of anthropogenic noise into the polar bear's environment to operate with caution. Key words: bear hearing, polar bear, evoked potential.

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5 Reserch Conferences at Poznań Zoo

5.1 Second International Conference Animals and Zoos, Current Research Focus Poznań 24.-25.05.2005

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Oral Presentation

RESEARCH IN ZOOS: WHY? WHAT? HOW? WHERE? WHEN?

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The pace of change within our natural environment, driven by the increasing numbers of human beings (from 3 billion to 6 billion in the last thirty years) and their desire consume, and to have larger amounts of property and possessions has significantly reduced the space available for other animals on the planet. In the process it has placed large n umbers of different species of animals at risk of failure to survive. Indeed many have already gone. Research within zoos is essential to help efforts being made to restrain this destruction and to provide a knowledge base upon which to build some form of future for many of our zoological (and botanical) species.

The research required of zoos has many different contributions to make; to the welfare of the animals in the wild; to their better management in the wild, and to a better understanding of their husbandry in zoological collections over the short, medium and longer term. I will raise question such as Why? What? How? Where? and When? They require discussion. Investigation and analyses will ultimately reveal both general and specific answers for each taxon.

KULAN'S PEDIGREE ANALYSIS

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The kulan (*Equus hemionus kulan*) is the only odd-toed ungulate left in the wild in the northern Eurasia, the sole remaining relative of the millions of tarpans, wild asses, and horses that once roamed the open expanses of the continent. Smaller and stouter than domesticated horses, the kulan is the swiftest of all equids, capable of reaching speeds of 70 kilometers per hour for brief periods and sustaining a pace of 50 kilometers per hour. Kulans feed on grasses and low succulent plants, thriving in flat desert plains of Central Asia. Nonetheless, kulans require favorable feeding grounds in winter and adequate water in the hot summer, needs which may lead entire herds to travel considerable distances every year.

Following a population clash in Turkmenistan from some 5000 animals in the mid-1990s, the present population is numbering around 600 animals. A population of some additional 700 kulans has been established in neighbouring Kazakhstan. Poaching, competition with domestic livestock and a shortage of water are the main threats for the survival of the kulan in the wild.

The main task of the EEP is to choose the best animals for breeding. A large number of animals within the European population have never bred most of them have never been in a breeding situation

before. These include a number of genetically valuable animals. Many of these animals are now too old to breed. Some zoos have bred them with siblings, so that a careful management of the population is essential to improve its genetic set-up.

The genetic challenges that confront small population in Zoos is loss of genetic variation though genetic drift, inbreeding depressions and selection for the captive keeping. All of these have an influence on the species' fitness. The main purpose for breeding programs is to create a stable demographically and genetically population, capable of maintaining high level of genetic variation. Suitable breeding strategy, rational selection of animals for breeding attempts to mitigate of loss in genetic variation, populations' gene pool and thereby it allows to retain, as much as possible, valuable genes of the founders of the population. Genetic management is most effectively in populations with completely known pedigrees.

In this work pedigree analysis were made for kulans from European Zoos. During calculation, procedure recommended by the EAZA were used .

GENETIC VARIABILITY IN THE SNOW LEOPARD (*UNCIA UNCIA*, SCHREBER, 1775) AND LEOPARD (*PANTHERA PARDUS*, LINNAEUS, 1758) POPULATIONS

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Longevity is one of the most important trait for captive animal species. The trait is determined by both genetic and environmental effects. The objective of this study was to evaluate genetic effects on longevity in leopard and snow leopard populations kept in zoological gardens. The data have been extracted from the International Species Information System (ISIS)The data set included 1434 individuals of leopard and 1256 of snow leopard.

The genetic parameters were estimated via an animal model including fixed effects: sex, year and place birth, subspecies (for leopard) as well as random additive genetic effect. Genetic, phenotypic and environmental trends have been derived as well. Estimation of the parameters has been performed by the use of the derivative-free restricted maximum likelihood algorithm. Heritability estimates of longevity are low: 0.02 (for snow leopard) and 0.107 (for leopard). This indicates the presence of considerable environmental effects. On the other hand, heritability can be underestimated since the empirical distribution of longevity is skewed.

THE INFLUENCE OF THE HAND REARING ON BREEDING PARAMETERS IN AFRICAN HUNTING DOGS (*LYCAON PICTUS*) AND MANED WOLF (*CHRYSOCYON BRACHYURUS*)

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One of the basic questions facing the breeders of endangered species is how the further breeding performance is influenced by the rearing method.

We had decided to compare the life history of large sample basing on the data recorded by ISIS and recorded by many zoos.

Due to obvious reasons we selected two species of canids, a social one and solitary species, represented by large captive populations with significant number of hand-reared individuals. There were African hunting dog *Lycaon pictus* (3300 individuals recorded from known parents, of which 913 were males and 773 females) and maned wolf *Chrysocyon brachyurus* (2528 individuals – 836 males and 765 females).

In the hunting dogs the rearing method influenced further reproductive performance in a very significant way. Only 5.5% of males and 6.3% females further reproduced in a group of hand-reared animals compared with 25.3% of males and 27.8% of females reared by mothers.

In the maned wolves population 10% of males and 11% of females in the hand-reared group reproduced compared to 33.8% males and 36.6% females naturally reared. Those differences are highly significant statistically and of course biologically.

The comparison between the two species didn't show significant differences.

It can be said the rearing method had a very significant effect on the further reproductive performance and it didn't differ significantly between a social and asocial species.

THE QUALITY OF SOCIAL RELATIONSHIPS IN HERBIVORES DEPENDS ON QUALITY AND DISTRIBUTION OF RESOURCES

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Theoretical models on social relationships developed by WRANGHAM, VAN SCHAIK and STERCK have demonstrated that food distribution has an important influence on quality of within- as well as between-group relationships. Food (or other resources) that is mostly evenly distributed and of similar quality is not being monopolized by any individual, and relationships to regulate access to the resource in advance are mostly absent from these species (scramble competition). Resources that can be monopolized however lead to social relationships that regulate access in advance, primarily via dominance or any alternative method of allocation. These in term lead to the development of socio-positive relationships and mechanisms to counter by eg grooming or other partnerships, enabling animals to develop alliances against other contenders. Trials regarding food distribution in grass- versus browse eating ungulates and kangaroos have demonstrated that these predictions, mostly based on primate studies, also hold for large herbivores. Grazing species (blackbuck, equids, white rhino, red kangaroo and others) are unable to cope with artificially clumped feeding situations except by aggression, browsing species and intermediate feeders have abilities to regulate tensions by increasing positive behavior more than aggression when forced to feed in close contact. These findings also have implications for zoo-animal keeping and conservation biology.

SIMILARITIES IN BEHAVIOURAL DISORDERS AFFECTING HUMAN AND NON-HUMAN PRIMATES

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Similarities can be observed in certain behavioural disorders affecting human and non-human primates when welfare is unlikely to be good, including human rumination syndrome (HRS) or regurgitation and reingestion of food (R/R), and trichotillomania, or hair-plucking. Although non-humans are frequently used as models for human disease and other health problems, the sorts of behavioural disorders listed above have yet to be investigated on a large scale for non-human primates and our knowledge of similar human conditions may actually be greater. Scientific comparisons of these conditions are lacking and the use of different terms in relation to the human and non-human disorders has probably not helped. These factors may result from researchers' attempts to avoid accusations of anthropomorphism. Instead, a fear of anthropomorphism may limit scientific investigations of these behaviours and I address this in my research. I describe certain behavioural disorders that have been observed in non-human primates and provide details of disorders that may be equivalent in humans, highlighting the similarities (and differences) that are currently known. Implications for the welfare of zoo animals are discussed, particularly in relation to efforts to maintain good welfare.

PROBLEM WITH THE PROBLEMS: THE CONSIDERATIONS CONCERNING AN ABNORMAL BEHAVIOUR IN ZOO ANIMALS

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The so-called abnormal behaviour in zoo animals is well-known. However, the border between "normal" and "abnormal" may be seen as rather vague particularly in this case. This is the result of fact that the observed types of abnormal behaviour in zoo animals are diversified (they can refer to the whole behaviour inventory), and their function are sometimes controversial. In this short presentation some kinds of less conspicuous abnormal behaviour were mentioned (e.g. certain forms of agonistic behaviour, new behaviour evoked by visitors, even stress and sickness behaviour). The copulation behaviour in primates served as an example of interpretation pitfall in analysing abnormal behaviour. The problem of stereotyped behaviour was also discussed as functionally controversial (is it benign or harmful for animals ?) taking into

account the notion of : ”copying” in welfare definition. Some remarks concerning classification of abnormal behaviour was also made.

PARENTAL BEHAVIOR OF CARNIVORES UNDER ZOO CONDITIONS- ELEMENTS DISTURBED, NON-DISTURBED AND CHARACTERISTIC FOR CAPTIVITY

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In zoos we observe abnormal and stereotypical behavior as well as behavior typical for species and studied earlier in the field. We examined parental behavior of carnivores at the Poznan zoo and compare results with data collected by others in the field.

Bat-eared fox (*Otocyon megalotis*) establishes monogamic pairs or small family groups. Males participate in guarding, grooming and playing with the youngs. Offsprings learn by imitation what to eat and how to get it. In captivity we observed similar behavior in a family consisted of parents and two youngs (a male and a female): the mother and the father contacted with their offsprings with the same frequency (all the social contacts). The family rested and foraged commonly, but youngs preferred resting in a close body-to body contact with the father. The father groomed cubs more often than the mother. We didn’t record the vocalization between parents and offsprings, earlier reported from the field.

The Snow leopard (*Uncia uncia*) lives solitarily and pairs only during the female estrus. Infanticide and maternal defense are typical for free-living individuals. In captivity we observed parents with one offspring. The father presented the higher level of social tolerance during playing, foraging and resting with the daughter than the mother. The male participated more intensively in parental care after weaning of the young.

The Asian small-clawed otter (*Amblonyx cinereus*) is a social species establishing groups up to 14 individuals in the field. Like in the other mustelids, otters’ cubs are dependent on their mother because they need to acquire hunting skills by learning, but the father may participate in parental investment. In captivity we observed a breeding pair kept together with four juveniles and one subordinate male. Social nesting of the parents (the female α and the male α) and the male β with cubs, and social playing and foraging were recorded. All the adults (not only the mother) appeared to actually teach youngs to catch prey. The father and the mother took care of juveniles with similar intensity.

We discuss collected data in the light of influence of enclosed conditions on the typical behavior.

EUROPEAN BISON *BISON BONASUS* RESTITUTION IN WESTERN POLAND – CONCEPT, CURRENT STATUS AND STRATEGY FOR FURTHER DEVELOPMENT

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After six centuries of absence of the Europen Bison on the Western Poland territory on 29 of February 1980 katedra Zoologii Akademii Rolniczej w Poznaniu under the guidance of Prof Ryszard Graczyk reintroduced 8 European Bison (4 bulls and 4 cows) on the are of Forestry Enterprise Wałcz. The bisons originated from free ranging herd in Bialowieża Forest. This is currently the youngest free ranging herd in Poland and the westernmost population of free living bison in Europe.

The current population stands st around 20 individuals with a slow growth tendency. The largest cohesive group numbers 16 individuals. Altogether during 25 years of the herd history around 48 young had been born. The most significant factor of mortality was poaching. During 25 years of research we could document loss of 31 individuals (14 bulls, 14 cows, 1 calf and 2 unsexed individuals). Loss of at least 7 individuals can be attributed directly to poaching. Other important factors reducing the size of the population were: deaths due to natural reasons (4 individuals), culling of excess individuals, euthanasia due to injuries or diseases (7 individuals), roadkills (5 individuals. Other or unknown reasons account to 4 animals. The further development of population will be supported through introduction of unrelated individuals to provide much needed variability into the genepool. Additionally there is a new center for captive breeding being created in Western Pomerania in cooperation with Katedra Zoologii (Kocury, „AGROBRUSNO”).

The behavioural research on the reintroduced population showed clearly that the animals behave like wild ones with high level of antrophophoby. The animals are not supplementary fed. They don't cause significant damage to forests and field crops. The presence of wild bison had been accepted by local communities and treated as natural part of the environment.

The population in Pomerania continuously expand the range. Single individuals are known to migrate as far as 130 km. hey can subsequently become a nucleus of additional subpopulations inhabiting suitable habitats all over Pomerania and become the next step of restitution of European Bison in the Western Poland.

REHABILITATION OF BIRDS OF PREY *FALCONIFORMES* AND OWLS *STRIGIFORMES* AT POZNAN ZOO IN THE YEARS 2000-2004

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Poznan zoo participates In rehabilitation of birds of prey and owls for many years. The results presented in this paper are a short summary of our work and treatment or rehabilitation methods. During the last five years there were 322 individuals representing 13 species of birds of prey and 5 owl species admitted to our rehabilitation station. 82,92% of the total numbers were birds of prey.

210 individuals (65.22%) could have been released to the wild. In the birds of prey group 67.04% of the total had been released and in owls 56.36%. All bird had been ringed prior to the release. The most numerous species were European kestrels *Falco tinnunculus* – 142 (53.18%) followed by common buzzard *Buteo buteo* – 47 (17.60%), white-tailed sea eagle *Haliaeetus albicilla* - 23 (8,61%), sparrow hawk *Accipiter nisus* – goshawk *Accipiter gentiles* 15 (5.61%) and marsh harrier *Circus aeruginosus* – 9 (3.37%). The most numerous owl species was tawny owl *Strix aluco*- 21 (38.18%) followed by long-eared owl *Asio otus* – 17 (30.19%) and barn owl *Tyto alba* – 15 (27.27%). The fledglings accounted to 46.60% of the total followed by chicks – 23% aldults – 20% and immature – 5.28%.

The bird were brought to our zoo due to a number of different reasons. The most numerous were birds that had fallen out of the nests and counted to 48.76% of the total. The second group was of birds that showed weakness due to hunger or another reasons – 27.64% followed by birds with broken wings – 15.22%, wings damaged in other ways – 5.60%, shot by hunters – 1.55% and other 1.24% of the total.

THE CONTRIBUTION OF EX-SITU ANIMAL TO THE CONSERVATION OF WILDLIFE SPECIES IN NIGERIA

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The Science of conservation is the pivot around which every aspect of wildlife management resolves. The reason for this assertion is not far fetched.

For wildlife study to be a reality and to be successful, the animal species involved must as a matter of fact be in existence.

The endangered or animal species whose existence is threatened are on the increase on daily basis. This could be attributed to the galloping increase in the world population over the years.

For the sake of this work, some of the workers of the zoological garden were approached for an oral interview and past and present available data were also collected.

The result revealed that the population of the inmates of the zoological garden is on the decline. And also, that the mortality rate out-weighs the natality rate. Majority of the animal species have failed over the years to reproduce, due to the configuration of their habitat which seem to be counter reproductive.

Nevertheless, the wildlife species that are still found in the zoological garden gave the overall impression that it has contributed Immensely in reducing the threat of extinction that is starring the animal in the face.

Therefore, to put the conservation effort in proper perspective, the government, corporate bodies, voluntary and non-governmental organization societies, clubs and individuals are urged to assist and collaborate the institutional efforts in providing quality health and management care that will ushered in a meaningful conservation for the zoological garden inmates (animal species).

CURRENT CONSERVATION STATUS OF THE BAWEAN DEER *CERVUS KUHLII*

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The Bawean Deer belongs to the least known in terms of biology and current conservation status deer species. The last systemic research was performed in the 1986. Since then there are just limited scope reports.

The current paper presents the results of a field survey performed in November 2004 as well as data on captive population kept in Indonesian zoos.

The current distribution of the Bawean Deer is restricted to two relic forested areas on the island. On a smaller Pulau Cina island, connected to Bawean during low tide by a swampy pass (overgrown by mangroves in the recent past) the presence of two, or possibly three individuals had been confirmed. This low number is a result of a hunt performed during 2002. On the main island all the traces are restricted to surroundings of Kastroba lake. The total population is unlikely to exceed 200 individuals. The main threats are as follows:

- poaching
- destruction of forests and converting them to fields
- replacement of natural forest through yati (Asian teak) *Tectona grandis* plantations

There are around 200 bawean Deer kept in Indonesian zoos, but the future of this species in captivity is uncertain due to lack of any breeding coordination and high inbreeding (the whole population dervies directly from 3 individuals imported in the middle 70's). Three unrelated animals are kept privately on Bawean Island.

RESTITUTION OF THE PEREGRINE (*FALCO P. PEREGRINUS*) IN POLAND

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The Peregrine falcon was at the beginning of XXth century a widespread species in Poland, although it was always scarce. It was most numerous in Masurian Lake District.

Since 1950 a catastrophic reduction of numbers had been recorded. The last successful nesting was recorded in the 1964. From 1970 till 1989 over 20 direct observations had been made. There were just two unsuccessful nesting attempts.

Polish falconers attempted captive breeding of peregrine already by the end of 1970's but the breeding was achieved in the middle 1980's. All birds used for this project represent nominal subspecies F.p.peregrinus and originate from German, Scottish and Scandinavian population.

Reintroduction was initiated in the 1990 and it had been performed firstly on forested lands, in the Pieniny mountains as well as in large cities (Warsaw, Kraków). The participants (five breeding stations and numerous other organizations) are represented in the Council for Peregrine Restitution in Poland. Altogether, in the years 1990-2004 216 peregrines had been reintroduced through "hacking" method.

Since middle 1990's there is an increasing trend of recording wild peregrines in Poland. First confirmed nesting was noted in the 1998. Since then there are new reports on a yearly basis. In the year 2004 there were at least 10 nesting pairs (perhaps another 10 were not found) and 50 chicks fledged from them. Most of the breeding birds originate from reintroductions, some are additionally known to nest in neighboring German areas.

THE KHUR EQUUS HEMIONUS KHUR, LESSOM 1827 – REVIEW OF EX-SITU AND IN-SITU PROGRAMMES OVER THE LAST 30 YEARS

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The khur, Indian subspecies of kulan is restricted in distribution to the salt desert Little Rann of Kuch in Gujarat State of Western India, where especially for this species a reserve covering 4953 sq. km. had

been created. The latest count performed in January and February 2004 revealed the population increase by 36.06%. The total population stands at 3863 individuals. The highest density is in the Dhrangadhra region, in the south-eastern part of the reserve. Such a high density had been achieved through installing a number of water sources as well as planting, especially during 1980's large areas of mesquite *Prosopis juliflora* bushes that are a source of food for khur. The development of mesquite groves reduced however the extent of grasslands dominated by such important food plants as *Cyperus capillaries and Dichantium annulatum.* Additionally the grasslands are the habitat of *Sueda fructicosa* – plant gathering slightly salty water in its leaves. After droughts (1986-88) natural dispersion had been observed. There is a danger of hybridization between khur and domestic ass, especially on the fringe of the reserve. In the 1963 the diseases transmitted from domestic stock caused high mortality, resulting in all time low population count – just 362 individuals. Such a danger exists also today. From 1960's onward there were khur in Indian zoos – first individuals as early as 1956 in Sakkarbaug zoo in Junagadh. The first captive birth occurred on 13 of August 1964 at Maharajah fetesingh ZOO at baroda, Gujarat (Gaekwad, 1965), next one 03.03.1965 win Ahmedabad ZOO, Gujarat (David, 1966). Subsequently the births had been recorded in three institutions – Ahmedabad, Junagadh where a single mare "Tepuri" gave birth to seven offspring and National Zoological park, New Delhi. The khur kept in zoos were all acquired as wild caught, young animals aged 1.5 – 2 months. The capture had been discontinued in the 1986 due to problems with further raising (mostly due to heavy parasite load). In the 1984 there were 25 khur kept in Indian zoos, just ten remained by March 2001. In November 2004 that equid species had been kept just in Junagadh ZOO where 5 stallions and 3 mares remained. All of the mares were wild caught on 18th of August 2001. Khur was represented in European collections mostly in XIX century. London ZOO acquired its first stallion on 3rd of May 1832 followed by a mare on 5th of May 1849. Subsequently three births had been recorded there (Flower, 1929). During the years 1842-49 nine offspring had been recorded at paris ZOO (Harper, 1945 after Gee, 1963).

PRELIMINARY OBSERVATIONS ON THE ACCLIMATIZATION OF VISAYAN WARTY PIGS *SUS CEBIFRONS NEGRINUS*

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On 28th of April 2004 after months of intensive efforts from many people both on the Philippines, in Holland, USA, Germany and Poland four pairs of Negros Warty Pigs *Sus cebifrons negrinus* arrived safely and apparently in good mood to absolve an obligatory 6 months quarantine before being moved to Rotterdam zoo. This was a culmination of 12 years of hard work of the "Visayan Warty Pig (Negros) Conservation Programme" led by William Oliver of the Fauna and Flora International.

They had been released into four separate stables app. 16 sq. m in the same pair compositions as on the Philippines.. Each stable was individually heated through hot air circulation to a temperature of 24 Celcius and a hot basking spot (app.35 C) was also provided. After app. 2 weeks of acclimatization that went quite uneventfully three pairs had been released into outside, sandy paddocks app. 600 sq. m. each. The fourth pair after a month had been moved to another place in the zoo to allow them to use a large, ca. 3000 sq. m paddock overgrown by grass and various shrubs as well as other vegetation. Keeping this pair gave us opportunity to observe very interesting behavioral patterns. The pigs dug for insects in the soil, collected vegetation and built nests. Then they moved them several times over the period of several months. Then, at the end of October enlarged belly was noted in one of the females – "Mina". After few days teats were also clearly visible. The birth took place in the night from 29th to 30th of October. In the morning two apparently alert and very much alive piglets had been spotted in the nest together with "Mina". On third day, 2nd of November in the morning the piglets were found missing. They were probably destroyed by sow, or the male.

VITAMIN E DEFICIENCY OF TAMMAR WALLABY (*MACROPUS EUGENII*) IN CAPTIVITY

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Vitamin E deficiencies have been identified in numerous species of captive wildlife (Robbins, 1993), and documented as a specific health problem in zoo animals for more than 50 years (Dierenfeld, 1989) The tammar wallaby (*Macropus eugenii)* is one of the smallest wallabies of genus *Macropus*. All species of this genus are herbivorous, and most are mainly grazers. Nutritionally, Vitamin E can be one of the most challenging vitamins in the diet of captive Tammar wallabies because it is most likely to be deficient,

since this species belongs to the small group of animals in which Vitamin E deficiency, and therefore nutritional muscular dystrophy, is not prevented with small traces of Selenium. In December 2002 Temaikèn's Tammar wallabies changed their fruit based diet to a higher fibre diet. Their basal diet consisted of 0.3 kg pellets for rabbits (19% CP, 2.3% crude fat, 18% crude fibre), 0.3 kg fresh clover, 0.15 kg alfalfa pellets and 0.15 kg alfalfa cubes fed in the evening with 50 g chopped banana and 50 g chopped apples. This diet was supplemented with vitamins (Vionate®S, Novartis), amino acids and 1.5 ml of Vitamin E + Se (Norzoquin Selequin, VETEC S.A.: Vit E 3333 mg/kg and Se 0.11 mg/kg). In April 2004 four wallabies were carried from the exhibition area to the Reproductive Centre of Temaikèn Foundation. The animals were located in an enclosure of 49.5 m^2 open area and a 8.526 m^2 family area. The new place had soil floor with some shrubs that allow them to hide and the fences were covered with black HDPE (high density polyethylene) Raschel knitted fabrics. In November 2004 workers started to build a new enclosure 5 m away from this place. Apparently the additional stress of crowding and noises increases the vitamin E requirement significantly. Thereby, between December 2004 and February 2005 three of these animals died with evidence of myophaty after presenting weakness of the hind limbs which begins insidiously and progresses rapidly to complete ataxia. Necropsy and histopathology showed typical lesions of deficiency in Vitamin E (α-tocopherol). All animals presented pale, firm muscles in the hind limbs on necropsy. Histologically, there were marked hialine degeneration, muscle fibre fragmentation, increment of acidophilia in some areas and Zenker's necrosis in great areas with dystrophic calcification.

ANIMAL COLLECTION OF POLISH ZOOLOGICAL GARDENS

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Thirty five years ago Polish Zoological Society, Section of Zoological gardens started to work on gathering and publishing the data on the animal collections held in Polish zoological gardens. Until now 26 volumes of the *Informator Polskich Ogrodów Zoologicznych* had been printed, covering the years 1965-2004. There is now a small anniversary of 20 years since the data for volume 6 had been presented in unified way showing not only the status at the end of a given year but also all births, deaths and moves in the collection. Due to that reason it is possible to track the record for all species of animals kept over a period of 21 years. The data on offspring born and reared cover 40 years of history of 10 out of 14 zoos participating in the latest 3 editions. There is no comparable publication in the history of zoos all over the world.

The animal collection of 14 Polish zoos at the end of 2004 covered 28632 individuals (excluding invertebrates) representing 1870 taxa (species, subspecies, races, color variations) belonging to 1579 species. 341 specie reproduced during the year 2004 (21.6% of the total).

This publication proved to be very useful in many aspects of zoos activity and is an invaluable source of a multitude of information. It helps in scientific research on the development of zoos and captive population, disseminates knowledge and helps in planning collections.

ESTABLISHING AN OUTDOOR ENCLOSURE FOR EUROPEAN GROUND SQUIRRELS

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In 2000 and 2001, we constructed enclosures for European ground squirrels (*Spermophilus citellus*). A site was chosen within the natural habitat of the species, in a former vineyard in the north of Vienna, Austria (48°18'N, 16°23'E). The area is situated on an east-exposed slope (elev. 220–260m) with lean pasture, scattered fruit trees and shrubs. We set up 3 rectangular enclosures covering a total area of 427m². Each enclosure consisted of a vertical coated-wire grating (mesh 20x20mm, 2mm gauge) laid 110cm deep into the soil and projecting 90cm aboveground. On the upper third of the grating, an aluminium sheet metal of 32cm width was riveted such that it inclined inward in an angle of about 45°. All enclosures were surrounded by a wire-mesh fence of 2m height, on top of which we fastened horizontal protective nets to exclude aerial predators. Before releasing squirrels, we prepared artificial burrows by means of a hammer drill. The holes were 5cm wide and ≥30cm deep, and induced digging behaviour. As it turned out that terrestrial predators were able to overcome the outer fence, we installed electric fencers (discharged energy 0.07J, voltage 7500V). They were connected to wire strands mounted on the sheet metal on top of the grating. In 2002 and 2004, respectively, we removed the electric fencers because they were inefficient in excluding predators. Instead we constructed net tunnels by putting in PVC arcs and attaching the protective net to the wire grating such, that the gap between net and grating was closed. We provided the ground

squirrels with supplemental food because densities maintained in the enclosures were about a magnitude higher than in free-ranging populations.

The enclosures proved workable in acquiring conditional and behavioural data. Annual losses were lower then what had been observed in the field. Percentages of successfully reproducing females approached 80%, with litter sizes within the natural range (2–7).

We consider the enclosures as appropriate for maintaining European ground squirrels under semi-natural conditions. The design we developed could also be adapted to management and conservation measures.

SPONTANEOUS PLANT COVER OF THE ANIMAL PADDOCKS AS AN IMPORTANT SECODARY HABITAT ELEMENT; THE ANALYSIS OF FLORA OF THE POZNAN NEW ZOO

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A significant number of animals in today's zoos are exhibited on open paddocks. The habitat where the animals reside is not indifferent both to visitors and animals, mostly due to quite contrary reasons. The habitat of the paddocks is shaped by existing plant cover, both planted especially and spontaneously. The flora of the animals paddocks at the New ZOO covers 215 species (around 45% of the total number of vascular plants recorded for the zoo area) grouped into 58 families and 58 genera. The plant communities depend on environmental conditions prevalent on a given paddock. It had become clear that the paddocks planned and used in a rational way not only allow common species of plants to thrive but also allow to save a number of species classified as rare or threatened in regional scale. 18 species of plants recorded from paddocks (8.4% of the total) are threatened with local extinction and 4 are under protection by law. So, the paddocks can become important refuges for valuable plant species or even whole communities. To save the existing biodiversity of the plants growing on paddocks several factors had to be considered. Firstly overcrowding is to be avoided and species selection especially careful. The best option is to use the existing habitat types for animals actually using such a type of habitat. Such naturalistic paddocks are usually the bast possible option for environmental education in zoos.

THE PRINCIPLES OF ORGANISING EXHIBITION AREAS IN ZOOLOGICAL GARDENS ON THE BASIS OF THE EXAMPLE OF COMMON HIPPOPOTAMUS *HIPPOPOTAMUS AMPHIBIUS*, OR THE CO-OPERATION BETWEEN THE LANDSCAPE ARCHITECT, BREEDER ANIMALS, AND ZOOLOGIST IN THE PROCESS OF DESIGNING AND MODERNISING ANIMAL ENCLOSURES

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The aim of study is to determine the principles for organising exhibition areas on the example of common hippopotamus enclosures as well as identifying issues which are crucial for co-operation between experts who design and upgrade animal enclosures. The information and data were obtained from theoretical (chamber) and outdoor research.

During the theoretical research the following three groups of information were considered: zoological data, breeding animals data and design data. Having processed the data, I have identified 11 features, which influenced the functioning and organising hippopotamus' exhibition areas in zoological gardens. These include: exposition (location), size of the area, vegetation, water, relief, light, ground (surface), visibility shaping, position of particular exhibition components, fence, and behaviour of animals.

The outdoor research included visiting of 7 zoological gardens and evaluating animal exhibitions. This evaluation included the 11 features mentioned above and ordinal scale from 0 to 3 was used. The results of this evaluation show that the most important factor in hippopotamus' exhibition are water and water filtering. Certain interdependencies which influence the organisation and functioning of an enclosure were identified (the size of enclosure and behaviour of animals).

Posters

SURVIVAL ANALYSIS IN THE POPULATION OF DAVID`S DEER (*ELAPHURUS DAVIDIANUS*, MILNE-EDWARDS, 1866)

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The current population of David's deer, which had for centuries inhabited the central-eastern China, is derived from 18 individuals kept in British Park Abbey group. Survival analysis is suitable to monitor the variation of longevity of individuals populations. In earlier study by Molińska-Glura et al. (2004), higher survival for deer females compared to males was reported whereas medians for mortality for both sex groups were similar. The object of this study was to determine the survival and hazard functions for the clustered subpopulations of David's deer kept in zoological gardens. The data were extracted from the International Species Information System (ISIS). Pedigree and survival data on 1192 individuals were obtained from 56 zoological gardens (for the years 1947-2000). Two criteria (average life length and percentage of individuals that survived one year) were used to cluster these units. Six cluster groups were formed by the use of both Euclides norm. In general, the cluster groups are not connected with climatic conditions. Moreover, their size varies. Survival and hazard functions were derived for the clustered groups.

HOW EEP PROGRAM IS INCLUDED WITHIN CARPATHIAN REINTRODUCTIONS OF EUROPEAN BISON

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The Carpathians, being the largest and the least altered mountain range in Central Europe offer the best ecological conditions to establish there a viable, self-sustainable meta-population of European bison. Four countries are involved in the project: Poland, Slovakia, Ukraine and Romania. It is very easy to explain the benefits of such program for the future of the species, and its implications for the restoration of missing ecological niche in the ecoregion. The project is aimed in choosing proper animals from genetic point of view to enrich the gene pool of existing in the region herds. The best sources of animals are EEP zoos and up to now two groups of European bison were transferred and released. The paper will present all details about chosen for reintroduction stock.

PRELIMINARY STUDIES ON INBREEDING RATE IN SITATUNGA POPULATION (*TRAGELAPHUS SPEKII*)

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Sitatunga, called „water antelope", inhabits the wet areas of central Africa. Since 1756, the species is kept in zoological gardens. The relatively small size of this population leads to mating of relatives. The objective of this study is to evaluate the inbreeding level of the population kept in zoological gardens. Data for the present study have been obtained from the ISIS base. The pedigree of 3661 individuals (including place and date of birth as well as the date of death) have been considered. Inbreeding coefficients were recovered from the additive relationship matrix. The average inbreeding level in the population studied was 4.4%. However, there were 16% inbred individuals. It should be noted that inbreeding level of individuals born in 1756-1957 was null which can be due to incomplete pedigree data. On the other hand 18% inbred individuals have inbreeding coefficients that ranged from 0.03125 to 0.5. Non-negative relationships between population size and inbreeding rate have been registered. As already mentioned, it can be determined by the availability of pedigree data. The next step of our study concerns inbreeding effects on longevity. Inbreeding coefficients were included in the model as covariable. Moreover, the model includes the effects of place and date of birth, sex and additive genetic effects.

BEHAVIOUR OF ASIATIC LION (PANTHERA LEO PERSICA) UNDER ARTIFICIAL REARING AT ZOO

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Unlike other felid species lions are social animals, that is why socialization in early rearing is important for their behavioural ontogeny. It happens at a Zoo that a dam is not able to take care of her offspring because of a number of reasons.

Behaviour of lion male under artificial rearing conditions at the Zoological Garden of Łódź was observed during first 6 months of his life. 3-month old dog female of Golden Retriver breed was attached to the lion at early second month of his life. This combination of two species was aimed at a socialization of a lion that had a social nature like a dog. Behavioural data were collected during 5 observation periods from 2nd to 6th month of lion's life (every month, a few days, from 8.00 to 18.00 h).

Socialization process seemed to be successful. The animals accepted each other that was shown by social interactions in play behaviour. Duration of lion's social behaviour was the highest in the 2nd month (37% of total activity), from 3rd to 5th month on the average 24% and only 10% in the 6th month of lion's life. Walking and vocal stereotypies in the lion were observed during dog's absence (when a dog was taken for a walk). This abnormal behaviour started from 4th month of lion's life and it indicates a strong emotional bond between individuals and a social isolation distress.

Artificial socialization between the lion and the dog enabled to perform typical species behaviours. Significant influence of age on duration of particular lion's behaviours in early life's period was stated.

IS THE WEEKLY FEEDING SCHEDULE INFLUENCING COPULATION IN GOLDEN EAGLE (*AQUILA CHRYSAETOS*) AT POZNAŃ ZOO?

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In several birds species, males offer material gifts to their mates during mating season.

The role of such behavior is to increase female reproductive success. It was also observed that the males use such gifts before extrapair copulations.

Therefore we decided to test if the feeding cycle of Golden eagle in captivity influenced the number of observed copulations. Investigation was carried out during the years 2004-2005. Golden eagle were fed three times a week (Monday, Wednesday and Friday). Male didn't take food straight to female's bill. Altogether 101 copulations had been observed.

There were no statistically significant differences between number of observed copulations, days of copulations and number of occupancy of copulation's branch at feeding and fasting days

DAILY ACTIVITY AND CHANGES OF BODY COLOUR OF *CHAMAELEO (TRIOCEROS) WERNERI* IN CAPTIVITY

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Chamaeleo (*Trioceros*) *werneri* is a montane species with very limited range of distribution. It is native only to the Uzungwe and Uluguru Mountains, Tanzania.

Animals used in the studies were offsprings coming from parents imported from Tanzania to Poland in 2001. The observations were conducted on five individuals; two males and tree females. The studies connected with daily activity started when animals were 1-month old and finished when they were half a year old. In this time chameleons were kept together in terrarium 70x40x40 cm situated in a greenhouse. Inside the terrarium some branches at varying heights and angles for relaxing and basking were placed, a heat lamp (25 Watt) and some living plants (*Chlorophytum* sp. and *Bougenvilla* sp.). The plants are very important because they enable the animals to hide and feel secure. The terrarium were sprayed every morning and during some warm days couple of times during the day. However the main food were crickets chameleons ate

other species of insects too (mealworms, flies, grasshoppers). The second part of studies connected with changes of body colours were conducted when animals turned a year and a half. Then the animals were kept separately but the arrangement of terrariums and food were very similar.

The studies were focused on observations of chameleons during the whole day and registration of different kinds of behaviour expressing various emotional states or kinds of activity. There were: neutral posture, fear, submission, hunting, impressive posture, emotions connected with contact with other individuals of the same and opposite sex, moving. Animals were photographed and colours of every part of body were analyzed. Results of this part of studies show that variability of coloration of various parts of body is differentiated. The studies of daily activity revealed that the main time of basking was between 10-12 a.m. and 4-5 p.m. In the early morning lizards were found usually on the branches among leaves of plants where they spent nights. Daily schedule of activity was similar to this observed by other species of chameleons (*Chamaeleo chamaeleon*, *Furcifer cephalolepis*).

FIRST EXPERIENCE IN HAND REARING LONG HAIRY ARMADILLOS (*CHAETOPHRACTUS VILLOSUS*) IN TEMAIKÈN FOUNDATION

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In December 2002 Temaikèn's Long Hairy Armadillo (Chaetopractus villosus) collection consisted of 4 adults (2.2.0). One of the females delivered, for the first time, two pups that weighed 118,53 g. and 108,33 g. They were hand reared due to parental neglect at 1 day of age. The hand rearing formula was based on Esbilac Powder (Puppy Milk Replacer Pet-Ag Inc) and water. The formula averaged 35 % protein (DMB) and 44.33 % fat (DMB). Initially the pups were feed every two hours around the clock decreasing to 1 time/day by 75 days of age. The mean milk consumption was 10.65 % (as fed basis) of body weight and gained 14.84 g/day from during lactation. At weaning their weights were 1225,33 g. and 1197,33 g. respectively.

TYPES OF SOCIAL BEHAVIOR OF THE SNOW LEOPARD (*UNCIA UNCIA*) AT THE POZNAN ZOO

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Free-living snow leopards are generally considered solitary animals except during the breeding season. Their primary type of communication is marking. They scrape the ground and trees, spray urine, or leave feces as a sign to mark their territories and advertise for mates during breeding season. Females are responsible for raising the cubs, with no assistance from the males, which can present infanticide behavior.

In captivity we observed a pair with one juvenile (a female). Vocalization, aggressive behavior (threat postures and attacks), social grooming, social playing, social identification, following and sexual behavior were distinguished in contacts between snow leopards. Threat postures and attacks were typical for relations in a pair and appeared with the vocalization (before attacks) and intensive marking of the enclosure area (after attacks). Aggressive behavior was the most frequent in a period of the adult female estrus. The male and the young female groomed the adult female mostly. The daughter provoked social playing with both parents. Social identification was characteristic for the male's behavior and the young female very often followed her parents.

PARENTAL BEHAVIOR OF THE BAT-EARED FOX (*OTOCYON MEGALOTIS*) AT THE POZNAN ZOO

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The Bat-eared fox is a canid species from Africa. Two free-living populations are known in the field. This species is rarely kept in zoos.

The parental behavior of a pair with two juveniles (a male and a female) was observed at the Poznan zoo. Both parents participated in costs of parental care. The intensity of social contacts with youngs was

similar for the father and for the mother, but social resting was observed more frequently for the father. The father invested in playing even more than the mother. Offsprings foraged together with their parents and slept in the same burrow. Parents didn't communicate with youngs by vocalization, but the young male and the young female barked and squealed. Surprisingly, social grooming was more typical for relations within the pair and observed sporadically as an element of parental behavior. Youngs evidently were teached by parents what to eat. Paternal investment needs further investigations.

SOCIAL BEHAVIOUR IN PETAURIDS UNDER ZOO CONDITIONS – CONSEQUENCES FOR SUCCESSFUL BREEDING

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Petaurids are Australian possums and all species possess well-developed dorsal stripe and facial markings. This family contains 11 species which include the Sugar glider (Petaurus breviceps), Ringtail possum (Pseudocheirus peregrinus) and Striped possum (Dactylopsila trivirgata). Little is known about the biology of most of the petaurid species both in the field and in captivity. They are rarely kept in European zoos. Examination of their behaviour under different enclosure condition and by different group composition is very important for successful management.

The Sugar gliders in the wild nested socially in groups of up to seven adults in hollow trees as well as live solitary and the social organization has been still studied. In captivity establishing of social groups with mutual grooming and agonistic behaviour performed against non-group members were observed.

The Ringtail possums can live in small social groups with single individuals being the dominant. In a recent study on captive it demonstrated that males and females could discriminate between sexes and individuals using urinary cues.

The Striped possum's behaviour is dominated by agonistic interactions and less diverse (lack of affiliative behaviour) in comparison with other petaurids. Number of social contacts is associated with the size group and enclosure but independent on the group composition in captivity.

Two-ways of zoo-keeping are suggested to breed petaurids:

- traditional enclosure for social groups of gliders and ringtail possums let them to maintain group cohesion,
- separation of possum individuals to avoid aggressive behaviour and pair them when females are sexually receptive only.

This assumption needs further investigations.

TRADE IN ENDANGERED SPECIES ON THE INTERNET IN POLAND

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In 2004, the Polish Society For Nature Protection „Salamandra" initiated a project to find out how popular the illegal trade in endangered species is on the Polish internet. During the 5 month investigation it was established that 1400 illegal offers of sale were placed on the internet. It was estimated that total costs of all offers was nearly € 240,000. Unsurprisingly, reptiles and invertebrates made up the largest portion of these animals (about 1/3 each), but by value mammals and birds dominated. As well as the species protected by European Community law, species also given protection under Polish law were found, such as: Otter (*Lutra lutra*), Wolf (*Canis lupus*), Lynx (*Lynx lynx*), Peregrine falcon (*Falco peregrinus*), Long eared owl (*Asio otus*), amongst others.

COMPOSITION AND USEFULNESS OF SELECTED FOODS FOR MONKEYS

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The aim of the study was to determine the food preferences and evaluate the food composition as well as to distinguish the content and assess digestibility of particular foods for selected species of monkeys. Composing a proper dose for wild animals in the zoo is extremely difficult. This results both from the species diversity and from the individual preference of particular monkeys. The study presents the authors' own research and the information provided by the workers of the zoo in Łódź. The research was carried out from March to November 2002 on the group of 7 monkeys, with age range from 10 to 38 years. On the basis of the research it was observed that the basic foods for monkeys in the Łódź zoo were fruit and vegetables. Monkeys' favourite foods were: grapes, strawberries, cucumbers, biscuits, bananas and tomatoes. The least preferred were: cheese, pepper, carrot and citrus fruit. The biggest influence on the food choice was the dominance of novelties. It was determined that food portions given to the monkeys had a substantial water content, whereas the biggest part of the dry matter consisted of carbohydrates. The content of the detergent fiber in the examined foods was scarce, with the highest values of NDF and the lowest values of ADL. The digestibility of the basic food components was lower for older and weaker animals. The lowest degree of digestibility was observed for crude fiber and detergent fiber. The digestibility of other components was about 80 %.

UNUSUAL SHAPE OF ACROSOME IN EUROPEAN BEAVER (*CASTOR FIBER*)

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Sperm morphology is as characteristic to different species as fingerprint is to humans. Rodents are especially interesting due to exceptional sperm morphology. The prominent feature in these animals is asymmetry of sperm head and the shape of the acrosome. Initial problems in evaluation of semen quality in European beaver encouraged us to study this species.

9 free living adult European beaver males with body weight 13.3 – 23.9 kg were captured during breeding season. Animals were sacrificed and their reproductory organs were collected along with the fluid from cauda epididymis and ampulla of ductus defferens. After preparation the material was analyzed in transmission and scanning electron, and light microscope. Sperm morphology and the processes of acrosome development during spermiogenesis were evaluated.

Our analyses showed that European beaver sperm is characterized by a large acrosome. It length exceeds that of the spermatid nucleus as early as the maturation phase of spermiogenesis. During following phases of spermiogenesis the acrosome does not stay along the longitudinal axis of spermatid, but is convoluted along the transverse axis of the head. Until now such changes were not described in other species.

The study was supported by the State Committee for Scientific Research 2PO409726

SEMEN COLLECTION IN *TETRAONIDAE*

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One of the methods of conservation of threatened species is the use of artificial breeding (semen and embryo banks). It is also predicted that the methods used for mammals like semen collection may be used for breeding and conservation of threatened forest grouse species. The semen obtained from various species can be used in future in founding new groups with the gene transfer from other populations into isolated sub-populations of black grouse and capercaillie.

The latest observation on a new reintroduction method show that the new one might bring much better results than the traditional one, as it allows to produce birds less dependant on traditional cage breeding (Krzywiński, Keller, 2005). According to IUCN guidelines it is important to use the genetically proper birds to assure the long term survival of local sub-populations.

The goal of this work is to work-out the methods for semen collection for further use in captive breeding. . Using similar methods to those developed for mammals we had collected the semen from various *Tetraonidae* species with the use of tame female of a given species. The semen had been collected from capercaillie *Tetrao urogallus,* black grouse *Tetrao tetrix,* ruffed grouse *Bonasa umbellus* males as well as from a hybrid black grouse/ capercaillie. The semen was also collected from black grouse and capercaillie with the use of alien species female like common pheasant *Phasianus colchicus.* Observation had also been made on the behavior of males capercaillie towards a stuffed female and a phantom.

It seems that the developed methods might be used in conservation of threatened *Tetraonidae* and will provide important data on breeding biology as well as allow to produce hybrids for further genetical research.

TRANSFORMATION FROM MENAGERIES TO NEW MILLENNIUM CONSERVATION CENTRES

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The collection of wild animal species of non-domesticated origin, living in captive environment is referred to as a zoo. The transformation and modernisation of a menagerie is also referred to as zoo or conservation centre. The first zoo was the royal menagerie of ancient Egypt and Assyria.

During the ancient days, which were before 18th century, individuals for entertainment kept wild animals. Conservation awareness was lacking during the period. Before the 21st century few menageries developed to the stage of the conservation centres. They realised the threat to the life of many animals of the wild, in fact, too many zoos were living in the past, to survive they need to stop relying on spectacle and get serious about saving the animals outside their walls. During the 20th century, Government, Zoo Directors and Educators took different dimensions to save the species from extinction, many organisations were established for this purpose. The new millennium ushered in, improvement to encourage the wild life, these includes conferences, breeding-techniques, training, biodiversity researches, international conservation education programmes and sponsorship and support to less privileged institutions and individuals. It is a period of branching out.

SELECTED PROBLEMS OF CREATING AND ENRICHMENT ENVIRONMENT OF ORANG-UTAN *PONGO PYGMAEUS* LIVING IN CAPTIVITY

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The aim of this study is to identify the major problems of creating and enrichment environment of orang-utans 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 orang-utans (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 orang-utans' 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 an 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 orang-utans that live in captivity. Moreover, by means of summing up of the results I was able to select the best designed orang-utan exhibitions, which are the ones in the zoological gardens of Cologne, Hamburg and Münster.

THE NORTH OF ENGLAND ZOOLOGICAL SOCIETY RESEARCH PROGRAMME

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Good quality research has an important role in modern zoos, as well as being a legal requirement. The North of England Zoological Society (NEZS), based at Chester Zoo, UK, is committed to research as part of its mission to support and promote conservation of plants and animals, as described in this presentation. In 2004, over 200 research projects were carried out at the Zoo by academics, students and Zoo staff, in a variety of basic and applied fields and this continues in 2005. Biological studies are carried out on diverse topics including elephant birth behaviour, nutrition of equids, genetics, studbook analyses of animal populations and the effects of various husbandry practices such as enrichment efforts on animal welfare, using a range of non-invasive measures. Education and marketing research projects are also conducted, such as evaluations of Winter Presenter Talks and their efficacy in educating visitors about animals, assessments of visitor satisfaction of their Zoo trip, and Annual Membership and staff surveys. In addition to its on-site research programme, the NEZS supports in situ research through various channels including financial and staff technical support for NEZS conservation programmes, grants and studentships, some of which are undertaken in conjunction with conservation partner organisations. The NEZS coordinates several in situ conservation programmes, which include large components of research. For example, the Jaguar Programme incorporates PhD research and is an investigation of jaguar-rancher conflict in South America, and the Asian Elephant Programme is a study of human-elephant conflict using Geographical Information Systems as a research tool. In 2005, research at Chester Zoo is thriving and interest is being shown by art and photography researchers, as well as scientists, in conducting projects at the Zoo. In this talk I present the holistic possibilities for zoo research efforts and how the NEZS uses these to try to achieve its conservation goals.

5.2 Animals, zoos and conservation Zoological Garden in Poznan, 2006

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Captive management of highly endangered species becomes more and more important. However, information on the requirements of successful reproduction is often limited. The Sumatran rhino is one of the most threatened mammals. Only 300 Sumatran rhinos are left in the wild. The captive breeding of the species is not a story of success. Sumatran rhinos are solitary animals. They can fight viciously if the female is not sexually receptive. It is therefore important for captive management to identify the right time of mating. The purpose of the study is to determine whether a correlation exists between the female oestrus cycle and the behaviour of the rhinos. Data was collected between March 2004 and October 2005 from two captive Sumatran rhinos (1.1) kept in the Sumatran Rhino Breeding Centre in Sepilok, Sabah, Malaysia. We conducted regular hormone analysis using faecal samples. The rhinos were introduced regularly to each other through a fence and the time spend in contact was measured. We conducted regular behaviour observation, and we did daily temperature measurements. Progesterone analysis indicated that the female is still cycling but cycling activity is irregular. Our findings also suggest that male activity, such as erection and masturbation correlate with the female's cycling activity.

EX SITU CONSERVATION OF THREATENED PRIMATES AND BEHAVIOR: THE CASE OF THE WHITE-NAPED MANGABEY *CERCOCEBUS ATYS LUNULATUS*

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The white-naped mangabey *Cercocebus atys lunulatus* is a little-known semiterrestrial monkey endemic of the Western Upper Guinean Forest of West Africa, and it is listed as Critically Endangered by the IUCN. We shortly review available knowledge on socio-ecology of *Cercocebus* and results of captive breeding programmes, evidencing issues in the husbandry and management that need to be improved for the long-term viability of the captive population and its future utilization in reintroduction programmes.

HOW DO YOU MONITOR RARE AND ELUSIVE MAMMALS? COUNTING DUIKERS IN KENYA, TANZANIA AND ZIMBABWE

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Duikers (Cephalophini) are relatively small-bodied, predominantly forest dwelling African antelope. Monitoring duiker populations is difficult due to their cryptic nature and occurrence in often densely vegetated habitats. Yet, monitoring programmes are urgently required as many species are threatened by habitat loss and widespread hunting. Two case studies involving estimating population density or abundance for duiker species are presented here. Camera-trapping appeared to be the most effective relative abundance index in a pilot study to monitor Harvey's duiker in the Udzungwa Mountains, Tanzania. Line transect counts, tracking strips and hair-traps recorded fewer duiker events per replicate. Spoor presence was found to be an unreliable predictor of grey duiker density as estimated from dung heap counts in the Matobo Hills, Zimbabwe. Establishing reliable monitoring methods is a fundamental step for more detailed work with endangered duiker species.

THE INFLUENCE OF INBREEDING ON EUROPEAN BISON SEX RATIO

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In mammals the sex ratio at the moment of birth should be equal or close to one but there are different factors which could change this value. The ecological explanations of those factors are different, putting large enhance into mother social rank and conditions, sometimes expressed trough mother age or body weight. There is a few studies in which inbreeding influence is discussed. Last years within Lowland line of European bison was noticed some changes of sex ratio because more male were born. Within Lowland-Caucasian line of the species the proportion of males is more stable. The study considered inbreeding coefficient, mother age and year of birth as factors of changing the sex ratio. Based on data from Pedigree Book and using the logistic regression it was stated that inbreeding level has influence on the increase of males' proportion within Lowland European bison. The Lowland-Caucasian line does not show any relation between inbred and sex ratio.

HOW GENETIC MONITORING IS IMPORTANT IN CONSERVATION?

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The problem of inbreeding and its effect on animal's fecundity and viability was observed for years. In a small population the limited possibility of choosing breeding mate may cause exterior's defects, health problems, poor semen quality and other increase in inbreeding level on higher frequency. The same problem could be applied to small isolated population in the wild where exchange of genetic material is limited. In consequence of inbreeding and drift such small populations are weaker and extinct more frequent. The aim of this paper is comparison of different examples where inbreeding depression was observed and some activities for populations rescue were done. For this analysis three species of *Felidae* was chosen. They all have very serious decrease of genetic diversity and they suffer from inbreeding consequence. The first is well known problem of Florida panthers *Puma concolor coryi* and, second, similar one with Iberian lynx *Lynx pardinus* and as a third species Cheetahs *Acinonyx jubatus*. Population Viability Analyses (PVA) is the method of analysis where all factors that may cause species extinction are included. This kind of simulation can help in the effective management and protection endangered animal's population. The data for these analyses were taken from previous PVA. The analyses were made for 3 different levels of inbreeding depression with lethal equivalent equal to3,0; 3,4 and 4,0. In each of these levels two kind of simulation were done. First without assuming any loss of habitat and with 25% reduces of environment. According to analysis's inputs the population should persist over 100 years. For each of case 500 repeats was proceeded. Only once simulation was optimistic and resulted in 1,0 probability of persistence for the Florida panther population. Rest of the simulations predicted 0,970-0,998 probability of survival, beside it estimations with 25% loss of habitat shown bigger probability of extinctions for all levels of inbreeding depression.

METHODS OF FENNECS *(FENNECUS ZERDA)* KEEPING IN EUROPEAN ZOOS

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Fennecs *(Fennecus zerda)* have been exhibited in European zoos for about 150 years. Now fennecs are exhibited in 37 zoos, the number of these animals being kept in zoos is around 100. We can observe the decline of births in European zoos. This smallest fox of the world not seams to be difficult for keeping in the zoo. Since 2003 fennec management data have been collected in 25 European zoos. The subject of research has referred to: dimension and different aspects of enclosures, enclosure's enrichment, feeding and characteristic of fennecs' behaviour in every zoo. Due to multiple methods of fennecs keeping and a small number of observations in the group, statistic analyzes of results couldn't be done. The main goal of this research is to find tendencies which could show the best conditions for keeping and breeding this species in zoos. Obtained data shows that fennecs breed better in zoos which don't keep them in the nocturnal houses, but assure them free access to the outdoor enclosures. The method of feeding shows influence on the fennecs' reproduction in captivity. Zoos which breed fennecs supply them with much diversified food. Also a good contact with the keepers is proved to have positive influence on fennecs' reproduction.

RECRUITMENT OF YOUNG INTO THE WORKING CASTE IN DAMARALAND MOLE-RATS, CRYPTOMYS DAMARENSIS, AND ITS INFLUENCE ON OTHER COLONY MEMBERS

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The eusocial rodents *Cryptomys damarensis* display a division of labor into frequent and infrequent workers; the division (caste) often being related to an individual's size. This study focuses on the recruitment of young into the working caste, particularly on the predestination of caste, developmental differences within a litter, first work attempts of pups, and the litter's effect on other colony members. Behavioral observations and weight measurements were conducted on a complete captive colony, and two litters (n=5 and n=3) were examined. The results showed discrepancies in growth rates within a litter, as well as in the amount of "work" performed. Based on the results it may be concluded that a predestination of castes does occur. Also, there exists a certain chronology of different types of work (digging, tunnel maintenance, food hoarding, nest building etc.) in which the animals are involved over time. The newborns were fostered by both the infrequent and frequent workers, however the infrequent workers exhibited a greater overall body mass change throughout the study.

CAN VERVET MONKEYS LEARN NEW BEHAVIOURS IN A SOCIAL CONTEXT?

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Researchers argue that social learning, as one mechanism of transmission, is directly relevant to our concerns about social intelligence. The aim of this study was to examine the behaviour of *Cercopithecus aethiops* in order to establish which is the social learning strategy adopted by these monkeys to acquire new behaviours. 9 vervet monkeys hosted at Parco Natura Viva – Garda Zoological Park and 5 housed at Parco Cappeller, in Italy, were presented with five different boxes to open in order to retrieve a reward. 9 monkeys of Parco Natura Viva saw a human demonstrator opened each box several times over two different sessions whereas the remaining five vervet monkeys, employed as a control group, did not. The results of this study show that the performance of vervet monkeys was better when they observed a demonstration than when they did not. However they did not reproduce the sequence of the behaviours observed. Thus, our findings suggest that vervet monkeys can learn new behaviours by observing others. Local and stimulus enhancement have certainly played a role in learning new behaviours even if emulation may be the strategy adopted by these monkeys to acquire new behaviours. However, it seems that there is not imitation. Key words: Vervet monkeys, social learning, new behaviour

BREEDING OF SUGAR GLIDERS (*PETAURUS BREVICEPS*, WATERHOUSE 1839) CAPTIVE POPULATION IN MOSCOW ZOO

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The research on sugar gliders (*Petaurus breviceps)* breeding and social behavior took place in Moscow Zoo, Scientific Department, in the period from December, 2004 to January, 2006. We studied two pairs and five family groups, which included adult, subadult and juvenile animals. For registration we used videotaping and such methods as time sampling and continuous journaling. All together 476 hours of observations had been processed. In the period when adult male and female are introduced to each other, the establishment of friendly relations takes place and only afterwards mating occurs. Great variety in behavioral repertoire and evident superiority of friendly contacts shows that this species appears to be highly social. Apart from the process of pair formation, we described the state of females pouch depending on their reproductive status, and stages of development of the young. In all family groups, each animal has its own role, which depends on individual characteristics of this glider. It is typical for sugar gliders juvenile to have relatively long "childhood", when social learning occurs. In raising a juvenile mother undoubtedly plays the main role, but all other members take part as well.

THE POLAR BEAR FEMALE BEHAVIOUR BEFORE, DURING AND AFTER THE CUBS' BIRTH

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One of the most important events in the polar bear female life such as the cubs' birth was observed in the Leningrad Zoo. The female behaviour before the parturition, preparing to parturition, cubs' birth process and interactions between the female and her cubs during the first days were studied thanks to video recording.

SOME ASPECTS OF STEREOTYPIC BEHAVIOR IN AN ASIATIC ELEPHANT (*ELEPHAS MAXIMUS*) FEMALE IN A ZOO

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The daytime behavior of an Asiatic elephant female, kept in the Municipal Zoo of Wrocław, Poland, in an indoor pen and, weather permitting, an outdoor paddock, was scanned at constant intervals and the recording was continuous for 140 hours on 35 days for one year. The observation period was divided into five seven-day samples: spring indoors, spring outdoors, early fall outdoors, late fall indoors and winter indoors. Stereotypic sequences involved bouts of highly repetitive stereotypic movements proper and much more variable inter-bout behavior. Stereotypic movements were asymmetric and accompanied by protraction of the right hind leg and to-and-fro swinging of the trunk. The share of time devoted to stereotypic behavior was the lowest in the early fall when the elephant was regularly released to the paddock and the highest in the late fall after she had to stay in the pen after several months of spending days outside. This suggests that stereotypies are enhanced by changes of the management routine. However, on comparing the late fall and winter fixed management periods, stereotypies were much more frequent in the indoor pen than in the outdoor paddock, suggesting that the confinement to a barren pen also contributed to the observed levels of stereotypies.

THE DISTRIBUTION AND INBREEDING LEVEL IN DALMATIAN PELICAN POPULATION (*PELECANUS CRISPUS*, BRUCH, 1832)

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Although, as it already mentioned, Dalmatian Pelicans have been kept in zoological gardens over many decades, since the 80's of twenty century an intensive breeding and protection of the species began. Unfortunately, the population is relatively small. To our knowledge, no results on inbreeding rate in Dalmatian pelicans have been available in literature. The objective of this contribution was to estimate an inbreeding level in Dalmatian Pelican population in context its distribution around the world. Records of 889 Dalmatian Pelicans (extracted from SPARKS computer programme of the Dalmatian Pelican EEP studbook by Piotr Ćwiertnia - edition of 01.06.2005) were analysed. The birds studied hatched (in zoological gardens) or caught from wild between the years 1957-2005. Two approaches have been employed to estimate inbreeding coefficients (with and without pedigree information). Only 26 registered as inbred birds were hatched in three zoos (Vienna, Prague and Poznan). By far the largest share in captive population have birds kept in just two French collections. The individuals in both zoos were not pedigreed. The hypothetical inbreeding for these birds, yielded 0.13 for Villars and 0.39 for Mullhause.

SEXING OF EASTERN WHITE PELICAN (*PELECANUS ONOCROTALUS*) BASED ON BIOMETRIC MEASUREMENTS

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We examined sexual size dimorphism of Eastern White Pelicans (*Pelecanus onocrotalus*). Investigation were carried out in Poznań Zoological Garden (Poland). For adult and juvenile individuals culmen length was taken on late Autumn (1993-2003) (N=46). Very detailed investigation were carried on chicks reared, during 1998, 1999 and 2002 years. Totally body mass was taken for 20 birds, culmen length for 12, and corpus length and wing chord for 9 birds. Sex determination on culmen length is possible in age 21 weeks. For younger chicks better method for sexing is use body mass, which allow in age 5 weeks, on sexing every second chick.

DEVELOPING THE RESEARCH POTENTIAL OF ZOOS AND AQUARIA

GORDON MCGREGOR REID
Co-Chair EAZA Research Committee, Director General North of England Zoological Society (Chester Zoo)

I must first express my thanks to the organisers for inviting me to give the opening address at this the 3rd research-themed conference 'Animals, Zoos and Conservation'. I, along with all the other participants, greatly appreciate the work put in by staff of the Zoological Gardens of Poznan and of the Adam Mickiewicz Insitute of Systematic Zoology, Poznan. In particular, I should thank Drs Piotr Cwiertnia and Radoslaw Ratajszczak of Poznan Zoo for being such wonderful hosts. As active members of the European Association of Zoos and Aquaria (EAZA), the organisers have developed an interesting and exciting programme of talks. In supporting this conference, Poznan Zoo is leading the way in demonstrating to the wider zoo community the high value of science and research.

THE IMPORTANCE OF ZOO PARTICIPATION IN GLOBAL SPECIES CONSERVATION

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Zoos have a legal and moral responsibility to be active in conservation. Participation is possible through education & research, ex-situ and in-situ activities. It is important for zoos to publicise both their scientific knowledge and their mission statements in the interests of all zoos and conservation generally.

MORE DATA FOR YOUR DOLLAR. HIGH QUALITY RESEARCH ON A LIMITED BUDGET, THE EXAMPLE OF PAIGNTON ZOO'S RESEARCH PROGRAMME

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The zoo environment provides a unique and valuable resource for scientific research not necessarily dependent on expensive equipment or specialist facilities. At Paignton Zoo Environmental Park, Devon, UK, we have created, with very limited financial resources, a relatively large and diverse Science Department, specialising in several areas of zoo research. Despite limited monetary support the Department continues to produce high quality, published research, collaborating with a range of research institutions and students. Research is carried out by permanent staff members and students from local universities and colleges and from further afield, ranging from BSc to PhD level. One of our most productive schemes in terms of research output is to offer year-long work placements or internships for students hoping to gain invaluable experience in the world of zoo research. Investigations are carried out on a range of topics including: reproduction, parasitology, behaviour and psychology, with studies in pure and applied areas often helping to solve husbandry problems and promote good animal welfare.

OPTIMALISING THE ROLE OF ANIMAL RESCUE CENTRES BY RESEARCHING THE SOURCE OF THE PROBLEM

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This paper discusses several ways in which rescue centres worldwide are expanding their role by researching problems related to the animals they receive. They are key witnesses to the serious welfare implications for wild animals that fall victim to, for instance, the animal trade and entertainment industry. The work of AAP, Sanctuary for Exotic Animals in the Netherlands will be highlighted as a case in point. Many behavioural studies are done in this centre on the resocialisation of primates and other (exotic) mammals. Information about the effects on the animals is recorded and statistics are kept on the requests for intake from all over Europe. An in-situ research project has been running since 2003 to investigate the illegal trade route of the Barbary macaque from North Africa into Europe, and the consequences for the wild population. Monitoring exactly what is needed, and why, is fundamental to start solving the issue at the source. By professionalising and making use of their observations to good effect, those involved in the rescue and rehabilitation of displaced animals can effectively alert the (international) public and relevant authorities.

HOUSTON ZOO AND RICE UNIVERSITY: INSTITUTIONAL SYMBIOSIS

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We report on a novel university–zoo partnership – the Houston Zoo and Rice University Consortium in Conservation Biology – established in January 2004. The consortium connects students and keepers; the former are given the opportunity to work with a diverse number of animal species, and the latter can employ the results of the research in exhibit management. Moreover, this close cooperation provides the researchers with additional background information from the zookeepers and ensures the meeting of the American Zoo Association standards. My presentation gives an overview on the workings of such close collaboration, and provides examples of the fascinating and valuable research conducted by the students under the guidance of zoo curators and staff.

ACTING LOCALLY: PAIGNTON ZOO'S CONSERVATION RESEARCH PROGRAMME FOR NATIVE SPECIES AND HABITATS

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The conservation of native species and habitats is an effective way for zoos to meet conservation targets. The Whitley Wildlife Conservation Trust, parent organisation for Paignton Zoo Environmental Park owns three nature reserves whose mission is to protect biodiversity. Within these reserves and other local habitats we conduct research to: monitor the species present, evaluate habitat management and restoration and further scientific knowledge of key species and habitats. We maintain a list of potential projects that are carried out by students from BSc to PhD level. The following case studies illustrate the range of our research.

- Monitoring: Creation of a database for native species.
- Evaluation of habitat management: The effect of coppicing on small mammals, butterflies, Carabid beetles and plants within Clennnon Gorge nature reserve.
- Investigating habitat restoration: Use of yellow rattle in the restoration of a species rich hay meadow in Primley Park
- Increase scientific knowledge of key species and habitats: The effect of population size and habitat quality on levels of genetic diversity in meadow thistle.

RESEARCH FOR CONSERVATION – WHAT A BIG ZOO CAN AND SHOULD DO

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The Centre for Research and Conservation (CRC), is the government-funded research department of the Royal Zoological Society of Antwerp (RZSA). Along the lines of the 2005 World Zoo and Aquarium Conservation Strategy (WZACS) the focal point of our research activities is sustainable population management. Both ex-situ and in-situ, managing populations sustainably requires the coordinated efforts of a whole range of research disciplines. Within the CRC we have gradually developed four disciplines where we combine strictly zoo-related research as well as fundamental scientific research. We report to scientists in peer reviewed journals as well as to zoo colleagues and to the general public. Our future plans are to initiate collaborative research projects with other zoo research departments, facilitate joint research projects and share research facilities and local expertise with zoos that don't have an in-house research team. Future joint applications for research grants from the European Union would be a next step forward for Zoo-research and zoo based conservation activities.

THE INTRODUCTORY ANALYSIS OF INCIDENTS INVOLVING CAPTIVE ANIMALS DURING THE 1990-2005 PERIOD

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Abstract: The knowledge concerning incidents involving the captive wild animals is to great degree anecdotal. In this paper the database of incidents in the world (with some unintentional overrepresentation of USA) during the last fifteen years was constructed. The source of information was the documentation from the Internet The database consisted of 481 cases which resulted in 530 human victims. The incidents occurred in zoos, circuses and other institutions (e.g. from entertainment and advertisement industry). Felids, elephants and primates were the chief animal culprits. Tiger (*Panthera tigris*) turned out to be the most dangerous as regards the number of incidents and as causing the greatest number of human victims .Elephants were ranked as the second, causing most of all human deaths. Surprisingly great number of cases involved also primates but they often caused rather minor injuries. They were eight situations where the incidents the most frequently took place. Intrude on animal, placing it in unfamiliar environment and lack of control and safety were the generalized underlying causes of incidents. This database should be supplemented by the fuller press reports to better understand particular cases (characteristics of the culprit and injured).

EVALUATION OF SELECTED EDUCATIONAL OPPORTUNITIES OF ANIMAL EXHIBITIONS IN ZOOLOGICAL GARDEN BASED ON A CASE STUDY

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The aim of the hereby research was to identify the criteria influencing the educational value of animal enclosures. Next, the criteria were used to evaluate 11 selected exhibitions of chimpanzee (Pan troglodytes) and bonobo (Pan paniscus) in different zoological gardens. The criteria were identified during two-stage cameral analysis, which included project, behavioural and organisational assumptions. The analysis provided 52 criteria divided into 9 groups: area size, vegetation, water, ground (relief), landscape (shaping of visibility), arrangement, equipment components, microclimate, animals. The criteria were then used to evaluate the exhibition using an ordinal scale (-1, 0, +1). The total result indicated the best designed and arranged exhibitions with highest educational value in Münster and Cologne. Criteria from the groups: area size, landscape (shaping of visibility) and arrangement were the key points for evaluating the educational value o fan exhibition. High notes obtained for these groups of criteria had positive influence on other criteria. Moreover, it was proved that a criteria from groups: landscape (shaping of visibility), arrangement and vegetation are decisive creation of a "natural" barrier between the visitors and animals, which harmonised with the surrounding landscape.

THEORETICAL BASES OF ENVIRONMENTAL ENRICHMENT AS APPLIED TO KEEPER-ANIMAL INTERACTIONS

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The working model of zoo environment enrichment has been elaborated. This model is based on the concepts of "optimal arousal level" and data concerning the influence of predictability and controllability of environment on animal's sensitivity to external stimulation. According to this model a functional classification of enrichment tools and an algorithm for choosing such tools are suggested. The efficiency of our approach was tested in Moscow Zoo's practice. Special emphasis was made on keeper-animal interactions as a tool for enrichment and improvement of animals' psychological state

KEEPING OF *CERVIDAE* IN LITHUANIAN ZOO

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Cervidae are an ecologically important group of animals. Their keeping in captivity arouses many various problems, especially of moose, reindeers, roe deer and others. The proper feeding of these animals is very important in the zoo, for example, moose eat leaves, small branches and bark of lot sorts of trees and bushes in the wild. Lichens are very important part of the ration of the reindeers, especially in winter. It is quite difficult to make it under zoo conditions and it has impact for the health of animals and success of breeding.

SURVIVAL RATIO OF ELEPHANTS IN POLISH ZOOLOGICAL GARDENS SINCE THE NINETEENTH CENTURY

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Since late nineteenth century, Polish Zoological Gardens have kept altogether 52 specimens of both the Indian (Elephans maximus) and African (Loxodonta africana) elephant species. There were nine bulls and thirty cows of the former species and three bulls and ten cows of African elephants. The first Indian elephant female, named *Kaśka* come to Warsaw in 1884 and managed to survive seven years in very bad conditions (the enclosure). At the beginning of the twentieth century, the Poznań zoo kept a pair of Indian elephants including the bull (*Little Cohn*) – originating from the Sarasani Circus in 1913 (Table 1) – and the cow (*Dora*) that came to Poznań in 1910 from the zoo in Koln. In August 1913, the bull became famous for the extraction of its upper incisor without any narcosis. The Warsaw Zoo which – in 1928 – had the largest

group of elephants of both species (15 specimens altogether) received the first offspring born in any Polish zoo. It was a female named *Tuzinka* and it was born on April, 16th 1937 to the first breeding pair composed of the bull *Jas* (originating from Frankfurt/a.Main in 1928) and the cow *Kaska II* (that came to Warsaw in 1929 from Rotterdam). After World War II, eight Polish zoos kept single specimens or small groups of elephants. The Zoos in Gdansk and in Katowice mixed the two species in the same enclosures. Besides, Gdansk and Wroclaw zoos received Indian elephant females from some circus. The animals were in poor condition and had serious health problems (primarily with their hooves, but they also had other diseases). The Indian elephant female from the Wrocław zoo named *Ceylon* – born most probably in 1932, which died on the 23rd of April 2000, at the age of 68, was probably the oldest elephant in Poland and one of the oldest elephants living in European zoos. At present, seven African elephants live in Polish zoological gardens: they include a small breeding group (one bull and three cows) kept by the Warsaw Zoo, two females living in the zoo in Katowice and one cow of the Gdańsk Zoo. Six Indian elephants live in five zoological gardens in Poland, including an eight year old male, born at Paris Zoo .

THE ARTERY OF THE HEAD IN SOME MAMMALIAN ORDERS

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A comparative analysis of the main arterial roads of the head was conducted on 117 species representing 9 orders of the phylum Mammalia. The observations were performed on corrosion casts of the arteries of the head, after injection with plastics. As a result of the conducted comparative analysis it was found that blood to the area of the head and the organs located within the face and the cranial cavity is directed using two specialized arterial roads, for which the maternal vessel is the common carotid artery. The external carotid artery and the maxillary artery constitute the main bipartite arterial road of the head. The internal carotid artery was another road supplying primarily the brain, and in the course of ontogenesis it is connected with the stapedial artery, undergoing extensive modifications. The stapedial artery as a component of the main arterial road of the head in adult animals is found only in some of the investigated rodents. The internal carotid artery in mammals exhibits a wide variability. It is strong and creates anastomosis with the arteries of the base of the brain in Primates, Perissodactyla, Xenarthra, Lagomorpha and only in some Rodentia. The thinner internal carotid artery fuses with the rete mirabile epidurale rostrale in Camelidae. The extracranial segment of the internal carotid artery is completely reduced, in Artiodactyla except for the musk deer and spotted musk deer and in some species from the order Carnivora. The rete mirabile arteriale, the rete mirabile epidurale rostrale in Artiodactyla and the rete mirabile of the maxillary artery in some Carnivora mediate in the transport of blood from the maxillary artery to the vessels of the arterial circle of the brain. It was shown that some traits of the arterial pattern of the head have the characteristics of discriminants useful in taxonomy. The shown variability of the pattern of arteries of the head of the investigated animals is another confirmation of the biological variability of mammals.

SOME MORPHOMETRIC FEATURES IN TERMS OF HEART VASCULARISATION OF THE INDIAN ELEPHANT (*ELEPHAS MAXIMUS* LINNAEUS, 1758)

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In our study we used 2 hearts of the Indian elephant of both sexes. In one case we used the corrosion-cast technique, in another case the heart was dissected and opened through ventricles and atriums. Several measurements were taken, e.g. the width of the ventricle, aorta and pulmonary trunk walls, the length of ventricle walls and internal diameters of main vessels. There are two coronary arteries observed on the corrosion cast, each arising from left and right aortic sinuses. The left coronary artery divides into the paraconal interventricular branch and the circumflex branch. The right coronary artery goes through the coronary groove and terminates on the atrial surface of the heart as the subsinuosal interventricular branch. We considered the symmetrical type of arterial vascularization of the heart in the Indian elephant. We found three veins of the examined cases: the great cardiac vein, the middle cardiac vein and the small cardiac vein. All veins run in grooves of the heart and flow into the coronary sinus.

VASCULARISATION OF THE GIRAFFE HEART (GIRAFFA CAMELOPARDALIS)

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The study of the heart vascularization was performed on 3 giraffe hearts using the corrosioncast technique and injection with colored latex. We observed that the heart is supplied by the left coronary artery and the right coronary artery. The left coronary artery arises from the left aortic sinus, forms a common trunk and consists of two major branches: the paraconal interventricular branch and circumflex branch. The right coronary artery is less developed than the left, it arises from the right aortic sinus and runs behind the pulmonary trunk, passes on the atrial surface of the heart and terminates on the right ventricle wall. We considered the left type of arterial vascularization in the giraffe heart. We found three veins of the examined cases: the great cardiac vein, the middle cardiac vein and the small cardiac vein. All veins run in grooves of the heart (the paraconal interventricular groove – the great cardiac vein, the subsinuosal interventricular groove – the middle cardiac vein and the coronary groove- the small cardiac vein) and flow into the coronary sinus.

A CASE OF HYDROCEPHALUS IN THE PRZEWALSKI'S WILD HORSE

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A rare case of hydrocephalus in the Przewalski's wild horse was described. Some morphological observations were taken and corrosion cast of cephalic arteries was made, also bones of cranium were macerated for the purpose of further analysis. On the basis of the morphological analysis and a comparison with literature data we considered hydrocephalus of the internal type. In the examined case we found serious changes in the cephalic arteries pattern. Deformation of particular bones of the cranium was stated.

THE MORPHOLOGY OF THE TONGUE IN THE PYGMY HIPPOPOTAMUS (CHOEROPSIS LIBERIENSIS)

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The aim of the study was to describe the morphology of the tongue in the pygmy hippopotamus (*Choeropsis liberiensis*) and characterize the distribution and structure of the lingual papillae on the dorsal surface of the tongue. The observations were made on the two tongues of adult pygmy hippopotamus obtained from the ZOO Garden in Poznan. Tongue in pygmy hippopotamus has an elongated body with broad apex. The characteristic structure on the posterior part of the tongue is an elevation of lingual muscle called lingual prominence. On the ventral surface of the apex the fibrillar structure resembling lyssa were found. On the dorsal surface of the tongue 3 types of lingual gustatory papillae: fungiform papillae, vallate papillae and foliate papillae and two types of mechanical papillae i.e. filiform papillae and conical papillae.

THE MORPHOLOGY OF THE TONGUE IN THE FEATHERTAIL GLIDER (ACROBATES PYGMEUS, MARSUPIALIA)

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The aim of the macro- and microscopic studies was to describe the morphology and the threedimensional structure of the lingual papillae in the fruit nectar and fruit feeder marsupial feathertail glider (*Acrobates pygmeus*). Five tongues of an adult male feathertail glider were used for the study. The microscopic observations were made on the serial histological slides and on specimens under a scanning electron microscope. The elongated tongue of the feathertail glider with a sharpened apex is ca. 10 mm in

length. On the dorsal surface of the tongue three types of lingual papillae were distinguished, i.e. filiform papillae, fungiform papillae and vallate papillae. The arrangement, shape and size of filiform papillae and its processes change, depending on the part of the tongue, so that the surface of the tongue resembles a brush adapted to effective ingestion of semi-liquid food. Fungiform papillae are uniformly scattered between filiform papillae only on the anterior and middle part of the lingual body. On the smooth root of the tongue three oval vallate papillae are arranged in the form of a triangle. The structure of the tongue and the arrangement of lingual papillae in the feathertail glider resemble those morphological traits observed in Marsupials and also in small Insectivores.

THE MICROSCOPIC STRUCTURE OF THE LINGUAL PAPILLAE N THE ADULT AND NEWBORN EGYPTIAN FRUIT BAT (ROUSETTUS AEGYPTIACUS)

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The aim of study was to characterize the distribution of the lingual papillae in the fruit-eating Egyptian Fruit Bat and also to compare the structure of the lingual papillae in the first week after birth with adult specimens. The results show that the distribution of the fungiform papillae and giant filiform papillae on the anterior part of the tongue and vallate papillae on the root of the tongue is similar to the insectivorous Chiropterans. The characteristic features connected with diet of Egyptian Fruit Bat is the pattern of the filiform papillae on the posterior part of the body of the tongue. Our results showed that the development of mechanical papillae is continued after the birth of animals.

COMPARATIVE ANALYSIS OF SKULLS OF RED DEER (CERVUS ELAPHUS) AND REINDEER (RANGIFER TARANDUS)

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The aim of investigations was to compare craniometric features of red deer and reindeer. Thirty eight skulls of red deer and twenty skulls of reindeer were measured. Each skull was characterized by fourteen parameters. On the basis of Principal Components Analysis and T-test it was found that these species are different as far as cranial shape is concerned. Despite of the fact that *Rangifer tarandus* has smaller skull in the total length parameter, its nasal cavity is wider comparing to this feature of *Cervus elaphus*. This trait is connected with strongly developed nasal conchas system of reindeer. This may be a result of the adaptation to existing in low temperatures climate. On the basis of the set of craniometric features, the sex dimorphism of reindeer was not observed. In case of red deer the sex dimorphism occurs in proportion with ageing of males. The process of a long term modeling of a skull may be related to strongly developed antlers of older males.

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WHAT'S IN A HOWL? COMPARING THE VOCAL BEHAVIOUR OF CAPTIVE HOWLER MONKEYS.

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The howler monkey genus (Alouatta sp.) is characterised by the production of loud call or howl vocalisations. Investigations into Alouatta howl calls have suggested territorial demarcation, inter-troop spacing, mate defence and attraction, group cohesion and resource location as possible functions of these vocalisations in the wild. In terms of the social function of these calls, the alpha male of Alouatta troops may use howl contests to assess opponents and rival males and perform howls as an alternative to physical conflict. Females are often a limiting resource for male howler species therefore transmitting information on the identification and rank of an individual may be beneficial during mate selection and defence.

The breeding rates of Alouatta species in the captive environment are low within European institutions and are limited in number and diversity of founders, making breeding from all pairs a priority. Behavioural and vocal data were collected on four captive groups of A. caraya; two family groups, and two single pairs. This preliminary study investigates the influence of social housing situations in captive Alouatta caraya and its possible influence on behaviour patterns and breeding rates.

THE INFLUENCE OF HUSBANDRY SCHEDULES ON THE ACTIVITY RHYTHM OF CAPTIVE KOALAS

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Animal behaviour is controlled by endogenous circadian rhythms. These rhythms synchronise the organism with its environment, especially the day-night cycle, using periodic external signals as time clues. In zoos, husbandry often follows a fixed schedule with regular times for feeding and handling. This is sometimes used to enhance activity. However, in species which are not diurnal, the keeper's schedule might be in contrast with the endogenous rhythm of the animal. In this case they disturb the synchronisation with daytime and interrupt resting periods.

Activity patterns of four koalas (one male, three females) have been observed at Taronga Zoo, Sydney, Australia. The koalas were kept as group in an outdoor enclosure. The keeper entered three times daily. Contact with the koalas was rare and brief. One male and one female have been observed for six weeks each in winter and summer at Tiergarten Schönbrunn, Vienna, Austria. The koalas were kept in separated indoor enclosures. The keeper entered frequently. Contact to the koalas is regular and extensive, they were weighed daily at 10:15.

Activity pattern at Taronga Zoo were uniform, related to twilight and did not change significantly during the year. Little activity was observed during the morning, but became more frequent in the afternoon. At Vienna Zoo, relation to daytime was weaker and the individual patterns showed clear differences. Patterns of the male were basically similar to those at Taronga Zoo, but in the female, no clear pattern was detectable. There was no extensive resting time, but activity was less common in the morning. Weighing usually interrupted a resting period.

To test if weighing in the morning at Vienna Zoo interferes with the endogenous rhythm, it was shifted to 16:00, when both koalas displayed feeding activity. From the first day of the shift, the male rested for a longer time in the morning and stayed active after the weighing to feed on the fresh browse. In the female however, there was little change in activity pattern.

INFLUENCE OF ZEITGEBERS AND MASKING FACTORS ON BEHAVIOURAL PATTERNS OF CAPTIVE MOOSE (ALCES ALCES)

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A basic time pattern of behaviour is genetically fixed in each and every organism and controlled by the internal clock. The internal clock is the link between an organism and the periodic structure of its environment. It enables the organism to adjust its timing to the periodicities of the changing environmental conditions caused by day-night cycles, phases of the moon or seasonal changes. So called "zeitgebers", such as light, temperature, social factors or feeding times, synchronize the internal clock and surrounding terms . It is essential for health and well being of an animal, that the components of the internal clock controlling different body functions are synchronized with each other and with the environmental periodicities.

In the artificial zoo environment an animal experiences a set of influencing factors resulting of daily keepers' treatment and routine, possibly artificial light and temperature regimes and other impacts of the enclosure structure and the visitors. The aim of the thesis was to characterize factors influencing behaviour of moose (Alces alces) in captivity and to evaluate their significance to moose' well being. A special aspect was to examine behavioural time patterns regarding the influence of zeitgebers and so called "masking factors". In contrast to a zeitgeber a masking factor has a more immediate influence on animals' time patterns – it is a direct impact on a certain behaviour, which is not shown when the exterior stimuli cease to exist. It is never anticipated, whereas zeigeber stimuli are.

During long term studies at three different moose facilities with different daily and annual keeping conditions (Georg von Opel Freigehege für Tierforschung e.V., Kronberg i. Ts., Germany; Dierenpark Planckendael, Muizen-Mechelen, Belgien; Wildpark Alte Fasanerie Hanau Klein-Auheim, Germany) the behaviour of a total of 3.3 moose was recorded using 24-hours infrared-time-lapse video-technique and analysed with chronoethological tools.

Light is one of the strongest and most important zeitgebers. It has turned out that the behaviour of captive moose is controlled by the natural light-dark cycle, and it has the strongest impact on moose that

are kept under semi-natural conditions. In moose husbandries with a stronger influence of keepers' daily routine and strict feeding times, however, light is competing with the zeitgeber "food". The latter is anticipated under all keeping conditions throughout the year, but factors like weather conditions, temperature and the motivation to leave the stable in the morning can enhance duration and intensity of food anticipatory behaviour. Moose are kept in separated stables during the night throughout the whole year at Dierenpark Planckendael and throughout the winter months at Georg von Opel-Freigehege für Tierforschung . Limited space and no stimulation to search for food and to browse alter the nocturnal behaviour remarkably. These parameters can be looked at as masking factors. The animals' time patterns change abruptly the day they are left on the outdoor enclosure over night in summer at Georg von Opel-Freigehege für Tierforschung. Nocturnal keeping in the stable has a strong impact on the natural continuous food intake of moose and feeding aspects are the most critical point in moose husbandry. Therefore zoos and wildlife parks should think over this form of husbandry or at least shorten the time in the stable as far as possible.

5-YEAR RECORDS FROM A EUROPEAN RESCUE CENTRE FOR PRIMATES

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The lack of shelter for displaced wild animals in Europe has been identified by many rescue centres and animal welfare organisations in the field. AAP, Sanctuary for Exotic Animals in The Netherlands keeps records of all the animals within its specialisation for which shelter is requested. This article presents the data on primates from the past five years (2002-2006) covering the particular species, source and geographical location. Some patterns that stand out are discussed, such as the large number of wild-caught Barbary macaques illegally imported into Europe. The total quantity of requests over this time period shows a marked increase, and those that can be satisfied remain only a small percentage of this total. This is compromising law enforcement and the welfare of the individual animals waiting for placement. Moreover, after rehabilitation at AAP, only a limited number of animals are successfully relocated for long-term housing elsewhere. This puts considerable pressure on the intake capacity of the sanctuary, a trend which is experienced by many other institutions involved in placing rescue animals in Europe. More extensive, efficient cooperation is recommended between a) authorities b) facilities offering immediate shelter and c) those able to provide long-term housing.

POLONINY PROJECT: THE ACTIVITY OF PARCO NATURA VIVA – GARDA ZOLOGICAL PARK FOR THE CONSERVATION OF EUROPEAN BISON (BISON BONASUS BONAUS).

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European bison (Bison bonasus) is the largest herbivore in Europe. Historically it was distributed throughout western, central, and south-eastern Europe. Habitat degradation and fragmentation were the primary reasons for the decrease and extinction of this species in wild. In the 2003 the Large Herbivore Foundation started a project to re-establish the European bison over its former natural range in the Carpathians and Ukraine. Parco Natura Viva in collaboration with two European zoos was involved in this project. In order to have a big herd of bisons in the Carpazi area, on the 13th of June 2004 five bisons (two females born at Parco Natura Viva) were released in the National Park of Poloniny in proximity of a population of wild bisons. During the winter of 2005 a female of Parco Natura Viva copulated with a wild adult male and in spring a puppy was born. This puppy is the first European bison wild born at National Park of Poloniny since 1415 this event is a great success for the conservation of this specie. During 2006 Parco Natura Viva organized the first research mission to the Poloniny involving three Italian Universities interested in starting research activity in co-operation with the staff of Poloniny Park. The aim of this research will be to monitor the activity of the European bisons and to carry out studies on the species of Poloniny area. In order to monitor the animals during the winter Parco Natura Viva bought a sled-bike to move on the snow. These aspects show that the cooperation between Parco Natura Viva and Poloniny Park is very important for the success of the European bison conservation project.

CAUGHT ON CAMERA – USING CAMERA TRAPS TO SURVEY ELUSIVE ANIMALS IN KENYAN COASTAL FORESTS

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The Whitley Wildlife Conservation Trust runs a conservation project investigating the distribution and habitat requirements of Aders' duiker. These are critically endangered antelope with confirmed sightings from only two coastal forests in Kenya and on Zanzibar. Recorded sightings, indirect duiker signs and camera traps have been used to find out more about this elusive species.

In 2005 duiker signs (pellet piles and tracks) were quantified along with sightings of Aders' duiker in 40 plots throughout the forest. These were related to vegetation measures including canopy cover, visibility and plant species along with measures of human and elephant disturbance. This revealed positive relationships between duiker signs and low visibility and high number of duiker food plants. A negative relationship was seen between duiker signs and elephant disturbance. Aders' duiker sightings were greater in areas with more canopy cover. In 2006, 10 camera traps were set up within the forest. During a 3 month sampling period 10 pictures of Aders' duiker were taken along with another 17 animal species. These results are beginning to build a picture of the habitat requirements for Aders' duiker and the success of the camera trapping suggests that this technique may be valuable for surveying forests for this species and other elusive animals.

NON-INVASIVE HORMONE ANALYSIS OF THE REPRODUCTION ACTIVITY ON THE EURASIAN AND THE IBERIAN LYNX IN CAPTIVITY.

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Monitoring sexual hormones is especially important in efficient ex-situ breeding programs of endangered mammals. Thus, the aim of the presented study was (i) to identify relevant fecal steroid hormone metabolites in captive Eurasian lynx, (ii) the biological validation of fecal hormone measurements in both sexes, and (iii) finally a comparative metabolite analysis between Eurasian and Iberian lynxes. The radiometabolism study was performed for testosterone (i.v. injection of [3H]testosterone in a male) and for progesterone (i.v. injection of [3H]progesterone in a female). Fecal and urine samples were subjected to HPLC analysis to identify radiolabelled metabolites and immunoreactive hormones.

In males, the majority of testosterone metabolites are substances with a higher polarity than testosterone. Only minor proportion of radioactivity co-eluted with authentic testosterone and dihydrotestosterone. The testosterone immune assay measured substantial amount of immunoreactivity, correspondeding to two radioactive peaks. The seasonality of Eurasian lynx reproduction was confirmed by a seasonal pattern of testosterone excretion, with high testosterone levels during breeding season in March/ April. Preliminary results on testosterone measurements in Iberian lynx feces confirmed the suitability of the applied testosterone immune test in this highly endangered species. HPLC separation of Iberian lynx feces extracts revealed a similar metabolite pattern determined by EIA that were typical for Eurasian lynx fecal extracts.

In females, the seasonal fecal hormone profiles showed two peculiarities: (i) a significant positive correlation between fecal gestagen and estradiol metabolites and (ii) elevated concentrations of gestagen metabolites during lactation. Therefore a pregnancy diagnosis based on fecal steroid hormone metabolite seemed to be unattainable. In Eurasian lynx, majority of radiolabelled metabolites were substances with a high polarity. The first of the two major polar HPLC peaks was hydrolyseable, and seemed to vanish towards the end of pregnancy. The elution position of the major immunoreactive metabolites coincided with both polar radiolabelled peaks. Minor peaks were found at the positions of authentic progesterone, DHP, pregnenolone and pregnandiol. The HPLC profile of Iberian lynx feces showed the same elution pattern suggesting similar gestagen metabolism in both lynx species. Since the present results don´t facilitate pregnancy diagnosis in the two lynx species, other analytical options, like urinary relaxin, are under current investigations.

NON-INVASIVE MONITORING OF HORMONES AS A RESEARCH TOOL IN ZOO AND WILD ANIMALS

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Hormones (sex steroids and corticosteroids) are of great scientific interest because they are largely involved in virtually all body functions including the regulation of reproduction, development, stress reactions and the expression of behaviour. Traditionally, hormones are measured in blood samples that provide a measure of circulating plasma steroid concentrations. The main drawback of blood collection is the necessity of catching and handling animals, which is not always feasible or desired. In addition, handling causes stress which may influence the measured hormone values. During the past years, the non-invasive measurement of steroid metabolites in mammalian feces has become more and more important. Unlike blood sampling, the collection of excreta does not require special skills. Typically, samples can be collected with great ease, even in the field, and sampling usually does not conflict with animal welfare considerations and does not require special permits. Due to bacterial enzymes fecal steroids are not stable and undergo metabolism. Therefore the best option is to collect a sample shortly after defecation and to freeze immediately. A second option is to use alcohol as preservative to stabilize samples especially in the field, where direct freezing of the samples is difficult.

Because metabolism and excretion of steroids differ significantly between species these non-invasive methods must be validated for each species before application. In this regard one of the most important aspects is the physiological validation of the technique. This can be done by pharmacological induction of physiological changes in circulating hormone levels and evaluation whether these changes are reflected in measured concentrations of fecal steroid metabolites afterwards. In this respect, the most widely used approach is the stimulation of adrenocortical activity with ACTH (ACTH challenge test) and testosterone release with GnRH. Ideally, fecal samples have to be collected frequently a certain time before and after the challenge. For females samples collected throughout a cycle or a pregnancy are necessary to establish an optimal assay for follicular and luteal activities.

Usually the chemical identity of the fecal metabolites is unknown but they might be characterized and probably identified with the help of a radiometabolism experiment. After injection of 3H (tritiated) labelled hormone, the excreted metabolites of a particular steroid can be analysed by high-performance liquid chromatography (HPLC). The HPLC fractions can be tested in several enzyme immunoassays for steroid metabolites to select the most appropriate assay and to optimize assay conditions. Finally analytical validation must be carried in the lab before an assay can be used for physiological studies in a zoo or wildlife species.

In summary measuring steroid hormone metabolites in fecal samples has become a powerful, non-invasive tool that provides important information about an animal's endocrine status. Emphasis must be placed on the establishment and analytical validation of such non-invasive methods. Altogether these aims are only accessible in cooperation between motivated zoo staffs and experienced labs. In the near future establish routine methods might be transferred to scientifically ambitious zoos equipped with their own lab.

EX SITU CULTIVATION OF THE ZOOXANTHELLATE SOFT CORAL SINULARIA FLEXIBILIS FOR BIOTECHNOLOGICAL EXPLOITATIONS

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The zooxathellate soft coral Sinularia flexibilis is a dominant octocoral on many Indo-Pacific coral reefs that releases pharmaceutically-important antimicrobial and toxic compounds. For sustainable production of these potential drugs, mass production of the coral is essential to preserve the natural sources. Because of the biotechnological importance of S. flexibilis, species-specific growth kinetics in captivity is necessary for long-term cultivation. In a series of studies, we investigated survival and specific growth rate, light- dependency, and optimum water velocity in captivity. Colonies of this soft coral showed high survivorship (100%) under all experimental conditions and fast growth rates in submerged mass within periods of 4 to 18 weeks. Mean doubling times of 10-20 weeks was recorded depending on the experimental conditions. These mean that biomass gain of S. flexibilis was not stopped by the cultivation system. Light-

dependency of this symbiotic octocoral was in a range of light intensities

(100- 400 µmol $m^{-1}s^{-1}$); lower and higher intensities had decreasing effects on the average growth. For water velocity, the growth characteristics were measured over a range of water velocities (3 – 19 cm s^{-1}) for 12 weeks. At a water velocity of ±11 cm s^{-1} (Reynolds between ~10,000) the mean µ was highest as well as density of zooxanthellae, chlorophyll a, protein, and number of protruding branches (buds). It was found that optimum turbulent flow as well as structural features of S. flexibilis facilitated thinning the boundary layer for efficient mass transfer of nutrients demanding for zooxanthellae photosynthesis to maximize coral growth. The concentration of a typical metabolite of S. flexibilis, flexibilide, was also influenced by the water velocities, being highest at ±11 cm s^{-1}. Overall, we have found that this species is highly dependent on light as the main source of energy, and an optimized turbulent flow for maximum growth. In conclusion, this soft coral is capable of captive cultivation for pharmaceutical development. This will provide the ultimate goal of supplying sufficient quantities of "sea-derived drugs" without destroying valuable natural resources.

INFRARED THERMOGRAPHY AND HISTOLOGICAL RESEARCH OF GIRAFFE SKIN

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During routine checkups at Zoo Frankfurt, infrared thermographical observations showed that giraffes emitted heat non-uniformly across their fur surface. The effect was shown to be correlated with fur colour, and independent of the level of incident solar radiation.

In the 1920's research focussed on the development and, more specifically, the physiological meaning of fur patterns. In 1916 Häckers advanced a theory of " Polycentric –Rhythmic Growth". This proposed that during growth there is a correlation between the devolution of blood vessels and the pigment coating of the skin. De Beaufort (1928, Amsterdam Zoo) argued that " the bigger blood vessels, close to the skin, (of a skinned reticulated giraffe Giraffa camelopardalis rothschildi) were situated along the white fur areas and that those blood vessels branched into smaller ones which merged into danker pigmented skin areas."

These observations raised the question if the different coloured fur patterns of giraffes have a special function in thermoregulation. Likely to be the possibility that giraffes might use different fur patterns as thermographic windows. Thermographic windows are known as body areas which show less thermal insulation, that for the produced body heat can be emitted easier. A number of thermographical and histological studies were carried out on reticulated giraffe (Giraffa camelopardalis Rothschildi) in order to resolve this question.

One analysis included thermographical pictures, a hair density study of different coloured areas, and measurements of the skin thickness underneath the different fur colour areas. Analysis of multiple thermographic pictures, taken both inside and outside the stables and during different seasons, showed that even without any incident solar radiation the reticulated giraffe (Giraffa camelopardalis rothschildi) had different average temperatures in black, brown and white fur areas. Specifically, black fur areas showed significantly higher heat emission than white and brown areas. Histological analysis indicated that black fur areas had significantly lower hair density than white or brown fur areas. In addition, the epidermis thickness underneath black fur areas was significantly thinner than that underneath white or brown fur areas. These observations led to the conclusion that heat loss is higher over black fur areas because those areas have less thermal insulation. The best insulated fur parts are the white ones. One could say that reticulated giraffe (Giraffa camelopardalis rothschildi) use their black fur areas as thermographic windows.

VASCULARIZATION OF THE BRAIN IN GIRAFFE (GIRAFFA CAMELOPARDALIS)

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The aim of the study was to analyze the system of arteries of the brain in the giraffe, including the arterial circle of the brain, its branches and junctions, as well as individual variation of vessels. The cerebral veins, dural sinuses and emissary veins were also analyzed.

Analyses were performed on postmortem material, 12 heads of giraffes obtained from Polish zoological gardens. The age of examined animals ranged from 1.5 years to 12 years. Moreover, arteries of one fetus aged approx. 10 months were also analyzed. Arteries of the head in the examined animals were injected with latex and vinyl superchloride dissolved in acetone.

In the giraffe, similarly as in other ruminant species, obliteration of the intracranial segment of the internal carotid artery was observed, together with the presence in the cranial cavity of the rostral epidural rete mirabile, from which the preserved intracranial segment of the internal carotid artery exteriorizes. The rostral artery of the brain and the caudal communicating artery, participating in the formation of the arterial circle of the brain, are formed from the segmentation of the end intracranial part of the internal carotid artery.

Among branches of the arterial circle of the brain in the giraffe the following arteries were found: the internal ethmoidal artery, the middle cerebral artery, the rostral choroid artery, the caudal cerebral artery, the rostral cerebellar artery and the caudal cerebellar artery. It was shown that the basilar artery is thin and may not participate in the blood supply for the brain. On the basis of the conducted analysis it was found that the arterial circle of the brain in the giraffe blood is supplied mainly by the maxillary artery. Blood outflow from the brain of the giraffe through the dural sinuses, which communicated with cerebral veins. Blood leave the cranial cavity through the emissary veins.

ALLOMETRIC ANALYSIS OF THE CRANIAL PARAMETERS OF THE AMERICAN MINK (MUSTELA VISON) CONSIDERING THE SKELETON OF THE MASTICATORY APPARATUS

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The aim of the study was to reveal specificity of the masticatory apparatus structure in american mink. Craniological relations were evaluated in a sample of 25 adult mink crania (18 females, 7 males). Standard cranial and mandibular measurements, together with 21 measurements, were used to statistical analysis. The results highlighted the differences of some craniological relations between males and females. Most features of masticatory apparatus were highly correlated with total skull length. Next, allometric equation was build, where independent variable was the total skull length. Total lengths of dental row of maxilla and mandible were significantly shortened relative to total skull length. Simultaneously, intense development of the posterior part of mandible, for attachment of masticatory muscles was observed. Length of the pallate was significantly greater then dental rows. Moreover, izometry between total skull length and pallate length was observed.

MORPHOLOGY OF THE CEREBRAL SULCI OF THE GIRAFFE (GRAFFA CAMELOPARDALIS L.)

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The aim of the study was the analysis of the exterior surface of the brain. Most importantly sulci of the pallium. The shape of the giraffe brain is pear-shape, with larger mass directed caudally. Sulci on the surface of the pallium is numerous and deep. The gyri was also dense and well-defined.

Among sulci of the pallium of the brain in the giraffe the following sulci were found: lateral rhinal sulcus, ectomarginal sulcus, ectolateral sulcus, suprasylvian sulcus, ectosylvian sulcus, sylvian fissure, diagonal sulcus, presylvian sulcus. Moreover, the sulci on the medial surface of the brain and topography of the base of the brain were also described.

ARTERIES OF THE HEAD OF THE WHITE RHINOCEROUS (CERATOTHERIUM SIMUM, BURCHEL,1817)

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The aim of the study was the comparative analysis of the arteries of the head of the white rhinocerous, represented Rhinocerotidae family. Corrosive preparation of the arteries of the head of the white rhinocerous female was studied. The age of these specimen was 3,5. Common feature of the arteries of the head of white rhinocerous and all Perissodactyla is the way of the terminal division of the common carotid artery. In white rhinocerous the lingual artery and the facial artery, depart seperately from the arterial trunk, like in other animals of Tapiridae family. Arterial rete mirabile of the white rhinocerous is only one case recorded at the Perissodactyla order. This is also distinguishing mark of the Rhinocerotidae family.

MORPHOLOGY OF THE SKULL OF THE GIRAFFE (GRAFFA CAMELOPARDALIS L.) IN RELATIONSHIP TO THE PHYLOGENY OF THE SPECIES

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The aim of the study was the analysis of the cranial structures of the giraffe and the confirmation of the phylogenetic relationship between giraffes and selected representatives of the hoofed mammal family.

Craniological relationships of 12 various giraffe skulls from the Department of Animal Anatomy were studied. The age of the animals differed. Selected craniological features of the giraffe skulls were investigated. These features were compared with the skulls of selected hoofed mammals. Identified features of the skulls are stated to be similar to that of Ruminants. Most of these features suggested a quite large similarity between giraffe, deer and cattle, which also suggested close affinity of their taxons. Lesser, but an observable similarity to the giraffe skull was the relationship to sheep and goat. Especially in the lateral and basal parts of the skull. Emissary foramina and shape of the nuchal plate were similar in the pronghorn antelope. The position of the facial crest was the one single analogy also observed in the pig. In the horse, the shape of the nuchal plane was closely related and in the camel the general shape of the skull was also similar.

DISTRIBUTION AND MICROSTRUCTURE OF THE LINGUAL PAPILLAE IN THE INDIAN ELEPHANT

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The present study investigated the morphology and distribution of the lingual papillae in the Indian elephant. The macroscopic am microscopic studies were performed on the tongue of the 50 years old female called Kinga from Zoological Garden in Poznan. The tongue after dissection was measured and tissue samples were fixed by embedding in 10 % formalin. For the LM microscopy the histological slides were stained with Masson Goldner and PAS staining and documented in Zeiss Axioscope Plus LM microscope.

Tongue of the Indian elephant have an elongated immobile body, closely filled the space between bodies of mandible. The length of the tongue is ca. 48 cm and width of the lingual body is about 14-18 cm. Thickness measured on the body of the tongue is ca. 28 – 30 cm. The dorsal surface of the tongue is flat and covered by multilayered squamous epithelium of thickness ranges from ca. 400 um on the apex of the tongue to ca. 5-6 mm on body of the tongue. The most characteristic feature of the tongue is triangle in a shape of apex of the tongue, which fill the sulcus of the mandible. Length of the apex from their tip to the dorsal surface of the tongue is about 24 cm. The mechanical papillae are scarce and on the anterior part of the tongue represented by short filiform papillae with one keratinized process. The lingual gustatory papillae are represented by fungiform papillae on the apex and lateral borders of the body of the tongue, four rounded vallate papillae on the root of the tongue and foliate papillae on the lateral surfaces of the posterior parts of the lingual body.

THE SEM STUDY OF THE LINGUAL PAPILLAE IN POLAR FOX (ALOPEX LAGOPUS, LINNAEUS, 1758)

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Present study shows the results of the scanning electron microscopic observations on the dorsal surface of the tongue in the polar foxes (Alopex lagopus). The aim of observations was to describe the distribution and microstructure of the lingual papillae. The samples from the apex, body and root of the tongue of the eight polar foxes were fixed in 2.5 % glutaraldehyde and postfixed in 1 % osmium tetroxide. After dehydratation in ethanol and acetone series, the samples were critical point dried, sputtered with gold and observed in scanning electron microscope Zeiss 435 VP.

The tongue in the polar fox is about 7 – 8 cm in length. The division in the rounded apex, elongated body and short root of the tongue in the polar fox is clearly observed. In the midline of the tongue the median sulcus were present. The ventral surface of the tongue is smooth without lingual papillae. The most numerous types of the lingual papillae on the dorsal surface of the tongue are mechanical filiform papillae. The filiform papillae consist of a short rounded base with single large posterior process and 10-14 short well keratinized anterior processes. The typical feature on the margins of the tongue apex is the accumulation of the fungiform papillae on the anterior border of the tongue. On the body of the tongue, the fungiform papillae were even distributed between filiform papillae. In the posterior part of the body of the tongue the secondary processes of the filiform papillae undergo reduction and on the root of the tongue in front of the vallate papillae area the filiform papillae have only single posterior process. The second type of mechanical papillae i.e. conical papillae cover the surface of the root of the tongue, which surround the gustatory vallate papillae. The total number of vallate papillae in the polar fox ranges from 5 – 7. The gustatory foliate papillae are situated symmetrically on the posterolateral areas of the margins of the root of the tongue. They consist of the 4-6 laminae and the dorsal part of each lamina fuse with base of the conical papillae.

Our observations states that the distribution of the lingual papillae is similar to those in the other species of the Carnivores belonging to the family Canidae i.e. silver fox (Jackowiak and Godynicki, 2004), racoon dog (Kobayashi et.al. 2004).

THE MORPHOLOGY OF THE STOMACH IN THE WHITE STORK (CICONIA CICONIA)

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The stomach in the birds is two chambered and consists of the glandular proventriculus and a muscular ventriculus called gizzard. The aim of our study in the white stork was to describe anatomy of the stomach and to describe the microstructure of the wall of the proventriculus and gizzard. Four stomachs of the adult white storks from the Zoological Garden in Poznan were used. The organs were fixed in 10 % neutral formalin. For light microscopic study the samples of the wall of the particular parts of the stomach were dehydrated and embedded in paraplast. The histological slides were stained with Masson Goldner and observed in Zeiss Jenaval and Zeiss Axioscope microscopes.

The glandular part of the tongue called proventriculus is an elongated structure ca. 6 in length. Thickness of the wall is about 10-12 mm and the diameter of the small lumen is about 3-4 mm. The wall of proventriculus consists of mucosa covered with simple columnar epithelium. Subepithelial connective tissue of the lamina propria of mucosa forms a thin layer. The predominant layer of the wall is submucosal, which is filled with elongated lobules of gastric glands. The 3-4 mm thick muscle layer, is arranged as inner circular and outer longitudinal layers of smooth muscle.

The ventriculus is the aglandular stomach. In all storks we founded well-filled stomach, which take a rounded shape, ca.7.5 -8cm in diameter. The wall of the gizzard is thinner as proventriculus and its thickness is about 7-8mm. The wall consists of mucosa lined with yellow-brown layer of hard cuticle, thin submucosa and well-developed thick muscular layer. The superficial cuticle on the surface of the mucosa is produced by short tubular glands.

THE MORPHOLOGY OF THE TONGUE IN THE GIRAFFE (GIRAFFA CAMELOPARDALIS)

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The aim of the study was to describe the morphology of the tongue of a giraffe (Giraffa camelopardalis) and characterize the distribution and structure of the lingual papillae on the dorsal surface of the tongue. Tongues of an adult 8 years old giraffe and foetus in the last trimester of pregnancy were obtained from the ZOO in Poznań. After dissection the tongue were fixed in 10 % formaldehyde, measured and documented with a digital camera.

Tongue in adult giraffe and its foetus has an elongated body with pointed apex. The total length of the tongue of an adult giraffe is approx. 43 cm, and total length of the tongue of a foetus is approx. 17 cm. The characteristic structure on the posterior part of the tongue is an elevation of lingual muscle called a lingual prominence. The length of a lingual prominence of an adult giraffe is approx. 17 cm., and the width reach about 8 cm. The length of a lingual prominence in foetus is approx. 7,5 cm., and width is about 4 cm.

On the apex, body and on the lingual prominence of the tongue there were observed two types of mechanical papillae and two types of gustatory papillae. Mechanical papillae are represented by filiform papillae, which are present on the surface of the apex, corpus and on the lingual prominence and also by conical papillae, distributed mainly at the root of the tongue.

The most numerous gustatory papillae are fungiform papillae. They create peculiar accumulations on the border of the apex of the tongue. The number of these papillae is in the adult specimens and foetus i.e about 122 – 124. On the body of the tongue the fungiform papillae are scattered between the filiform papillae.

Second type of gustatory papillae are vallate papillae of which number on both posterolateral surfaces of lingual prominence is about 8-10. The body of the each vallate papilla is surrounded by numerous conical papillae with bunt ends which bases are partly joined.

Development of the mucous membrane on the ventral surface of the lingual apex

IN THE PRE- AND POSTNATAL LIFE OF THE RABBIT

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The aim of this study was to describe the structure of the ventral surface of the apex of the tongue in rabbits in the period from day 15 of prenatal life to the 6th month of postnatal life. Investigations were conducted on 77 tongues of the rabbit (Oryctolagus cuniculus), collected at day 15, 18, 20, 22 and 26 of prenatal life (p.c.) and at day 1, 15 and 30, as well as in the 6th month of postnatal life (p.p.). Material for examinations came from the abattoir. Tissues for examinations, originating from the ventral surface of the apex of the tongue, were observed under a light microscope and a scanning electron microscope and next subjected to morphometric analysis in order to assess the thickness of the epithelium at individual stages in the life of the rabbit.

Samples for observation under the light microscope were fixed in 10% neutralized formalin or Bouin solution, dehydrated in alcohols (from 50% to 96%), embedded in paraplast and sliced into sections with the thickness ranging from 3 to 5 µm, in three planes, i.e. in the median, transverse and horizontal planes. The following staining methods were applied in the study: Masson-Goldner, orcein, resorcin-fuchsin or PAS.

Morphometric studies were conducted on the basis of images of histological specimens, observed under a light microscope, mounted with a camera with a computer image analysis program MultiScan v. 6.08. The thickness of the epithelium covering the ventral surfaces of the apex of the tongue in individual periods of the pre- and postnatal life of rabbits was analyzed morphometrically. On the basis of the obtained results the primary statistical characteristics were determined: mean (x), minimum value (Min), maximum value (Max) and standard deviation (SD). Using the F test statistical differences were determined for mean values of the measured trait in successive periods of the pre- and postnatal life of rabbits.

For the observation of the connective tissue core of the ventral surface of the apex of the tongue, samples were first fixed in the Karnovsky fixing solution and then placed in a 10% NaOH solution at

room temperature (21-24oC). After the epithelium was removed, samples were dehydrated, critical point dried and sputtered with gold. These specimens were observed under a scanning electron microscope Hitachi S-4200.

As a result of the conducted investigations it was shown that the epithelium covering the ventral surface of the lingual apex in the period from day 15 p.c. to the 6th month p.p. changed from a 1-2 layer epithelium into nonkeratinized stratified squamous epithelium. Glycogen was identified at day 15, 18 and 20 p.c. in the cytoplasm of epithelial cells and the mesenchymal tissue. Starting from day 22 p.c. structurally differentiating lamina propria mucosae was observed, in which elastic fibers were identified, arranged primarily perpendicularly to the longitudinal axis of the tongue. Morphometric analysis showed an increase in the thickness of the epithelium in successive periods of life in the rabbit, except for day 18 p.c., when the value describing the thickness of the epithelium was smaller than the value shown at day 15 p.c.

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LINGUAL PAPILLAE IN THE RACCON DOG (NYCTEREUTES PROCYONOIDES)

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The aim of this study was to investigate the structure of the mucosa on the dorsum of the tongue in the raccoon dog, focusing on lingual papillae.

A total of 11 tongues of the raccoon dog (Nyctereutes procyonoides) were used in this study. The material came from animals of both sexes and was collected after they were slaughtered at a fur animal farm.

Immediately after they were removed, the tongues were placed in 10% neutralized formalin or Bouin's solution. After fixation measurements were taken of the length of the apex, body and root of the tongue and the width of its individual parts. For analyzed traits arithmetic means (X) were calculated along with minimum values (Min), maximum values (Max) and standard deviation (SD). Next, smaller samples with lingual papillae were collected from tongues and then they were dehydrated in a series of alcohols with increasing concentrations (50%-96%), embedded in paraplast and sliced using a Leica RM 2055 rotation microtome into sections with thickness ranging from 3 to 5 µm. Tissue samples were sliced in three planes, i.e. sagittal, transverse and horizontal. The Masson-Goldner staining or HE were applied in this study.

Two types of mechanical papillae are found on the tongue in the raccoon dog, i.e. filiform and conical papillae, along with three types of gustatory papillae, i.e. fungiform, foliate and vallate papillae. The most numerous, filiform papillae are distributed on the dorsum of the apex and body of the tongue and on the margins of the tongue. Fungiform papillae are located among filiform papillae. Two foliate papillae are located dorso-laterally in the posterior part of the lingual body. Vallate papillae are arranged in a V-like manner, 3 - 4 papillae on each side of the tongue. Conical papillae are located caudally, behind vallate papillae.

Filiform papillae have the basal part, on which there are between 11 and 14 conical processes with their apexes extending towards the pharynx. The biggest process is found in the posterior part of each filiform papilla. Fungiform papillae are distributed irregularly on the tongue. Foliate papillae are composed of 3 - 7 folia papillae, arranged parallel one to the another. Individual folia papillae are separated with deep furrows. Each vallate papilla is surrounded by a deep furrow, around which a marked, circular outer wall of the papilla was found. Occasionally two vallate papillae surrounded by a common furrow and outer wall were observed. Conical papillae have their apexes directed towards the pharynx. Their density decreases caudally.

MUCOSA ON THE VENTRAL SURFACE OF THE APEX AND LATERAL SURFACES OF THE BODY OF THE TONGUE IN THE COYPU (MYOCASTOR COYPUS)

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The aim of this study was to investigate the mucosa on the ventral surface of the apex and lateral surfaces of the body of the tongue in the coypu and to analyze morphometrically the thickness of the epithelium on examined areas. The analyses were conducted on 6 tongues of the coypus (Myocastor coypus). Material came from animals of both sexes.

Tongues for examinations under a light microscope immediately after being removed were fixed in 10% neutralized formalin or Bouin's solution. Next smaller tissue samples were collected from the ventral surface of the apex and lateral surfaces of the body of the tongue, which were dehydrated in a series of alcohols with increasing concentrations (from 50% to 96%), immersed in paraplast and sliced using a Leica RM 2055 microtome into sections of 3 to 5 µm. Tissue samples were sliced in three planes, i.e. sagittal, transverse and horizontal. In the study the applied method included Masson-Goldner, HE, resorcin-fuchsin or orcein staining.

Morphometric analyses were conducted on histological slides, which were observed using a light microscope coupled with a camera with a computer image analysis program MultiScan V. 6.08. The thickness of the epithelium covering the ventral surface of the apex and lateral surfaces of the body of the tongue was analyzed. Based on the obtained measurements the mean value (X), the minimum value (Min), the maximum value (Max) and standard deviation (SD) were calculated. Statistical differences of means for the measured trait were determined using the t-Student's test.

The tongue of the coypu is elongated in the anteroposterior direction. It has a round tip and a prominent torus linguae on the posterior half. Four different types of lingual papillae were observed on the tongue – filiform, fungiform, vallate and foliate papillae. Lingual papillae are located on the dorsal surface, margins and at the top of the ventral surface of the tongue. On the basis of microscopic observations it was found that the epithelium covering the ventral surface of the apex and lateral surfaces of the body of the tongue is nonkeratinized stratified squamous epithelium. It forms numerous epithelial streaks of different length, which grow into the lamina propria of the mucosa. Epithelial streaks differentiate the thickness of the epithelium.

VALLATE PAPILLAE OF THE TONGUE IN THE RABBIT (ORYCTOLAGUS CUNICULUS)

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The aim of this study was to describe the structure of vallate papillae in the rabbit, based on observations conducted under a light microscope, as well as a scanning electron microscope. Tongues for analyses were collected from 11 adult rabbits, Oryctolagus cuniculus, of both sexes. The material was obtained from an abattoir.

Samples for observation under the light microscope were fixed in 10% neutralized formalin or Bouin solution, embedded in paraplast and sliced into sections with the thickness ranging from 3 to 5 µm, in three planes, i.e. in the median, transverse and horizontal planes. Masson-Goldner staining or HE were applied in this study.

Specimens for observation under the scanning electron microscope were fixed in Karnovsky fixing solution, critical point dried and sputtered with gold.

For the observation of the connective tissue core of the vallate papillae, samples were first fixed in the Karnovsky fixing solution and then placed in a 10% NaOH solution for 20 days at room temperature (21-24oC). After the epithelium was removed, samples were dehydrated, critical point dried and sputtered with gold. These specimens were observed under a scanning electron microscope Hitachi S-4200 or LEO 435VP.

On the root of the tongue in the rabbit there are two vallate papillae, covered by nonkeratinized stratified squamous epithelium. The epithelium is characterized by variable thicknesses, forming epithelial streaks of different length. Taste buds are found both in the epithelium covering the papillae and in the

epithelium of the outer walls of the papillae from the side of the furrows. The outer wall of the vallate papillae is gradually transformed with no visible boundary into the surface of the root of the tongue devoid of papillae. The surface of the vallate papillae is uneven. The connective tissue core of the papillae is formed by numerous, irregularly shaped connective tissue papillae, between which epithelial streaks are arranged. Around the connective tissue core of the papillae there is a circular connective tissue fold, with a furrow located on its circumference and the core of the outer wall of the vallate papillae. Numerous excretory ducts of the posterior serous lingual glands open on the fundus of the circular furrow of each vallate papilla. Sometimes excretory ducts of these glands open directly onto the surface of a vallate papilla and then in their vicinity taste buds are found.

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YELLOW MONGOOSES (CYNICTIS PENICILLATA CUVIER, 1829) MARKING BEHAVIOR IN CAPTIVITY.

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The behavior of yellow mongooses (6 males and 16 females) was studied in Leningrad Zoo (St.-Petersburg, Russia) from January 26, 2004 till March 12, 2007. About 150 hours of visual observations have been analyzed.

Marking behavior allows animals to communicate with each other by means of smell marks. Yellow mongooses were noted marking their territory, the partner, cubs and new objects in their cage. Marking was carried out in various ways – by leaving urine mark, putting on an anus and facial glands secret, transference of one's own smell by rubbing a side and back part of the body. It was discovered, that these animals only marked their territory in every above mentioned way. As a rule, members of a family group marked each other with facial and anus glands secret. Both males and females used all marking ways. Marking frequency depended on mongooses' reproductive activity as well as on specific features of each individual. The greatest attention is given by the animals to marking their own territory and in the first place the nest box and special « marking places» such as ends of branches, snags etc. It was once noted that marking the territory was included in a set of stereotype movements in which case its frequency repeatedly increased. The most frequent way of marking is putting on a facial glands secret (rubbing with corners of a mouth, with cheeks and with areas behind eyes and ears).

In the process of ontogeny the first attempts of cubs to mark their parents were observed at the age of about 6 months, which is half a year before reaching sexual maturity.

ENRICHMENT OF MANED WOLVES (CHRYSOCYON BRACHYURUS)

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Maned wolves are dusk-active and nocturnal animals, who are rarely seen in action by visitors due to their lifestyle in zoos. In order to change this, enrichment measures were carried out during opening hours with the aim of extending the activity of the animals during daylight. Several enrichment measures, namely hidden feed, buried feed, hanging feed, feed in pipes, live feeds, objects on a rope, odour tracks of cinnamon and lions' excrement, were offered to the five maned wolves (1.1 with 3.0 pups) in order to observe their reactions. We could clearly recognise that the animals reacted differently to each measure. Movable or moving objects were far more interesting for the animals than odour tests or static objects. Objects thrown into the water tank increased activity most.

It must be said that compulsory enrichment did not lead to a significant increase of their activity and the animals kept their usual activity patterns.

In future studies new enrichment measures focusing on movable objects should be developed in order to improve the maned wolves' activity during opening hours.

TOGETHER OR SEPARATED - HOW GROUP COMPOSITION AFFECTS TIME PATTERNS IN A SOLITARY MAMMAL

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For unknown reasons, echidnas (Tachyglossus aculeatus) living in captivity rarely have offsprings. Today, modern enclosure arrangements, a well-balanced nutrition as well as good medical care are granted in zoological gardens. Therefore, these maintenance conditions cannot hold responsible for the poor birth rate. The reason might rather be attributed to the social surroundings, the conspecifics in the same enclosure. In wildlife, echidnas choose to live in solitary with exception of the mating season, albeit in zoological gardens they are kept in pairs or in even larger social groups all the time. Our long-term chronoethological analysis in the Frankfurt Zoo has compared animals living two by two or as single. The time pattern of locomotor activity and feeding from a solitary-housed animal is completely changed as soon as the enclosure has to be shared with a second animal. The chronological distribution of ingestion seems to be characterized by feeding competition between the animals caused by an assumed shortage of food. Then the sleep-wake-cycle is changed and shows a daily break during the long sleep phase in order to take up food. This could be interpreted as a stress reaction, which might have a negative impact on the reproductive system and explain the decreased breeding capacity of the female. Our results demonstrate that non-invasive analysis of behavioral patterns could give important insights into the well- being of animals and help optimizing maintenance conditions. Respecting the species-specific social structure might help to increase the birth rate of echidnas living in captivity. We conclude that our study is an example for demonstrating the benefit of the chronoethological method for evaluating husbandry conditions as species-appropriate.

RESULTS OF A STUDY ON ORANG-UTANS IN ZOO WITH SPECIAL FOCUS ON THE SUBDOMINANT FEMALE

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Behaviour observations in zoo can contribute to improvements of the welfare of captive animals. An important aspect when working on apes can be the consideration of the individual traits of the animals. For the present study the orang-utan group at Frankfurt Zoo were observed for three month having regard to chronobiological aspects. At the time of this study, the group comprised seven orang-utans: one adult male and the dominant female (both born in the late 1950ties), one female (born in 1989) with two youngsters (five years old and the baby, who was younger than a half year at the time of the observation) and the subdominant female (born in 1992) with a two year old infant. This subdominant female was raised by and lived for several months in a human family. The activity pattern of each member of the group shows individual differences, especially in spending 'free-time', just as the reactions to visitors and to enrichment offered by the keepers. The subdominant female furthermore shows specific characteristics in comparison to the other adults. She apparently avoids her companions by means of shifting activity phases to evening hours. Even during sleeping time she keeps off the others, which are cuddled in their 'nest' in a big box aloft: she builds her night nest on the ground. Different from the two eldest animals she likes sipping and playing at the enclosures' water tap, like she generally likes playing with water. Furthermore she alone aims at direct visitor contact in order to play or fodder begging. Like the other females the subdominant shows remarkable individual behaviour. The most outstanding one is intensive regurgitation and reingestion. Especially with evenings' feed she sometimes keeps herself busy up to one and a half hour. The results illustrate among other things that one should take into account the individual traits of the animals when considering environmental enrichment.

SOME ASPECTS OF MOVEMENT STEREOTYPIES IN THE SPECTACLED BEARS (*TREMARCTOS ORNATUS*) IN WROCLAW ZOO

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The daytime behavior of spectacled bears (two individuals), kept in the Municipal Zoo of Wroclaw in the outdoor enclosure, was scanned at constant intervals and the recording was continuous for 70 hours on 10 days for one season. Observations were carried out from 9 am till 3 pm. Analyses were carried out for

all aspects of stereotypical movements: form, bouts duration, frequency, spatial variability and total amount of time devoted for stereotypic behavior.

Observed form of stereotypical movement was pacing, interrupted sometimes by head-twisting (individual one – 31 recordings) and head-tossing (individual two – 260 recordings). The median value of time devoted for stereotypical movements was 57 min/h.

Frequency of choosing particular zones was calculated for every record of stereotypical movement for every individual separtely. One individual used six different paths for pacing and the other four paths. The most frequent path used by one of them was nearby the dry moat (85 recordings, n=179), while the other's favourite path was at the back of the enclosure (107 recordings, n=195).

INFLUENCE OF FEEDING REGIME ON MORTALITY AND GROWTH RATE IN THERAPOSIDS SPIDERS (ARANEA, THERAPOSIDAE)

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Influence of feeding regime on mortality and growth rate in Theraposids spiders (Aranea, Theraposidae)

Spiders of Theraposidae family belong to the section Orthognata, which consists of primitive, giant spiders with orthognatic arrangement of chelicerae. Theraposids inhabit naturally warm regions of Africa and both Americas. In accepted system 7 subfamilies of these spiders are distinguished (Avicularinae, Eumenophoriinae, Grammostolinae, Ischnocolinae, Ornithoctoninae, Selenocosminae, Theraposinae). Because of environmental preferences these spiders are characterized by wide plasticity even in the same genus, e.g. Brachypelma lives both in rainforests of Brazil and in Mexican deserts.

All Arthropoda including all spiders grow by leaps through systematic moulting. Moulting is a "delicate" process depending on: abiotic environmental factors (such as temperature, humidity); spider's own condition (like body damages, parasites, age and size, genetic component) and accessibility of food.

The purpose of the research was verification of the frequency of feeding influences on basic parameters of spiders' post-embryonic development (such as growth rate, survival, moulting synchronicity.

Experimental breeding consisted of 10 genus of Theraposidae family. Developmental parameters were researched in 6 of them: Acanthoscurria, Brachypelma, Chromatopelma, Poecilotheria, Phormictopus, Stromatopelma. Experimental sample was divided into 2 groups: (1) feed often; (2) feed rarely. There was also control groups consisting of: (3) species was fed well solely (Pterinochilus, Psalmopoeus); (4) species was starved solely (Lasiodora, Hysterocrates).

Analyses proved that a wide spectrum of features exists with feeding regimes accounting for variability. Apart from evident changes (e.g. decrease of body mass and size, decrease of moulting frequency, higher mortality), it was proved that there are also changes between proportions of some parts of limbs and between their rates of increase.

BREADING OF THE STRIPPED HYENAS IN THE LITHUANIAN ZOO

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The stripped hyenas are very interesting animals, but people often have a negative opinion about these animals as scavengers. Hyenas look like Canidae, but they are more kindred to Felidae and Viveridae. They aren't very rare, but we can't find them not often in zoos. They breed enough easy. Parents lose newborns or killed them. In many cases the cubs are handrearing by keepers.

During 1974-2002 years 19 stripped hyenas (including registered newborns) were kept at Kaunas zoo. They bred 8 times; 11 cubs (6 males and 5 females) were born; 7 (4M.3F) grew successfully. During 1974-2002 years 21 stripped hyenas were kept at Kaunas zoo. They bred 7 times; 10 cubs were born; 8 grew successfully. Not all the cubs were registered. The parents have eaten the cubs five times and three rearings were successful.

THE ANALYSIS OF THE REPRODUCTION OF WHITE AND BLACK RHINOS IN THE VIVARIAN CONDITIONS.

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Aim and materials:

The aim of the study was to present some trends in breeding as well as the current condition of the animals kept in captivity basing on the studbooks of the White and Black Rhinos.

In the 2005 issue you can find a chronological list of the animals organized by the date of the report, till 10.10.2005.

In last issues of the studbooks of both species data concerning 1503 White, 924 Black Rhinos was published.

Conclusions:

- The average age of a female when having the first calf was higher by about 2-3 years than the average age of females living at large . Another point is that the average age of males when their first offspring was born was lower then those living at large, which is connected with the lack of the territory competition with the older specimens.
- Increase in the amount of animals born alive should be accompanied by a growth of import of animals that had lived at large in preceding years.
- Unsatisfactory is the fact that till 01.01.2005. a very great number of females was pregnant only once
- The rhinos reproduce un-seasonally , but the factor that often influences the time of births is a geographical position of the establishment.

5.4 The White Stork in Poland studies in biology, ecology and conservation Tryjanowski P., Sparks T.H. &Jerzak L. (eds), Poznan 2006

Book can be ordered from Piotr Cwiertnia (details see review section)

PLASTIC STRINGS CAUSE LEG BONE DEGENERATION IN THE WHITE STORK *CICONIA CICONIA*

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Between 2001 and 2004, we examined White Stork Ciconia ciconia chicks whose legs had become tangled in plastic strings used by their parents to improve nest structure. The juveniles were in poor condition, usually with broken wings and/or legs, so they were delivered to wildlife rehabilitation centres where they were diagnosed radiologically. Out of 94 White Storks examined, 20 individuals (21.3%) had legs partly destroyed by plastic strings during the nestling period. The proportion of tangled chicks delivered to rehabilitation centres was significantly higher than the proportion of such chicks in the local population ($P < 0.0001$). All legs were tangled above the tarsometatarsi. In most cases the tangle resulted in leg autoamputation.

SEXING OF WHITE STORKS *CICONIA CICONIA* BASED ON BIOMETRIC MEASUREMENTS

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We examined sexual size dimorphism of the White Stork *Ciconia ciconia* in the Poznań Zoological Garden in Poland. From 93 measured storks, 46 were sexed using DNA extracted from blood samples and 12 by autopsy. Body morphometrics recorded included mass, wing chord, tail length, culmen length, depth and width of bill at its base for each bird. Male White Storks were generally, on average, larger than females in all measurements. Discriminant analysis based on biometric measurements was applied to sexual identification of White Storks. Birds for the study were from those sexed by DNA testing and 89% of birds were correctly identified.

WHY ARE WHITE STORKS *CICONIA CICONIA* DELIVERED TO CAPTIVITY? A CASE STUDY BASED ON THE EXPERIENCE OF POLISH ZOOS

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The aim of the paper was to analyse differences in the number of storks received by zoos in Poland, and investigate factors which influence the year-to-year dynamics of captive storks. We have used data reported in the "Directory of the Zoological Gardens" published from 1984 up to 2004. White Storks are delivered to zoological gardens and rehabilitation centres across Poland. The main reason why storks come into captivity are collisions and therefore birds have most frequently injured their wings. The number of storks delivered to zoological gardens and rehabilitation centres increased significantly during the investigated years.

FOOD SELECTION OF THE WHITE STORK *CICONIA CICONIA* UNDER CAPTIVE CONDITIONS

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Observation on food selectivity were performed in 2004 and 2005 at the Poznań Zoological Garden. Altogether 29 individual storks provided the basis for research (20 females and 9 males). The data were recorded during digestion efficiency research. During a10 day cycle the birds were fed according to a Cafeteria test. The diet contained mammals, birds, fishes, amphibians, insects and earthworms. The storks showed a strong preference towards mammals which constituted 40% of all food. The second most popular item were birds – 36% of the total. Fish were also popular and constituted to 39% of the diet. Storks virtually avoided insects: only 2% attempted to eat them. Earthworms were totally ignored.

DIGESTIVE EFFICIENCY IN CAPTIVE WHITE STORKS *CICONIA CICONIA*

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Digestive efficiency in the White Stork was studied in the Poznań Zoo in 2004–2005. Altogether 29 individuals of this species were investigated (9 males, 20 females). During 10-day-long experimental cycles, the birds were presented with food according to the 'Cafeteria' test. The diet consisted of mammals, birds, fishes, amphibians, insects and earthworms. The mean daily food intake per bird was 284.88 g (SD 113.99 g). The mean digestive efficiency was 72.06% (SD 6.19%). The research showed that the digestive efficiency is positively correlated with the quantity of food intake and body weight increase. The daily dietary requirement of captive birds proved to be very significantly lower than in wild birds.

6 Research Reports from Moscow Zoo

6.1 Euroasian Regional Association of Zoos And Aquaria, Scientific Research in Zoological Parks Moscow - Penza Zoo, 2006

The present issue of Scientific Research in Zoological Parks covers different aspects of the zoo management. Traditionally several articles are dedicated to keeping and breeding of reptiles and modern veterinarian methods of expert care in this taxon. Series of articles on marine aquariumistics is continued. Theoretical approach to the zoo environmental enrichment as well as some aspects of practical work in this context is discussed. Interesting case of hand rearing sugar glider cub is described. Analysis of acoustic components of swan species behavior continue the series of articles devoted to comparison of signal behaviour of these birds.

"Information" part presents translation of WAZA Code of Ethics and Animal Welfare, brief information about III International Conference "Animals, Zoos and Conservation" and also provides annotated list of main publications by Moscow zoo Department of Herpetology beginning 1981.

"Appendix" of this issue is devoted to 25th Anniversary of Penza Zoo and presents publications illustrating research activities of its staff.

The issue will be useful for zoo experts and keepers, as well as for students of biological universities.

CONTENTS

THE QUESTIONS OF ANIMALS' KEEPING, BREEDING AND BEHAVIOUR IN CAPTIVITY

BREEDING OF PINK ANEMONEFISHE AMPHIPRION PERIDERAION (PERCIFORMES, POMACENTRIDAE) AT MOSCOW

ASTAKHOV D.A., POPONOV S.Y., POPONOVA V.R., ZAITZEV N.V. ZOO.

In 2004, rotifer culture fed by the dense culture ($10 \cdot 10^{6}$ cells/ml) of unicellular alga *Nannochloropsis* sp. was used for rearing in "green" water *Amphiprion perideraion* during the first 20 days. Starting from the 14 day newly hatched nauplii of brine shrimp (*Artemia salina*) were added to rotifers for nutrition of juveniles. Survival ratio (to 2 year) of *A. perideraion* was 32 %.

NINE SPECIES OF LIONFISHES (SCORPAENIFORMES, SCORPAENIDAE, PTEROINAE) IN THE COLLECTION OF MOSCOW ZOO

ASTAKHOV D.A., POPONOV S.Y., POPONOVA V.R...

Data on the history of collection of the nine species of lionfishes: Dendrochirus bellus (Jordan et Hubbs, 1925), Dendrochirus biocellatus (Fowler, 1938), Dendrochirus brachypterus (Cuvier, 1829), Dendrochirus zebra (Cuvier, 1829), Pterois antennata (Bloch, 1787), Pterois miles (Bennett, 1828), Pterois mombasae (Smith, 1957), Pterois radiata Cuvier, 1829 and Pterois volitans (Linnaeus, 1758), in Moscow Zoo are described.

SOME ASPECTS OF PROLONGED MAINTENANCE OF MARINE FISHES IN CAPTIVITY. REPORT 17. FAMILY SCIAENIDAE (ACTINOPTERYGII, PERCIFORMES)

ASTAKHOV D.A., POPONOV S.Y., POPONOVA V.R.

Data on distribution and biology of 1 species of croaker: Sciaena umbra Linnaeus, 1758, conditions of prolonged maintenance and fungus disease of this species in Exotarium of Moscow Zoo are described.

SOME ASPECTS OF PROLONGED MAINTENANCE OF MARINE FISHES IN CAPTIVITY. REPORT 18. FAMILY SPARIDAE (ACTINOPTERYGII, PERCIFORMES)

ASTAKHOV D.A., POPONOV S.Y., POPONOVA V.R.

Data on distribution and biology of 1 species of porgy: Diplodus puntazzo (Cetti, 1777), conditions of prolonged maintenance and fungus disease of this species in Exotarium of Moscow Zoo are described. .

SOME ASPECTS OF PROLONGED MAINTENANCE OF MARINE FISHES IN CAPTIVITY. REPORT 19. FAMILY CARANGIDAE (ACTINOPTERYGII, PERCIFORMES).

ASTAKHOV D.A., POPONOV S.Y., POPONOVA V.R

Data on distribution and biology of golden trevally Gnathanodon speciosus (Forsskål, 1775) and conditions of prolonged maintenance of this species in Exotarium of Moscow Zoo are described.

EXPERIENCE OF KEEPING OF PREHENSILE-TAILED SKINK (CORUCIA ZEBRATA, GRAY 1855) IN TULA EXOTARIUM

ASTREIKO E.A., POPOVSKAYA S.P

Detailed data on keeping, feeding and successful breeding during three years of Corucia zebrata Gray are given in the article. Table with detailed information on frequency of matings, duration of gravidity, sizes and weight of the new-borns is given.

TO THE QUESTION ON THE REPRODUCTIVE BIOLOGY OF THE SNAKES OF GENUS PHILODRYAS WAGLER, 1830 (COLUBRIDAE, XENODONTINAE)

KORSHUNOV I.S.

Some data on the reproductive biology of two species of genus Philodryas (P. viridissimus and P. baroni) are given in the article. The complete cycle of breeding of Philodryas baroni is described. Data on the sizes of the eggs and new-borns are given.

PECULIARITIES OF THE REPRODUCTIVE BIOLOGY OF THE JAPANESE RATSNAKE ELAPHE CLIMACOPHORA BOIE, 1826 (COLUBRIDAE)

KUDRYAVTSEV O.B

Keeping and breeding of the Japanese Ratsnake Elaphe climacophora is described in the article. Exact data on the reproductive biology of this species are given.

HUSBANDRY AND CAPTIVE BREEDING OF BEAUTIFUL PITVIPER TRIMERESURUS (CRYPTELYTROPS) VENUSTUS VOGEL, 1991

SHYRYAEV K.A., KUDRYAVTSEV S.V., GANINA L.V

In the article first in Russia breeding of Beautiful pitviper *Trimeresurus (Cryptelytrops) venustus* Vogel, 1991 is described. New data on keeping and breeding of rare species are given.

SOME SUCCESSFUL RESULTS IN HUSBANDRY AND BREEDING OF THE RARE AND HARD-TO-KEEP VENOMOUS SNAKES AT THE MOSCOW ZOO (PART YI:2006 YEARS)

KUDRYAVTSEV S.V., GANINA L.V.

The article deals with some results of a continuous research aimed at developing methods for husbandry and breeding of rare and problem species of venomous snakes at Moscow Zoo, conducted especially intensively lately. Details of husbandry and captive reproduction of species with restricted areal, such as: Moorish Viper *Macrovipera mauritanica* (Gray, 1849), Hump-nosed pitviper *Hypnale hypnale* (Merrem, 1820) and hard-to-keep Temple pitviper *Tropidolaemus wagleri* Wagler, 1830 are given.

PROPHYLAXIS OF MINERAL DEFICIENCY IN CAPTIVE REPTILES AND USAGE OF MINERAL-VITAMINS SUPPLEMENTS.

VASILIEV D.B., SHVED V.S.

Main aspects resulting in mineral deficiency typical for captive reptiles are analyzed. Influence of various sources of artificial UV light on synthesis of cholecalciferol in case of lizards is considered. Algorithm for calculating composition and doses of commercial mineral supplements is given. Optimal composition of vitamin and mineral supplements for reptiles is calculated.

PROBLEMS IN EMPIRIC AND SPECIFIC ANTIMICROBIAL THERAPY OF REPTILES IN ZOO COLLECTIONS.

VASILIEV D.B., KARABAK V.I., SHVED V.S.

Data on species shift of dominating micro flora and its sensibility to antimicrobial drugs under long-term usage of broad-spectrum antibiotics at Moscow Zoo reptile collection are presented. Recommendations on antimicrobial therapy in multi-species associations of reptiles are given.

DEEP LITTER AS STIMULI INFLUENCING PRIMATES' BEHAVIOR.

MESHIK V.A., ZUBTCHANINOVA E.V., DUBROVSKYI V.YU.

We observed the influence of deep litter (hay) as a new stimuli on the monkeys' (*Macaca silenus* , *Cercopithecus Diana, Colobus guereza, Papio anubis, Papio sphinx*) behavior. Budgets of time for groups of these species were analyzed for periods of time without hay and with hay and data were compared. Hay as

a new stimuli intensified positive social relationships in full-value social groups. In cases of small group or single animal we observed intensification of negative behavior, which testifies psychological discomfort..

THEORETICAL APPROACH TO THE ZOO ENVIRONMENT ENRICHMENT.

POPOV S.V., ILCHENKO O.G., NEPRINTSEVA E.S., VOSCHANOVA I.P.

The working model of zoo environment enrichment is suggested in this article. The model is based on concepts of "optimal arousal level" and data concerning the influence of predictability and controllability of environment on animal's sensitivity for external stimulation. According to this model the functional classification of enrichment tools and the algorithm for choosing such tools is suggested. Efficiency of our approach has been tested when enriching animals' environment in Moscow Zoo.

COMPARATIVE ANALYSIS OF THE SWAN SPECIES' SIGNAL BEHAVIOUR. 2.COMPARIZON OF ACOUSTIC COMPONENTS OF BEHAVIOR

PANOV E.N., PAVLOVA E.YU

Acoustic behaviours of all six swan species of the world have been studied with use of comparative ethological approach. Interspecific differences revealed do not limited by dissimilarity in vocal repertoires as such. The whole diversity of sounds, extent of their structural complexity as well as modes of use of simple and comlex signals in communication process are also distinct. Individuals of different species show uneven ability to combine simple basic sounds to build signal of high level of integration, which was interpret as a different capasity to generate a highly variable acoustic production. In the most extent the vocal combinatorics is characteristic of the whooper swan while in the mute swan such ability seems to be minimal. Thus, the acoustic system of the first species can be defined as a labile one and that of the second species as a rather rigid. Signals of the maximum structural complexity (so called series and ensembles) appear to be of the highest communication value. These are present in repertoires of only three northern species (the whooper, whistling and trumpeter swans), where such sounds are part of the dramatic social interactions that ensure the strength of pair bonds and defence of breeding territory. In these species and in the black swan series are emitted by both partners at the end of copulation, just after mounting is finished. It is shown that divergence of the acoustic behaviour did not correspond to extent of the similarity in the external appearance of the species. Our findings suggest that the most closely related are the whooper and whistling (including Bewick's) swans. The behaviour of the trumpeter swan is quite different, which permits us to regard it as an independent species.

DATA ON REPRODUCTIVE BIOLOGY OF THREE-COLOURED HOG-NOSED SNAKE LYSTROPHIS PULCHER

KORSHUNOV I.S

Keeping and breeding of Three-coloured hog-nosed snake *Lystrophis pulcher* is described in the article. Data on keeping, breeding, temperature regimens, feeding, incubation of eggs and raising of the young are given. Our results demonstrate that possibly these snakes are one of the most productive.

THE PSYCHOBIOLOGICAL REHABILITATION OF YOUNG POLAR BEAR FEMALE WHICH HAD MENTAL RETARDATION

EGOROV I.V., NEPRINTSEVA V.R., ILCHENKO O.G

Successful environment enrichment of young female Polar Bear with mental retardation is described. The first positive reaction of animal on objects of enrichment was noticed 2 months after the work had been started.

THE SOILS CONDITION OF MOSCOW ZOO.

YURKOVA N.E.

The territories with green planting are very important for cities landscape. The soils of Moscow Zoo were formed under anthropogenic pressure. These soils have not been studied sufficiently. The most part of soil cover is of artificial origin. Soil pH is tended to alkaline that is usual for urban ecosystem. The territory is characterized with presence of heavy metals in large amount. Full-scale investigation of soil characteristics will be very significant for understanding of soil processes changes. It could help to preserve plant and animal diversity in the anthropogenic conditions.

III INTERNATIONAL CONFERENCE "ANIMALS, ZOOS AND CONSERVATION"

NEPRINTSEVA E.S., KONDRATYEVA L.V.

III International Conference (Animals, Zoos and Consevation) was held in Poznan (Poland), 8-9 June 2006. All talks concerned not only main problems of conservation, but also described researches which took place in different Zoos. Presentations about studying, saving, keeping and breeding the animals were made. A lot of posters have been done on various topics: behavior, anatomy, morphology, etc. This paper could be an interest for all kinds of specialists working with animals; it is a short review of all talks and posters which were presented at the Conference.

CONTRIBUTION TO DEVELOPMENT OF RUSSIAN AND INTERNATIONAL ZOO HERPETOLOGY AND HERPETOCULTURE BY MOSCOW ZOO DEPARTMENT OF HERPETOLOGY.

KUDRYAVTSEV S.V.

In course of the last 25 years, Department of Herpetology of Moscow Zoo made valuable contribution to development of both Russian and International zoo herpetology and herpetoculture in their various aspects – from basics to applied methods and technics. The present article gives an opportunity for estimation of such a contribution, providing a list of main publications by the Department staff members beginning 1981.

BREDING OF EAGLE OWL BUBO BUBO AT PENZA ZO

ZABIROV A.B., ROZHKOVA A.G. O

Management of eagle owls *Bubo bubo* at Penza zoo since 2002 is described with special reference on breedings in 2003-2005. Lack of breeding in 2006 supposed to result from hard frosts in winter which had affected physical state of the male. Success in breeding is reported to be connected with decreasing of stress caused by keepers and visitors and with the presence of alive mice, rats, hens, etc., in ration.

KEEPING AND BREEDING AZURE-WINGED MAGPIE (CYONOPICA CYANA POLLESCENS) IN PENZA ZOO.

ROZHKOVA A.G

Breeding of azure-winged magpies (*Cyonopica cyana pollescens*) in Penza zoo is analysed. Failure is supposed to be caused by insufficient enclosure size. It is recommended to minimize stress of birds during reproductive period.

METHODS OF ENVIRONMENT ENRICHMENT IN PENZA ZO

GOGOLEVA E.N. O

Some ways of environment enrichment for different taxa groups of animals in Penza zoo are described. Most of them concern diversifying of feeding methods.

6.2 Euroasian Regional Association of Zoos and Aquaria Scientific Research In Zoological Parks Moscow Zoo, 2007

The previous 21st issue of Scientific Research in Zoological Parks has been published by Novosibirsk zoo, the current one is presented by Moscow zoo. Traditionally it is dedicated to different aspects of the zoo management. Series of articles on marine aquariumistics and husbandry and breeding of venomous snakes is continued. Reviews are devoted to research activity of zoos in the territory of the former USSR, viral diseases of reptiles, problems of mammals' behavior optimization in zoos are presented. Behavior of a group of giraffes and sugar gliders captive population is discussed. Problematic articles consider reintroduction as a method of wild Amphibia conservation and a method of "individual distances" for behavior research. Other articles describe animal keeping in Budapest Zoo, preservation of the gene pool of the Przewalski horses at Askania Nova, methods of keeping and breeding *Inachis io* and the endangered Oriental White Stork. We made a decision to publish the translation of "Husbandry Guidelines 2006 - Common warthog" which is of great interest for keepers and also sets an example of similar reports.

Brief communication describes the first successful hand rearing of jerboas.

Information on the I st European Congress on Conservation Biology "Diversity for Europe" and conservation project «The saving of Meriones dahli" is cited. The issue will be useful for zoo experts and keepers, as well as for students of biological universities

CONTENTS

KEEPING, BREEDING AND DEMONSTRATION OF INACHIS IO, LINNAEUS, 1758 (LEPIDOPTERA, NYMPHALIDAE) IN THE MOSCOW ZOO.

TKACHEVA E.YU., TKACHEV O.A.

This article describes some experiments on keeping, breeding and demonstration of *Inachis io,* Linnaeus, 1758 (Lepidoptera, Nymphalidae) in the Moscow zoo. Data on optimal keeping conditions and terms of larval stages development are represented as well as results of experiments on keeping of cooled imago. This attractive species was found to be perspective for demonstration. The possibility of organizing of all-the-year-round exhibit with *Inachis io* is considered.

TWENTY-YEAR CONTINUOUS CULTURE MAINTENANCE OF THE HOST SEA ANEMONE ENTACMAEA QUADRICOLOR (CNIDARIA, ACTINIARIA) IN MARINE CLOSED SYSTEMS IN MOSCOW (P.P. SHIRSHOV INSTITUTE OF OCEANOLOGY - MOSCOW ZOO).

ASTAKHOV D.A., POPONOV S.Y., POPONOVA V.R..

Data and conditions of twenty years continuous culture maintenance of the general for all anemonefishes host sea anemone *Entacmaea quadricolor* at Moscow are described.

SOME ASPECTS OF PROLONGED MAINTENANCE OF MARINE FISHES IN CAPTIVITY. REPORT 20. GENUS AMPHIPRION. SUBGENUS AMPHIPRION (ACTINOPTERYGII, PERCIFORMES, POMACENTRIDAE, AMPHIPRIONINAE).

ASTAKHOV D.A., POPONOV S.Y., POPONOVA V.R.

Data on distribution and biology of 4 species of anemonefishes of subgenus *Amphiprion*: *Amphiprion (A.) clarkii* (Bennett, 1830), *A. (A.) ephippium* (Bloch, 1790), *A. (A.) frenatus* Brevoort, 1856, *A. (A.) melanopus* Bleeker, 1852 and conditions of prolonged maintenance of these species at Moscow Zoo are described.

SOME ASPECTS OF PROLONGED MAINTENANCE OF MARINE FISHES IN CAPTIVITY. REPORT 21. GENUS AMPHIPRION. SUBGENUS PARAMPHIPRION (ACTINOPTERYGII, PERCIFORMES, POMACENTRIDAE, AMPHIPRIONINAE).

ASTAKHOV D.A., POPONOV S.Y., POPONOVA V.R.

Data on distribution and biology of 2 species of anemonefishes of subgenus *Paramphiprion: Amphiprion (P.) polymnus* (Linnaeus, 1758) and *A.* (*P.*) *sebae* Bleeker, 1853 and conditions of prolonged maintenance of these species at Moscow Zoo are described.

SOME ASPECTS OF PROLONGED MAINTENANCE OF MARINE FISHES IN CAPTIVITY. REPORT 22. GENUS AMPHIPRION. SUBGENUS PHALEREBUS (ACTINOPTERYGII, PERCIFORMES, POMACENTRIDAE, AMPHIPRIONINAE).

ASTAKHOV D.A., POPONOV S.Y., POPONOVA V.R.

Data on distribution and biology of 3 species of anemonefishes of subgenus *Phalerebus*: *Amphiprion (Ph.) nigripes* Regan, 1908, *A. (Ph.) perideraion* Bleeker, 1855, *A. (Ph.) sandaracinos* Allen, 1972 and conditions of prolonged maintenance of these species at Moscow Zoo are described.

SOME ASPECTS OF PROLONGED MAINTENANCE OF MARINE FISHES IN CAPTIVITY. REPORT 23. GENUS AMPHIPRION. SUBGENUS ACTINICOLA (ACTINOPTERYGII, PERCIFORMES, POMACENTRIDAE, AMPHIPRIONINAE).

ASTAKHOV D.A., POPONOV S.Y., POPONOVA V.R.

Data on distribution and biology of 2 species of anemonefishes of subgenus *Actinicola*: *Amphiprion (Ac.) ocellaris* Cuvier, 1830 and *A. (Ac.) percula* (Lacepede, 1802) and conditions of prolonged maintenance of these species at Moscow Zoo are described.

SOME SUCCESSFUL RESULTS IN HUSBANDRY AND BREEDING OF THE RARE AND HARD-TO-KEEP VENOMOUS SNAKES AT THE MOSCOW ZOO (PART YII:2006-2007 YEARS).

KUDRYAVTSEV S.V., GANINA L.V., MAMET S.V.

The article deals with some results of a continuous research aimed at developing methods for husbandry and breeding of rare and difficult species of venomous snakes at Moscow Zoo, conducted especially intensively lately. Details of husbandry and captive reproduction of species with restricted areal, such as: hard-to-keep Kraits *Bungarus fasciatus* (Schneider, 1801) and *Bungarus flaviceps* Reinhardt, 1843, Bushmaster *Lachesis muta* (Linné, 1766) and Striped pitviper *Trimeresurus fasciatus* Boulenger, 1896 are given.

CAPTIVE REARING TECHNIQUE OF ENDANGERED ORIENTAL WHITE STORK (CICONIA BOYCIANA) ADJUSTED ON THE NUMEROUS SPECIES – GREY HERON (ARDEA CINEREA) IN REINTRODUCTION CENTER OF KHINGANSKY STATE NATURE RESERVE.

GAVRIKOVA E.YU., ANDRONOVA R.S.

Experience of captive rearing of Grey Heron and Oriental White Stork in Reintroduction Center of Khingansky reserve is described with particular attention to international experience in Oriental White Stork captive rearing.

BEHAVIOR OF A GROUP OF GIRAFFES (GIRAFFA CAMELOPARDALIS GIRAFFA) IN AN OUTSIDE ENCLOSURE OF MOSCOW ZOO.

ZUBCHANINOVA E.V.

This article continues our study (2004) on adaptation of two young giraffes to adult animals-residents. Observations were conducted in summer, 2005 when the group of giraffes was in outdoor enclosure. Decrease of locomotion and time for rest as well as increase of feeding time was discovered. Feeding preferences in young animals were revealed. Social environment in outdoor enclosure was found to be more favourable for giraffes basing on examination of their interactions. Recommendations for more rational disposal of feeding places were given after study of enclosure employment.

CAN A PLASTIC SALT-LICK TOY BE A FACTOR OF GIRAFFES ENRICHMENT?

ZUBCHANINOVA E.V., MOROZOVA E.YU., DUBROVSKYI V.YU.

A plastic salt-lick toy with smell and flavouring settings was used to decrease stereotype licking of different objects in giraffes in the Moscow zoo. This toy practically didn't effect the intensity of licking in contrast to hay availability. Individual attitude of different animals towards salt-lick and licking of partners' hair was noted.

BEHAVIOR OF SUGAR GLIDERS (PETAURUS BREVICEPS) CAPTIVE POPULATION IN MOSCOW ZOO. 1. BEHAVIORAL PATTERNS.

KONDRATYEVA L.V., ILCHENKO O.G.

Ethogramm of gliders social and individual behavior was composed (78 elements combined in 13 functional groups). Description of social behavioral complexes (peaceful, sexual and agonistic) and individual behavior (calm and during psychological discomfort) was made. To help in recognition of animals conditions, four listed types of behavior element–markers were picked out.

REINTRODUCTION AS A METHOD OF WILD AMPHIBIA CONSERVATION.

SERBINOVA I.A.

The problem of amphibian species diversity conservation is extremely actual to date. Such methods as captive prolonged keeping, crioconservation of gametes and reintroduction of raised captive born offspring to natural habitats can help to solve the problem. Reintroduction of endangered Pelobates syriacus in Georgia started in 2004 and covered natural habitats of the species near to Tbilisi (2004 and 2006) and Gori (2005). At the same time monitoring of hatching ponds of Pelobates syriacus in Georgia was carried out. Now there is a clear informatiom of Pelobates syriacus distribution and density in the most parts of Georgian area. The work to be continued.

BEHAVIOR RESEACH OF BARNACLE GEESE IN CAPTIVITY USING A METHOD OF "INDIVIDUAL DISTANCES".

SYROECHKOVSKI E.V., TARKHANOVA M.A.

About 30 Barnacle geese (Branta leucopsis) are kept at the Moscow Zoo. All the birds are identifiable through individual marking by colour rings. Their behaviour has been observed since 1998 and now we know the life history of every bird.

Barnacle geese are very sociable in all seasons, but during autumn and winter their activity is very low and interactions are few. During these periods all Barnacle geese often stay in a flock consisting of several groups and it's difficult to study their social structure and to determine whether the members of the observed groups are related.

In order to understand the relations of the group members a method of "individual distances" was used. This approach is based on the analysis of the spacial distribution of Barnacle geese in the flock, measuring mean distances between birds and comparison of these distances. The presence of statistically significant difference in mean distances between the birds in the flock would be the evidence of some positive or negative relationship between them. This means that the specimen of Barnacle geese can identify every bird in the flock and while moving each goose prefers to stay closer to some birds and farther from others.

In our analysis we have used a number of parameters including: mean distance, maximum and minimum distances and coefficient of distance variation. We also registered how often birds were found in different groups. The lowest mean distances are between parents and their youngest offspring and partners in pairs.

We found out that family bonds were very strong in Barnacle geese. Parents were tolerant to their older offspring in autumn and winter. Older offspring maintained a greater distance from parents than yearlings and were often on the perimeter of family group. The proportion of time offspring spent with parents declined as they grew older. Barnacle geese remained associated with their parents for a long time – they were observed together at least for 6 years. Adult offspring could occasionally leave and then rejoin their parents but they often stayed not far from them. The persistence and stability of family bonds were maintained mainly by males because sons preferred to stay close to their fathers. When the son found a breeding partner a new couple usually joined his parents. So we can conclude that a large social group of Barnacle geese with more than two adult birds may consist of more than one generation of offspring. Several generations of geese act as a large but loosely associated family.

RESEARCH ACTIVITY OF ZOOS IN THE TERRITORY OF FORMER USSR.

POPOV S.V.

The article discusses scientific activity of the regional zoos (researches, conservation programms, publishing and methodological activities) basing on analysis of 352 publications and questionnaires from 18 zoos.

APPROACHES TO ANIMAL KEEPING IN BUDAPEST ZOO.

VOLODIN I.A., VOLODINA E.V.

Budapest Zoo is among oldest in Europe (founded in 1866) and is situated on a small territory of 11 he. However, it exposes a lot diversity of animals. It is achieved for the account of very reasonable species selection, that allows keeping animals in mixed expositions and providing them large enclosures; for the account of terraced exposition and constant use of warmed pavilions. Principles of exposition design, environment enrichment, approaches to visitor feedback as well as technical decisions to enclosure construction, simplifying work with animals, are described.

PRESERVATION OF GENE POOL OF THE PRZEWALSKI HORSES AT ASKANIA NOVA: BREEDING IN LINES.

ZHARKIKH T.L., YASYNETSKA N.I.

A brief history of preservation and breeding of the Przewalski horse in captivity is given in the article, classification of the population in breeding lines and prospects of their further preservation are discussed.

VIRAL DISEASES OF REPTILES.

VASILIEV D.B., SHVED V.S.

Main forms of reptile diseases caused by retroviruses, reoviruses, paramyxoviruses, flaviviruses, herpesviruses, adenoviruses, iridoviruses, and poxviruses are considered. Matters of systematics of virus agents, clinical signs and pathomorphologic alterations caused by diseases are discussed, as well as current diagnostic methods, differential diagnostics and therapy.

SCIENTIFIC RESEARCHES ON OPTIMIZATION OF MAMMALS' BEHAVIOR IN ZOOS: A REVIEW.

NEPRINTSEVA E.S., VOSHCHANOVA I.P.

Scientific researches which deal with behavioral problems and psychological well-being of captive animals have received advanced development over the last decades and play an important role in providing an adequate animals captive environment for up-to-date zoos. The main approaches to optimization of behavior – environment enrichment, theoretical basis of improvement of animals' psychological state, analysis of causes of pathological behavior and studying of rearing conditions effects on behavior are reviewed here in apply to mammals in captivity. Conclusion resumes strategy of optimization of mammals' behavior in zoos.

HAND-REARING GREAT JERBOAS: OUR FIRST EXPERIENCE.

ILCHENKO O.G., VAKHRUSHEVA G.V., SAPOZHNIKOVA S.R.

Three great jerboas were successfully hand-reared in Moscow zoo in May-June, 2007. The appropriate intervals between feedings and milk formula were developed basing on our previous experience. We suppose the experiment was a success also due to the fact that the female was rearing the litter during first 2-3 weeks by herself. The very fact of nursing the litter by jerboa female in captivity is of great interest and rariry; it could be caused by preliminary homeopathic treatment.

FIRST EUROPEAN CONGRESS ON CONSERVATION BIOLOGY. "DIVERSITY FOR EUROPE". EGER, HUNGARY, 22-26 AUGUST 2006

MAKSUDOV G..

This item is a short description of main events of the Congress. The subject matters of 4 plenary talks, 16 symposiums, 22 sessions, 10 workshops are listed. Author regrets that among 1100 participants were only 7 Russians and only 1 Moscow representative. Many participants exclude Russia from Europe in their reports or know nothing about Russian biological science.

«THE SAVING OF MERIONES DAHLI (SHIDLOVSKI, 1962)» (THE FIRST STEPS OF DAHL'S JIRD CONSERVATION PROJECT).

POPOV S.V., ILTCHENKO O.G.

The first results of Euro-Asian Regional Association of Zoos and Aquaria conservation project are reported. Dahl's Jird is the most endangered rodent species in the territory of the former Soviet Union. According to our inspections in 2005 and 2006 the populations of Dahl's Jird in Armenia have directly disappeared. At the same time Turkish zoologists found out that the population of *Meriones meridianus* in the east of Turkey is actually the population of *M. dahli*. So, our future plans are: to try to get Dahl's Jirds from Turkey, breed them for establishing the stable captive population and then reintroduce the stock of the population into the late habitats in Armenia.

7 Individuell Projekts by Students

CONTENTS

A COMPARATIVE OBSERVATION OF THE INTRA- AND INTERSEXUAL STRUCTURES OF COMMUNICATION AND BEHAVIOUR OF SUBADULT AND MATING-EXPERIENCED MALES OF THE EUROPEAN MINK MUSTELA LUTREOLA (L., 1761) DURING THE PRE-RUT

CHRISTINA NIEBERG, OSNABRÜCK UNIVERSITY

The European Mink Mustela lutreola (L. 1761) is seen as one of the most endangered mammals in the world. During the last fifty years its population density decreased seriously. To protect this species, the department of Ethology at the University of Osnabrück and the association for the conservation of the European Mink "EuroNerz e.V." has been researching the social behaviour of the European Mink since 1997 in combination with a long-term breeding program. Due to the fact that 75% of the males and 25% of the females are unable to produce offspring, conservation breeding raises enormous problems. The reason for this lack of successful breeding lies in hyper-aggressive behaviour at mating attempts. The absence of socialisation of the young as well as being exposed to stress during ontogeny obviously determines an abnormal degree of aggression. On the basis of these problems the keeping methods were changed, so that the pubs were kept together in sibling groups after the separation from the mother (mother-offspringconflict) and additionally during winter time each male mink stayed with one sister. The development of a so called character-test for male minks facilitates the estimation of the reproductive capabilities of the tested males. This test includes several novel objects, with whom the male mink is confronted in a test-area, as olfactory, auditory and visual stimuli. The behaviour of the males towards these objects was recorded and analysed by video recording. To investigate the potential differences in mating behaviour between adult and sTo investigate the potential differences in mating behaviour between adult and subadult males of the European Mink Mustela lutreola (L. 1761) the test was accomplished in the pre-rut. If the sub-adult males are able to react like their adult conspecifics, the important process of socialisation during their juvenile ontogeny might have occurred or has been completed successfully. Otherwise they can be classified as hyper-aggressive individuals. According to the results all tested males have reproductive abilities so that none has to be described as hyper-aggressive. However, two out of eight sub-adult males reacted tetchy during the first mating attempt at rut-time. Hence, it cannot be certainly claimed if the socialisation is completed. The two sub-adult males rather miss the ability to use their aggressive behaviour adequately. KINDERMANN´s data (2004) revealed that hyper-aggressive male European Minks show in contrast to breeding males no impressive behaviour. Finally parallel movements as part

THE EUROPEAN MINK MUSTELA LUTREOLA (L. 1761) – MONOGAMOUS OR POLYGAMOUS?

CHRISTINA NIEBERG (UNIVERITY OF OSNABRÜCK)

The European Mink is seen as one of the most endangered mammals in the world. During the last fifty years its population density decreased seriously. To protect this species, the department of Ethology at the University of Osnabrück has been researching the social behaviour of the European Mink since 1997. Due to several field studies Spanish scientists (PALAZÓN et al. 1998, GARIN et al. 2002) discovered that a male European Mink patrols in two female home ranges. The male´s territory is much larger in size than those of the females and it encompasses them. According to these results the Parent-Family observations of the European Mink Mustela lutreola in outdoor arenas at the University of Osnabrück query the former supposition that the male mink lives solitaire. More information about the mating system is necessary to determine whether the male mink behaves monogamous or polygamous. Our research analyses the social behaviour of the male towards two female minks during their pregnancy until the pups show first activities. The observation showed a social behaviour of the male mink towards the females consisting of 2⁄3 of sociopositive contacts. Communication and play behaviour can be described as the predominant parts of occurred interactions. Scent markings by anal gland secretion increases intensely in approach to the birth of the litter. Regarding the definition of indirect paternal behaviour scent markings aim for protection of the offspring. Extraordinary was the identification of degenerative testes at the prenatal stage. Our results demonstrate a polygynous mating system for the male European Mink combined with social bonds to its female partners. None of these females gains a preference and the paternal behaviour is dispersed equally for both litters. Therefore the assumption of a female-defense polygyny could also be possible.

NUTRITIONAL AND ENERGETIC STUDIES ON CAPTIVE EURASIAN OTTERS (LUTRA LUTRA)

KATRIN RUFF (2007), UNIVERSITY OF HANOVER, GERMANY, PHD DISSERTATION

Concerted efforts have to be made to optimize the husbandry of the captive population of Eurasian otters (*Lutra lutra*), a severely endangered species. There are still problems in the husbandry of this species with low breeding success and nutrition-related diseases (KEYMER 1981). Improper feeding can severely affect health and well-being, hence adequate nutrition is an obligatory prerequisite for successful husbandry (HATT 2000). Up to now, feeding recommendations for *Lutra lutra* are based on experience of different keepers and not on scientific data, except those for energy supply (MELISSEN 2000). Therefore, the aim of this study was to conduct nutritional trials with the species to investigate basal data on nutrition in order to provide information to improve the captive dietary management.

An adequate energy supply is essential for animal husbandry in captivity. We measured a high digestible energy intake (721 kJ/ kg body mass $(BM)^{0.75}$/d) in trials of 2- and 5- year periods with 14 otters in comparison with other carnivores. Seasonal and sex differences occurred with higher intakes in winter than in summer and females with a higher intake than males. For the formulation of suitable diets for captive otters, the knowledge of their digestive efficiency of different diets is important. Therefore, we conducted digestibility trials of 9 otters determining dry matter, energy, crude protein and crude fat apparent digestibility (AD) resulting in low AD coefficients (75-85% for dry matter AD) in comparison to other carnivores. The study was conducted with eight diets, typical for otter husbandry, to facilitate diet calculations for keeping institutions. Prior to the digestibility trials we tested the marker chromium oxide which facilitates AD studies because it does not require that the feces are collected quantitatively. A trend towards underestimation of AD with the marker method was found in comparison to total feces collection.

The low AD coefficients of the otter were also confirmed in a trial evaluating the mink as a model species for which various nutrient recommendations exist from pelt industry. Adopting these recommendations for the otter would be an indirect method to obtain nutrient requirements because studies are difficult to perform with the Eurasian otter due to animal welfare constraints and keeping situation. Trials with otters and mink using the same diet and marker method showed low ADs as well as fast passage rates for both species, otters had even shorter passages and lower ADs than mink. This must be considered by taking the mink as model species for the otter.

A comparison of nutrient contents of in-situ and ex-situ diets used for captive otters showed differences mainly in vitamin A, B_1 and E, zinc, protein and fat between the natural diets of *Lutra lutra* and those fed to captive otters in keeping institutions. This provides another indirect method to obtain hints on the optimal nutrient intake through learning from nature.

The nutrition-related disease urolithiasis based on ammonium urate calculi is a significant problem in captive Eurasian otters which has to be included in nutritional studies to consider dietary influences promoting the disease. To assess the risk factors for otters to form ammonium urate calculi, feeding trials were conducted under varying dietary regimens collecting the urine quantitatively. The high concentration of uric acid and ammonium in the urine, accompanied by a urinary pH of 6.1, are factors which are proposed to promote the formation of ammonium urate calculi in dogs (GIESECKE et al. 1985). The impact of purine intake on the renal uric acid excretion demonstrated a dietary influence. The correlation between purine intake and renal uric acid excretion provides an opportunity to minimize the risk factor of high urate concentration for urate urolithiasis in the captive population through avoiding diets high in purine content.

Additionally, uric acid concentrations were determined in blood samples of otters to assess the risk of gout for the species. The mean plasma uric acid level of our otters was higher than that in dogs, but not reaching critical levels above which uric acid is prone to precipitate.

In conclusion, otter keepers have to consider species specific peculiarities of *Lutra lutra* like the high energy demand and lower digestibility compared to many other species. Further studies into the specific requirements of otters are needed to optimise animal health and welfare and to minimize nutrition-related disease problems like urolithiasis.

THESE PAPERS DEAL WITH THE DEVELOPMENT OF FEEDING ENRICHMENT PROGRAMS FOR COATIS (NASUA NASUA RUFA) AND RACOONS (PROCYON LOTOR) IN THE ZOO BISCHOFSWERDA/GERMANY IN SUMMER 2005.

KRISTINE MEISE

Enriching the environment for animals in a zoo is a good way to improve their living conditions. Varying the feeding conditions is the easiest way to realize this. From the observation of the animals behaviour we considered different enrichment programs whose effectiveness were verified by a comparison between a normal and an enriched feeding situation. The investigation concentrates on different components, for example changing the number of feeding times a day and the way of presenting the nourishment within the enclosure. But not only the context in which the food is presented, also the contents of the food itself can easily be modified. By changing the feeding routine the animals were motivated to show more activity.

The long-term effect of this enrichment programme shall be a permanent balanced social behaviour in the group because of a decrease in aggressiveness and a decreasing effect on stereotypes which often occurs in zoo animals.

ENVIROMENTAL ENRICHMENT – PROCYON LOTOR & NYCTEREUTES PROCYONIDES

CHRISTOPHER MEYER , HELYTHARI@YAHOO.DE, DIPLOMA-THESIS

Introduction:

The general idea of Enviromental Enrichment is to create a suitable enviroment for animals in captivity, and so to prevent abnormal behaviour or stereotypism. From August 2007 to December 2007 (beginn of the hibernation period) I examined several methods of occupation for use with the racoon, *Procyon lotor* and the racoon dog, *Nyctereutes procyonides*.

The examination took place at the „Alte Fasanerie“, Kleinauheim.

Methods:

The studied group consisted of 9 racoons (four females and five males) and 7 racoon dogs (a couple and 5 offsprings) . One male racoon showed a stereotypism, which was not completly manifested yet.

The experiments were designed to create sufficent occupation, suitable for a wildcat. Since it was not possible to deliver other reason for the racoon dogs to explore and roam the cage, all experiments concerning them were concentrated on the theme „food“The curiosity of the racoons allowed experiments not only based on food, but on the introduction of new objects and play, too.

Activities (Exerpt) for racoon dogs:

- Hidden Food stashes
  To give a reason to explore the cage parts of the daily ration of food was hidden or buried at several places thoughout the cage. The racoon dogs had to roam the cage, , fish and dig for his food, primary using their sense of smell. .
- Boxes
  Food was hidden in boxes and only accessable through a single small opening. The racoon dogs had to try and catch the food through these openings.
- Hanging Food
  Several pieces of food were hung at a height of 0,75 to 1.5 metres. The racoon dogs had to try and reach the food by jumping and getting up.

- Thrown food

To at least simulate the excercise of a hunt, food was thrown into several directions one or two pieces at a time. This activity is greatly suited for attracting visitors.

Activities (Exerpt) for racoons:

- Finger food
  To address the dexterity of the racoons was stashed in boxes, with openings for the hands of the racoons. The animals had to take the food by grapping them.
- Swinging food
  Food was put into buckets swinging at a height of 80cm. The animals had to feel for their food while balancing on their hind legs.
- Swimming food
  Since racoons tend to carry their food to sources of water, the food was prepared with several objects of distraction. The animals had to choose the correct objects and give in to their urge to wash it.

Result:

The overall condition of the study animals were greatly improved. During the study the need to allow more racoons to interact with an object arised, after that the interspecic aggression was lowered. The stereotypism of the male racoon did not show again after 5 weeks of work.

Discussion:

The examined activities were suited for the needs of the studied animals, and so the animals participated without hesitance as soon as the activity was ready to be used. Most of them participated even when their hunger was stilled, although it slowed them down.

ENVIROMENTAL ENRICHMENT – FELIS SYLVESTRIS

CHRISTOPHER MEYER , HELYTHARI@YAHOO.DE, STUDENT PROJECT

Introduction:

The general idea of Enviromental Enrichment is to create a suitable enviroment for animals in captivity, and so to prevent abnormal behaviour or stereotypism. From February 2007 to April 2007

I examined several methods of occupation for use with the european wildcat, *Felis sylvestris*.

The examination took place at the „Alte Fasanerie“, Kleinauheim.

Methods:

The study animal was a male wildcat, born in 2005 at „Wildpark Nordhorn“. The animal has been brought to Kleinauheim in dezember 2006. At the beginning of the examination the cat had slight overweight and was easily frightened by visitors or unknown noises. He spend most of his time in his burrow, where he eyed visitors or slept.

The experiments were designed to get the cat get used to his new home, lessen his fear and to create sufficent occupation, suitable for a wildcat. Since it was not possible to deliver other reason to explore and roam the cage, all experiments were concentrated on the theme „food“.

Activities (Exerpt)

- Hidden Food stashes
  To give a reason to explore the cage the daily ration of food was hidden at several places thoughout the cage. The cat had to roam the cage, climb trees, fish and dig for his food.

- Boxes
  Food was hidden in boxes and only accessable through a single small opening. The cat had to try and catch the food through these openings.

- Hanging Food
  Several pieces of food were hung at a height of 1 to 1.5 metres. The cat had to try and reach the food by jumping and climbing.

Result:

The overall condition of the study animal were greatly improved. The weight was normalized, constitution, agility and hunting skills were trained and improved. The cat roamed through all of his territory and was not frightened by visitors any longer. At the beginning of the examination the cat spend only approximately an hour outside its burrow, this time was greatly increased, since the main reason for this, his fear, was lessened.

Discussion:

The examined activities were suited for the needs of a wildcat, and so the cat participated without hesitance as soon as the activity was ready to be used, even when his hunger was stilled.

The cat showed great skill at opening the boxes, later in the exmination he was able to open them by lifting the lid.

ETHOLOGICAL AND ENDOCRINE STUDIES OF RACCOON DOG (NYCTEREUTES PROCYONOIDES) REPRODUCTION

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The aims of the present study were to gain extensive data about raccoon dog reproduction. In the behavioural studies the ethogram, the daily activity pattern and reproduction associated behaviour of raccoon dogs housed in enclosures were the matter of interest. Via analysis of year-round collected faeces samples the testosterone- , progesterone- and estrone- concentrations of male and female raccoon dogs were investigated.

Altogether 22 (9,13) animals were included in these studies, 12 (5,7) raccoon dogs were used for the behavioural studies, 16 (7,9) for the endocrine analysis. The behavioural studies took place in four different zoos in which raccoon dogs were housed in pairs or in small groups of two bitches and one male. Between September 2005 and July 2006 several observation phases, each of them lasted three to five days, were performed.

Faeces samples were collected from September 2005 until July 2006, too; before the analysis they were stored at -20° C. Of each sample the testosterone-, progesterone- and estron- concentration was investigated. Additionally a possibility for gender determination via hormone analysis of faeces samples was searched for.

Raccoon dogs in enclosures show different kinds of locomotion as there are: walking, trotting, galloping and jumping. Adult specimen do not climb vertically, digging is rare. Resting poses are standing, sitting and lying. When they are asleep usually all raccoon dogs of one enclosure lie close together; while they lie awake they might lie solitary although social resting is more common. For defecation these animals use special places which are called “latrines”, all raccoon dogs of one enclosure deposit their faeces at this site. Playing – solitary and social- is not very common; “prey”- and “running”- games can be found. Social games are often introduced by one animal leaping at the other. Two typical sounds can be distinguished: the “contact- call” and the “defending-call”; additional vocalisations are growling, hissing and yelping. Raccoon dogs do not bark. There are social and solitary forms of grooming; social grooming can be observed more often during breeding season. Aggression is very rare in raccoon dogs; there might be aggression between two bitches, who are housed with only one male, during mating season.

During summer raccoon dogs are more active than in winter, when activity may drop to less than one hour per day. In summer they are diurnal as well as nocturnal, in winter raccoon dogs remain nocturnal. Raccoon dogs housed in enclosures show, as a unique behaviour among the Canidae family, a winter lethargy, depending on the weather, as do their wild living conspecifics.

In the observed pairs no copulations could be seen and no pups were found. As all pairs, with one exemption, consisted of siblings, this failure to reproduce might be based on incest inhibition. This thesis should be investigated in further studies.

Through the endocrine analysis the seasonal reproduction of raccoon dogs could be proved. In the males testosterone levels are low between April and September with medium concentrations of 100-200 ng/ g faeces. From October on the levels rise and reach their yearly maximum of 980 ng/g faeces in February. In the bitches progesterone levels rise only once a year above the baseline level of 24-57 ng/g faeces. In April

the concentrations are highest with medium concentrations of 260 ng/g faeces. The estrone levels of bitches do not vary a lot during the seasons, the medium concentrations are between 37-114 ng/g faeces. The ratio of testosterone and estrone, the ratio of testosterone and progesterone and the testosterone concentration itself are useful endocrine parameters to distinguish between male and female raccoon dogs via faeces analysis. The safest parameter is the ratio of testosterone and estrone.

VISITOR INFLUENCES ON THE BEHAVIOUR OF A GROUP OF DHOLES IN SCHWERIN ZOO.

ANIKA RINGWELSKI
Dipl. thesis, Univ. of Braunschweig 2007

The Indian Wild Dog (Cuon alpinus) ist ranked under the predatious animals and belongs to the family of dog species (Canidae) and can be found in South Asia, Central Asia and South Asia. Only a few German zoos are able to present it and the International Union for the Conservation of Nature and National Resources (IUCN) classes the animals as vulnerable.

This study explored the interrelations between Indian Wild Dogs and zoo visitors. A matter of particular interest was to find out the reactions of the animals during increasing visiting numbers. The visitors can be regarded as an environmental enrichment for the zoo inhabitants but can also become a factor of stress in consequence of which the animals do retire and may develop a stereotypical behaviour. This study took place at the Schwerin Zoo and tried to find out if the activity of the dogs and their alertness were rising through increasing numbers of zoo visitors and if the the dogs felt disturbed during their recreation phases due to the onlooker.The effect of the normal day-to-day life in the zoo and the contact with well-known persons and subjects have also been considered. The “inconveniences” are mainly keepers and their carts, visiting domestic dogs, the recorder of this research, unusual noises and other unusual events. Another point of interest was to find out whether visitors do prolong their stay at the enclosure if the activity of the wild dogs increases. To get familiar with the dogs and their activities and habits special occurrences were noted down with the help of the “ad libitum method” during the preparation time. During this time the ethogram containing the relevant behaviour pattern necessary for the research was established.

The “scan method” was used in a 5-minute-interval to sign up the activity rhythm of the animals as well as their reactions and whereabouts in the enclosure when visitors were showing up. Every visitor at the fence and the reactions of the dogs concerning this matter were noted with the “all occurrence method”. Other occurrences, for example the arrival of well-known persons like keepers, the vet, zooinspector and loud, unknown noises like planes or building machines have been noted down with this method, too.

The Indian Wild Dogs showed no change in their behaviour and activities when observed by visitors at the enclosure, nor did they show an increase of their activity when the number of visitors heightened. The animals only reacted when visitors or any other persons left the usual footpath or got over the barricades to approach the enclosure. The dogs reacted with growls and threatening warning signals. The alertness has not been influenced by visitors. The dogs did not increase their alertness when the amount of onlookers was rising. The dogs did not feel disturbed by the visitors even not during their resting time and there was no difference in the amount of resting animals whether there was a great number of onlookers, only a few or even more. Even “lively” visitors who were loud or tried to lure the dogs (especially children) could not bring a change in the amount of resting dogs.

The dogs’ behaviour was only influenced by the appearance of keepers, their carts with which they bring the food to the animals and the showing up of the recorder of this research. These factors had a significant influence on the dogs’ activity. It was an increase of activity noticeable i.e. getting up, pursuing and roaming excitedly. No impressing or threatening behaviour was ever used towards the researcher but she caused an increase in the number of active dogs when showing up.

It proved true that the visitors remain for a longer time at the enclosure when the dogs act more lively. It made a significant difference how many wild dogs were active. The more dogs were active the longer the visitors stay and watch them.

SAVING POSTMORTEM GAMETES TO DEVELOPE ASSISTED REPRODUCTIVE TECHNOLOGIES FOR EXOTIC CATS

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All 37 species of the cat family (Felidae) except the domestic cat are endangered or threatened by extinction due to habitat loss and illegal hunting. Populations of endangered species in the world's zoos can, if appropriately managed, provide a range of conservation support mechanisms for their wild conspecifics. But by far most of the felid populations in zoos still have insufficient founders and/or are too small to maintain at least 90% of wild gene diversity over at least the next 100 years. For many of these, acquisition of further founders from the wild is impossible. Assisted reproductive technologies (ART), comprising in vitro fertilisation (IVF), artificial insemination and embryo transfer, have great potential to improve the capacity of the world's zoos to establish stable zoo populations and support the conservation of endangered species in the wild. Most ART techniques have become routine in economically important animal species such as domestic cattle, but still require adaptation and development for use in most non-domestic taxa. The IZW has established a successful in vitro culturing system for oocytes and a cryopreservation protocol for embryos of domestic cats. Therefore, oocytes are recovered from ovaries, matured in vitro and fertilized with former collected cryopreserved epididymal sperm. Developing embryos are cultured to blastocysts and then cryopreserved for future embryo transfer. Currently, the IZW is seeking to discover if this system is transferable to exotic felids, with the long-term objective of expanding their gene bank to include feline sperm and embryos of diverse species for special breeding and research projects. One endangered cat taxon which might benefit from these techniques in the near future is the Amur leopard which has less than 40 animals in the wild. The relevant conservation breeding programme in the world's zoos is one of those that is managed for maximum conservation support, but it has a small founder base and some genetic lines have shown possibly congenital defects associated with inbreeding. The population would benefit greatly from additional founders, but removal of leopards from the wild is out of the question. However, cryopreserved semen from wild or now-dead captive males could be used to produce embryos with captive females in the future.

BIOLOGY AND ETHOLOGY OF SYBERIAN TIGER (PANTHERA TIGRIS ALTICA) IN THE ZOOLOGICAL GARDEN IN POZNAŃ

MAJA SZYMAŃSKA, ANDRZEJ BERESZYŃSKI, HANNA SITEK, RADOSŁAW RATAJSZCZAK

Syberian tiger (Panthera tigris altica) is threatened by extinction. Population number of this species counts only about 300-400 individuals. Degradation of natural environment, decrease of the number of natural victims and primarily the activity of poaching for the needs of the East-Asiatic market make the struggle for the preservation of this species difficult. Zoological gardens including the Zoological Garden in Poznań take inactive part in the rescue of this species. In Poznań ZOO, optimal existence conditions for tigers have been created and studies on the biology and behaviour of these animals are conducted.

BIOLOGY OF JAPANESE MACAQUE (MACACA FUSCATA FUSCATA) IN BREEDING CONDITIONS OF THE ZOOLOGICAL GARDEN IN POZNAŃ

ANDRZEJ BERESZYŃSKI, KATARZYNA BYCZYK, EWA TRZĘSOWSKA, RADOSŁAW RATAJSZCZAK.

The breeding of Japanese macaque, Macaca fuscata fuscata, in Zoological Garden in Poznań is carried out in expositions conditions similar to natural ones. It creates perfect possibilities to extend the knowledge about the biology and behaviour of this species. Studies of a herd consisting of 12 individuals were carried out in the 2002-2003. They investigated the hierarchy in the herd, mutual communication of the animals, reproduction in the zoological garden and the animal health status. Living conditions created for the animals in Poznań ZOO insure to the macaques perfect physical and psychical health. The arrangement of the exposition imitating natural conditions permits to observe the behaviour of the animals characteristic of this animals in nature.

MIXED-SPECIES KEEPING OF HARBOUR SEALS AND CALIFORNIA SEA LIONS AT NÜRNBERG ZOO – BEHAVIOURAL OBSERVATIONS

JULIA KURZ, BSCTHESIS UNIVERSITY OF HEIDELBERG

Keeping mammals in social societies becomes more and more popular in the modern animal husbandry in zoos. In that case it's important to make sure, that none of the species, that are kept together, gets stressed or feels queasy.

The most famous specie that is kept in aquariums or delfinariums is the Californian Sea lion (Zalophus californius californius), because of its friendly character. They are easy to train and not aggressive against their keepers. Besides the socialization of Sea lions and Bottlenose dolphins (Tursiops truncatus) in the delfinarium of the Zoo Nuremberg, there is another socialization of 9 California Sea lions together with 2 Harbour Seals (Phoca vitulina) since summer 2005 in the Aqua Park. For the visitors this socialization provides the opportunity to discover and learn about the differences between Otariids and Phocidae on their own. Because the animals have been living together for approximately one year, the goal of this paper was to find out, if the animals do have equal social contacts or if every individual prefers identifiable partners for their social contacts. At the same time it should be recorded, if there are social contacts between both species. Another goal was to find out, if Sea Lions and Harbour Seals use the available enclosure evenly.

From the results it could be pointed out, that the observed animals in the Zoo of Nuremberg don't show any lack of social contacts. Except the already 22 years old female Sea lion Nancy, none of the animals show stereotyped behaviours, i.e. that the concept of environment enrichment and the training of the animals provide alternation and activity.

The question about a preference of certain individuals as contact partners could be answered clearly positively, most animals show inclinations to spend their social times preferentially with two or three other Sea lions. In the swimming behaviour for example, four of the females (Ginger, Kris, Hannah und Lisa) showed a remarkable grouping, whereas during the recovery time on land especially one of the females (Ginger) preferred another female (Sally) to spend her time with. Also the siblings Kim and Josie, that were moved from the delfinarium to the Aqua Park, spent remarkable more time together than with the other Sea lions. It is also clearly remarkable, that the bull and the oldest female are included hardly into the social relations of the others. The tolerance in this heterogeneous group can also be evaluated positively, so direct aggressions could not be observed at all and threatening bearing only very rarely.

The behaviour against the female Harbour seals was also neither aggressive nor threatening. Soziopositive contacts were not particularly frequent and intensive, but at least occasionally observed. The two Harbour seals among themselves showed only friendly behaviours, they typically do not always look for proximity of the other one, but moved also frequently alone. Threatening or aggressiveness of them was not observed at all.

Concerning the utilization of the enclosure surface, both species showed obvious differences. While the Sea lions used the left enclosure range (A) during the observation time significantly more, they showed additionally also daily temporal fluctuations. In the mornings, while they were swimming, they used the enclosure range in the middle (B) and the right one (C) more often. After the feeding however, they preferred the left range (A), in which the island is located, where the Sea lions preferred to spend their time on land. The Harbour seals were in contrast to that more frequently in the right (C) and middle (B) enclosure range and swam into the left third (A) only very rarely. Whether and how far this behaviour in the course of the common life of Harbour seals and Sea lions still changes, surely is an interesting aspect of research for following papers.

ENRICHMENT FOR SQUIRREL MONKEYS AT NÜRNBERG ZOO

MICHAELA HOFRICHTER, A LEVEL PROJECT

This work is a study of behaviour about a group of squirrel monkeys in the Zoo of Nürnberg. The monkeys were observed, while are confronted with new appeals. The group consisted of nine female adults and three babys.

Three hypotheses were tested in two experiments.

- The group of monkeys reacts to the new object, a ladder of coconuts` shells with behaviour of curiosity.

- The monkeys eat the food that is in the ladder. They are searching for food again in the next few days.
- The squirrel monkeys go over the bridge to the outside in spite of a rope that was fixed on the bridge.

The experiment took five days with ca five hours per day. In this time a ladder of coconuts` shells was fixed in the enclosure. From day to day the appeals were changed. On one day the shells were filled with food, on another day the ladder was rehanged, but was empty at the same time. Frequencies of behaviours were recorded and both first and second hypothesis were supported.

The second trial took the same time as the first experiment. For this a rope was fixed on the bridge to the outside enclosure. From day to day the colour of rope was changed. So the rope was beige on the first day, then blue on the next, then beige, then orange and beige on the last day again. During the observing behaviour such as jump over the rope showed that. The third hypothesis could be conferned.

VISITOR – INFLUENCE ON BEHAVIOUR OF A GROUP OF WESTERN LOWLAND GORILLAS AT THE NÜRNBERGER TIERGARTEN

ANGELIKA BAUER, A-LEVEL PROJECT

The lowland gorilla group consisting of four animals of the Nürnberger Tiergarten has been observed for eight days to find out if the number of visitors has an influence on the animals.

It was especially considered which place, direction of sight and body postures were chosen by the gorillas in the presence of a small, middle and big group of visitors. For this purpose the gorillas were focussed separately three times a day for a period of twenty minutes. In the first half of the focus it was recorded how often the gorilla averted his eyes, glanced to the visitors and closed his eyes. In addition it was noted how many times his looks weren`t detectable, that means the view to the eyes was obstructed. In the second half of the focus it was timed how long the gorillas stayed in different body postures and what his activities were in each posture. Before each focus the animals` whereabouts and the current number of visitors in front of the enclosure were recorded with the scan sampling method. In the following the established, average results for every group size were compared.

It turned out that the visitors largely have a positive and enriching effect because the gorillas showed a natural behaviour according to a daily routine typical for the species, what might be also a result of their long life in captivity. Furthermore a certain interest of the animals in the visitors could be ascertained. A noticeable negative influence was only shown in the increase of agonistic and self-directed behaviour. But these did neither develop into serious intraspecific or anti-visitor aggressions nor into behavioral anomalies like stereotypes or auto-aggressive behaviour.

These positive results do not only refer to the long life in captivity but also to the good living conditions in the Nürnberger Tiergarten which are essential for a good animal welfare. Therefore enrichment programmes are recommended.

Besides the visitor behaviour is also important. Guided tours, where visitors can feed the animals under supervision, or detailed information boards can spark interest in the animals and furthermore inspire to behave according to the situation in front of the enclosure.

OBSERVATION ON BEHAVIOUR OF A NEWLY FORMED PAIR OF ORANGS AT OSNABRÜCK ZOO

DIPL. THESIS BY EVA MANTEL, UNIVERSITY OF OSNABRUECK

Buschmann, a male orang-utan who is born at the Osnabrueck zoo in 1971 remained lonely for about nine months after his female companion died in September 2006. During that period he showed a conspicuous increase of repetitive regurgitation of food and obviously became less active in general.

Except during the mating season, adult male orang-utans show a solitary way of life in the wild while females and offspring travel together. Nevertheless, these intelligent animals are kept at least in pairs in zoos in order to prevent social isolation and to make social interaction and activity possible instead. As to orang-utans there are authors who are of the opinion that these animals are independent of social life and

able to live contentedly as an isolated individual (Maple, 1980, S. 216). Anyhow, a lack of stimuli within the enclosure and boredom as a negative result are common problems especially in ape-keeping. Due to their manipulative tendency and problem-solving behaviour great apes tend to be mentally and physically not challenged enough so that social contact is a possibility to diversify their environment and their everyday life in captivity.

For that reason the Osnabrueck zoo, in cooperation with the EEP programme, took an interest in finding a new partner for Buschmann and the efforts were a success.

On the 25th of June 2007, Astrid, a 23-year-old female from Antwerp zoo was resettled to Osnabrueck and put together with Buschmann only a few days later. This cosolidation means drastic changes in both animals´ habits and should be correlated with stress to a high degree.

The effects are to be established in a present study by means of ethological observations and endocrine investigations. Behavioural observations focus on the collection of data on social behaviour as well as distance parameters and are carried out by using the methods of scan sampling and continuous recording. The establishment of a relationship between the two orang-utans is of utmost importance. In addition to these observations and in cooperation with the DPZ Goettingen androgen and glucocorticoid concentration is analysed non-invasively from excrements. The collection of faeces of both individuals initiated already before Astrid was taken to Osnabrueck and will be continued allthough the adaptation phase (about 3-4 months). Direct correlations between behaviour and hormone expression might be detected and evaluated this way.

Integration of an unknown individual into an existing group or into an established captive habitat usually involves disturbance, increasing aggressive behaviour and physiological stress caused by changes in social structures and the need of establishing a new hierarchy. During the adaptation phase, most individuals show a high concentration of certain hormones such as glucocorticoids which is connected with behavioural parameters. The most important aspects of the present study are the observation of the development and change of relation and behaviour over time as well as possible differences in concentration levels of stress hormones in both orang-utans.

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GENETIC IMPORTANCE OF ANIMALS IN OUR STUDBOOKS - TURKMENIAN KULAN

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ANNA MĘKARSKA, CRACOW ZOO

The Turkmienian kułan is one of the is one of the swiftest in the ungulates. It is smaller and stouter than domestic horses but much more resistant, it feed by grass and small plants in flat semi-desert plains in Central Asia.

The populations

- Wild: ca. 1 400 individuals mainly in Badkhyz Reserve
- Captivity: ca. 142 individuals w 57 institutions in Europe i West Asia

Status of the population

- IUCN – critical endangered (CR)
- CITES – Appendix II

Material

To do proper management of the population and not to loose to much of genetic diversity, finding Genetically Important Animals (GIA) is necessary. Such animals should have priority in breeding. The main aim of this analyses was to find such individuals within Turkmenian kulan's studbook since the beginning of the EEP (in 1989) until year 2005. The second step of research was to check if those founded individuals passed their genes to next generations.

Method

Animal found as valuable could be living, dead or „Lost to follow up" if only fulfill conditions: 100% pedigree known; F=0,0; individual MK < MK for all population and big probability of gene lost. This

is one of the methods of population analyses but it is not the same as founders determine.

To all analyses SPARKS and Population Management 2000 were used.

Results

- The list of 24 chosen animals.
- Genes of 13 of them are lost irrevocable due to no living decedents (5 of that animals are from the wild, so they could be founders of the population).
- We don't have any information about animals which have status „Lost to follow up" (LTF) (#313, #936, #937, #481, #682), so their genes are lost for population – 2 of them are from wild parents.
- 75% of chosen specimens had been genetic important during all their live or analysed period of time.
- Genetic value of only 6 kulans decreased yearly (#233, #519, #566, #580, #586, #861). The reason of this fact was having sufficient number of offspring or relatives (onlu one of them is from wild parents)

Conclusions

- The population lost genes from animals which were potential founders. This means that a possibility of not to lost too much of gene diversity wasn't used.
- Only 25% of GIA value was used, the rest of the genes are lost.
- Doing such an analyses could be very helpful in population management, it allow to see which individuals should have priority in breeding.

SOCIAL BEHAVIOUR IN A MIXED GROUP OF ELEPHANTS AT AUGSBURG ZOO

A-LEVEL PROJECT BY ALINE GAUB, <LIVE.YOUR.DREAMS@WEB.DE>

The social behavior of a mixed elephant group in the Augsburger Zoo, consisting of two african and two asian cows, was studied. Main conclusions are that only marginal differences of social behavior between the two species could be recognized, although their lines of ancestry split about 6 million years ago. Which means that either there are no significant differences or they learned the behavior of the other species while being together in order to communicate on the same level. The observed mixed elephant group does not act like a harmonic family, but the basic structures of elephant cow groups in nature do exist in this group as well.

THE ACOUSTIC REPERTOIRE OF ASIAN ELEPHANTS (ELEPHAS MAXIMUS) IN CAPTIVITY

DIPLOMA THESIS OF MEIKE ARTELT, FREE UNIVERSITY OF BERLIN (2006)

The present study explores the acoustic repertoire of a group of 11 Asian elephants (Elephas maximus) in captivity.

Until now knowledge on the acoustic repertoire of Asian elephants has been rather poor. Studies concerning the communication of elephants were mostly done on African elephants (Loxodonta africana). Also, vocal classification has usually been related to behavior. Individual differences have hardly been investigated.

The major aim of this study was to improve the knowledge on the acoustic repertoire of Asian elephants. The questions were: (1) how many different call types are there and how do these differ, (2) is there an individual difference in usage or acoustical structure and/or acoustic parameters, and (3) are the calls found context dependent?

Data was collected at the Tierpark Berlin Friedrichsfelde, Germany, during July and October in 2005. The categorization was done visually, by listening, and using acoustic parameters.

In this study 21 call types were found, divided into nine major categories. Three of these have not been described previously. Individually different usage was found in all elephants. One call type found was

only used by one elephant. Individual differences were found in the produced Growls and clues on this also in the Trumpets. Different call types were used at different states of arousal.

AFFECT OF SLEEPING ARRANGEMENTS ON MALE WHITE RHINO BEHAVIOR AND HORMONE LEVELS AT THE TISCH FAMILY ZOOLOGICAL GARDENS IN JERUSALEM (THE JERUSALEM ZOO).

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Keeping all-male groups in zoos often eases the problem of surplus males in captive breeding programs of polygynous species. However, the welfare of the males in these species might be compromised when kept in a social structure that is not always natural. The Jerusalem Zoo holds two male southern white rhinos (Ceratotherium simum simum), in which males are considered solitary. Preliminary observations at the Zoo suggested that the males' sleeping arrangements, in adjacent compartments in the night house, may stress them because they cannot avoid each other's scent or voice, two major components of rhino communication. Hence, we tested the affect of the sleeping arrangements on the males' welfare by allowing each male to sleep outdoors for a period of about three weeks while his exhibit mate sleeps indoors. A similar period, when both males slept indoors, served as a control. We assessed welfare by measuring corticosterone (stress) and testosterone (sex) hormone levels in the feces, and by conducting behavioral observations. The results showed normal and stable corticosterone levels, except for a brief high peak for the dominant male when the two were re-united for the nights. In contrast, testosterone levels varied significantly between manipulations, dropping to non-breeding levels when both males slept indoors. This change corresponded with behavioral changes that suggested that the males were less relaxed. Also, relative changes in corticosterone levels suggest that the males treat the house as the most important part of the territory or even as an independent one.

INVESTIGATION ON THE SOCIAL, REPRODUCTIVE AND PLAYFUL BEHAVIOUR OF CAPTIVE WHITE RHINOCEROSES (CERATOTHERIUM SIMUM COTTONI)

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Social, reproductive and playful behaviour were observed in the group of northern white rhinoceroses (bull SUNI and cows NESÁRÍ, NABIRÉ, NASI, NÁJIN and her daughter FATU) in the Zoological garden Dvůr Králové in the Czech Republic from July to November 2005. A part of results of this observation was presented in the bachelor thesis; the next part of it will be presented in prepared diploma thesis.

In the ZOO Dvůr Králové, the bull SAÚT, which was with the herd of cows in previous seven years, was exchanged for SUNI in June 2005. The reason for this was that although a regular mating between SAÚT and NÁJIN occurred from the year 2001, the cow did not come to pregnancy. Expected results of this exchange have not come, because no mating was noticed. During the observation period, the bull was sexually interested only once in NÁJIN, NESÁRÍ and NASI. Nevertheless, the oestrous cycle was probably activated in five years old FATU (faecal samples for a hormone level evaluation were not regularly collected at that time). In days of sexual interest of the bull in her (6-8 July, 22-25 July, 18 September, 6-7 October), FATU stayed in close proximity of her mother, which threatened the bull.

Behaviour of animals was strongly influenced by accumulation of the animals on a limited area of the enclosure. Social behaviour was registered in both types – cohesive and agonistic. From 17 predetermined types of cohesive behaviour as described by Mikulica (1991), 15 were noted. Between cows in stabile bond (dyads or sometimes also triads), frequent cohesive manifestations and only few agonistic displays can be observed. A close relationship was recorded in pairs of cows NABIRÉ – NASI and NÁJIN – FATU. NESÁRÍ did not form a stabile bond with any cows and she gave only few cohesive manifestations to the other females.

The agonistic behaviour was observed in two types: subdued aggressive behaviour and defensive behaviour – active defence. From 12 predetermined types as described by Kuneš & Bičík (2001-2002), 11 were recorded. Bull SUNI was a common target of agonistic behaviour of cows, but in most instances, he

retreated after a conflict. A retreat of a dominant bull after a conflict with cow(s) or submissive bulls was also described in the wild (Owen-Smith 1973). The most frequent agonistic display of cows towards a bull was defensive behaviour. While this behaviour induced a retreat of the bull, it could be interpreted as a submissive gesture. Behaviour of a bull corresponds to high ranked, dominant animal.

The animals´ activity depends on their age and sex. Young animals were more active than the older ones, females in stabile bond had similar activity budgets and the biggest part of walking from total activity was registered in the bull. During the observation, animals have spent less than 25% of time with feeding; they dedicated the biggest percentage of time to lying (27-56%). Free-range white rhinoceroses of all age/sex classes devote an average of 48.8% of the daytime hours to feeding (Owen-Smith 1973).

A majority of manifestations of playful behaviour was registered in a young female FATU. The most frequent playful behaviour was horn wrestling, usually between a cow and bull, who commonly initiated this behaviour. Play horn wrestling is also ordinary between adolescents or between bull and adolescent. In this case, the stimulation generally comes from an adolescent, but a bull prolongs this (Meister 1997). At the beginning of my observation, in July, a frequent initiation of play horn wrestling with bull SUNI by adolescent female FATU could be recorded. An intensity of play horn wrestling between them was going down during August and at that time, FATU started to use more often a defensive threat towards bull, above all „Snarl" and „Snort". This behaviour could have been related to a start of oestrus in her in days 6-8 July and 22-25 July, when the bull was sexually interested in her.

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SOCIAL RELATIONSHIPS AND BEHAVIOR IN A NEW ASSEMBLY GROUP OF CHIMPANZEES IN OSNABRÜCK ZOO - MONITORING SOCIAL BEHAVIOURAL AND NON-INVASIVE RECORDING OF STRESS LEVELS USING FAECAL GLUCOCORTICOIDS

FRAUKE HOLLAND- OSNABRUCK ZOO, DIPLOMAPROJECT

Since many years chimpanzees Pan troglodytes have been held in Zoos all over the world. Chimpanzees are very social animals and for their well-being it is very important that they have to live in a group with other chimpanzees, with similar structure to the wild.

In this study the social relationships between chimpanzees after changing of the group composition were examined. It was assumed that changing the group composition caused "stress" to chimpanzees, and that an increase in stress is accompanied by an increase in cortisol concentration in faeces of the group-members.

In the end of 2001 the chimpanzee-group of the Osnabrück zoo consisted of five members: one adult male, two subadult males and two adult females. To multiply social interactions two external females were introduced into the pre-existing group. The process of integration was examined in a separate study (D. TERRUHN; 2003). These observation had shown that there was no stabilization in dominance between the group-members during the following half year.

Reason for the permanent "trouble" in the group was supposed to be a subadult male. After his departure the period of observing for this study started in october 2003.

For comparing results of behaviour and endocrine data with a stable social group, the chimpanzees of Krefeld zoo were examined. This Krefeld group stayed together for a long time so we assumed a stable social structure between the group-members, and according to this lower cortisol levels of these chimpanzees were expected.

Material & Methods:

The group in Osnabrück zoo (Tab.1) includes two adult males, four adult females and one juvenile chimpanzees. They were observed from october 2003 until february 2004. After having been housed together for one year. All group-members lived in an enclosure of inside area 59m2 and outside paddock 122 m2.

Table 1: Summary of all group-members in Osnabrück zoo during observation

Name (Code)	Sex	Day of birth	Status of reproduction	Place of birth
Tatu (Tt)	male	13.01.1989	adult	captive born Zoo Osnabrück
Quattro	male	06.05.1992	adult	captive born Zoo Osnabrück
Lady (La)	female	1969 (esitmated)	adult minimum one son; minimum one daughter	wild born
Vanessa (Vn)	female	1984 (estimated)	adult three sons	unknown
Fali (Fa)	female	03.09.1983	adult one daughter	captive born Zoo Basel
Vakanga (Vk)	female	07.02.1995	adult	captive born Zoo Zürich
Tisa (Ti)	female	24.08.2002	juvenile	captive born Zoo Osnabrück
Kume (Ku)	male	04.10.2003	juvenile	captive born Zoo Osnabrück

The comparison group of Krefeld zoo (Tab.2) was observed for a period of ten days (one adult male, four adult females and three subadult males).

Table 2: Summary of all group-members in Krefeld Zoo during observation period

Name (Code)	Sex	Age (in years)	Status of reproduction	Place of birth
Charly (Ch)	male	31	adult	wild born
Marius (Mar)	male	10	subadult	captive born Zoo Krefeld
Limbo (Li)	male	11	subadult	captive born Zoo Krefeld
Manni (Man)	male	7	subadult	captive born Zoo Krefeld
Gombe (Go)	female	31	adult minimum two pups	wild born
Balli (Ba)	female	31	adult minimum one pup	wild born
Lara (La)	female	22	adult three pups	captive born Zoo Krefeld
Menolly (Me)	female	20	adult four pups	captive born Zoo Krefeld

Behavioural data was collected through "focal sampling" (Tab.3), the spatial association between the group-members with the "scan sampling" method.

Table 3: Description of the monitoring behaviours → Ethogram

Behavioral categories	Codes of behavioral
stationary behavior	st

locomotion	lok
feed	fu
allogrooming	gr
social playing	sp
aggression to impress	ia
contact aggression	ka
friendly approximate	faz
active run	fl
avoiding	vm
Pant-grunts	pg
out of sight	nzs

To test for the hormonal response of "stress" samples of faeces were collected in the morning followed by behaviour measurements. The samples were analysed for immunoreactive cortisol by enzymimmunoassay.

Results

Concerning creation a stable hierarchy between group-members

Observing the aggressive behaviour shows that a social hierarchy was established. The sum of aggressive occurrence allows to calculate a dominance-index for each group-member. The calculation based on the method of MICHAEL/ZUMPE (1986).

Table 4 shows that Tatu is the α-male of the group and he dominates all other groupmembers. On the female side of the group Lady, the old resident female, takes the α-Position. The new female Fali stands behind Lady in the hierarchy. Their daughter Vakanga is the rank-lowest animal in the whole group.

Table 4: Summary of the Dominanzindexes and out of it resulting hierarchy between the group-members in the inside area

	Sex	Ordinal position	DI [%]	Ordinal position of adult females	DI [%] only adult females	Ordinal position of adult males	DI [%] only adult males
Tt	male	1	76,95			I	69,0
Qu	male	3	52,90			II	31,0
La	female	2	53,90	I	51,83		
Vn	female	5	24,60	III	33,33		
Fa	female	4	42,10	II	48,16		
Vk	female	6	9,55	IV	0		

Concerning the changes in social behaviours

Comparing to the previous study of D. TERRUHN (Oct.2002) all group members show higher activities in grooming each other, with the exception of Quattro and Tatu. An increase of social playing can be observed by all individuals. However, Tisa was involved almost in these activities, and there is not so much social play among the adult chimpanzees. In comparison to the observations from in 2002 the displaying as well as contact aggression between the members of the group were observed more rarely. But also in the current study, Tatu shows the highest level of aggressive behaviour, in the most cases against Quattro and against the two new females in the group.

Concerning the changes in social relationships between the group-members

It can be observed that there is a very close social relationship between Tisa and her mum Lady, but also the relationship between Tisa and Vanessa is very strong. In comparison to October 2002, the social relationships between Lady and Vanessa, and between Fali and Vakanga are closer. The current study showed that these relationships of the chimpanzees of the pre-existing group both to Fali and to Vakanga are getting closer. Especially the α-male Tatu searches the contact to the new females. So the social relationship between Tatu and Fali are getting closer than in 2002.

Concerning the changes of cortisol levels

With a median value of 1,47µg/g feces (DM) the cortisol levels of all chimpanzees in Osnabrück zoo, except Vakangais values, were higher than in the first observation from October 2002. But the cortisol levels of the compared group in Krefeld zoo, with a median value of 2,138µg/g (DM) also were considerably higher than in Osnabrück.

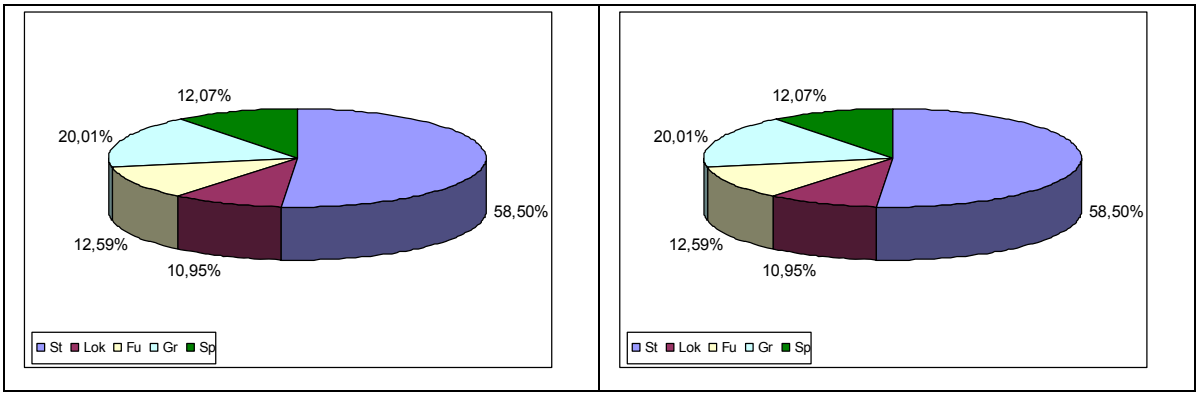
Thus further studies have to show if higher cortisol levels always correlate with unstable social situations.

Conclusions

The observation has shown that a stable social hierarchy was established in the chimpanzees' group. But it would be interesting to observe the changes in female hierarchy, because in the current study Fali showed her interest to take over the female α-position from Lady.

In comparison to observation time in 2002, the current study shows that the positive social behaviour patterns between the animals increased, while the negative social behaviour patterns decreased. This you can also see in changes of the frequency in different behavioral categories (see Ill.1 and Ill.2).

Illustration: Diagram of frequency in different behavioral categories in this study (right), Diagram of frequency in different behavioral categories in 2002 (left)



The structure of social relationship between group-members changed. Although the social situation between all group-members has stabilized, the cortisol levels were not significantly lower than before. The results show no clear correlation between a high cortisol level and an unstable social structure. Further studies are necessary for verifying the high cortisol level as "normal" in the Osnabrück-group.

The introduction of the two new females caused an increase of social interactions in the group. The group had to stabilized and the new individuals had to be integrated in the social structure of the group. The process of establishing is very stressful for a long time. So, if further integrations like these will be planned by the EEP, it should be taken into consideration that it will a long way and that the process may not be end successfully each time.

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8 Conference Anouncements and Reports

8.1 Anouncements

WAFL-2008, the 4th International Workshop on the Assessment of Animal Welfare at Farm and Group Level, Ghent, Belgium from September 10th - 13th 2008.

General topics

- Development, validation and automated measurements of indicators of animal welfare
- Development and improvement of welfare assessment protocols
- Application of welfare assessment protocols

Specific topics

1. Assessing emotional state
2. Improving animal welfare by adapting animals to their environment
3. Assessing health status of groups of animals in relation to welfare
4. Stakeholders' views on animal welfare

For further information. http://www.wafl2008.com,

THE IUCN WORLD CONSERVATION CONGRESS, BARCELONA, 5.-14. 10. 08

More than 8,000 of the world's leading decision makers in sustainable development: from governments, NGOs, business, the UN and academia. Together in one place for 10 days: to debate, share, network, learn, commit, vote and decide. The objective: ideas, action and solutions for a diverse and sustainable world.

Please visit www.iucn.org/congress to see the full information

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The 2nd Australasian Regional Environmental Enrichment Conference 2 November – 5 November, Auckland Zoo, New Zealand.

Check out the website for more details;
www.aucklandzoo.co.nz/reecconference/

Email: mary.bloomfield@aucklandcity.govt.nz

REEC Australasia Committee members; Rohan Cleave and Sheila Roe.

8TH ZOOS AND AQUARIUMS COMMITTING TO CONSERVATION JANUARY 23-26, 2009 HOSTED BY THE HOUSTON ZOO, HOUSTON, TEXAS

Zacc is a bi-annual event that promotes the role of zoos and aquariums in supporting conservation activities worldwide, both at their institutions and in the field.

http://www.houstonzoo.org/zacc/ For more information please contact conservation@houstonzoo.org

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International Marine Conservation Congress (IMCC)

Dates: May 20-24, 2009 Location: George Mason University, Washington DC

Major themes that will be addressed include:

- Global climate change
- The land-sea interface
- Ecosystem-based management
- Poverty and globalization

Please visit the conference website at www.conbio.org/imcc for more information.

International Arctic Fox Conference

14 - 20 February 2009, northern Sweden, in Vålådalen.

There will be a pre-congress tour to the arctic fox captive breeding station in Norway and a post-congress tour to the wild arctic foxes in the Helags area. Preliminary program includes several aspects of arctic fox bilogy: Behaviour, Physiology, Population genetics, Community ecology, Population and demography, Management.

Organizers

A. Angerbjörn, Stockholm University, Stockholm (angerbj@zoologi.su.se)
K. Norén, Stockholm University, Stockholm (karin.noren@zoologi.su.se)
Nina E. Eide, Norwegian Institute for Nature Research, Trondheim (nina.eide@nina.no)
http://www.zoologi.su.se/research/alopex/ ; http://www.nina.no/

INTERNATIONAL MARINE CONSERVATION CONGRESS (20-24 May 2009)

The goal of the IMCC is to put conservation science into practice through public and media outreach and the development concrete products (e.g., policy briefs, blue ribbon position papers) that will be used to drive policy change and implementation. This meeting will encompass the 2nd International Marine Protected Areas Congress (IMPAC1 was held in Geelong, Australia in October 2005). The IMPAC2 component will consist of an organized cross cutting issue within the IMCC addressing MPAs though the full range of posters, papers, workshops and symposia.

Major themes that will be addressed include:

- Global Climate Change,
- the Land-Sea Interface,
- Ecosystem-based Management, and
- Poverty and Globalization

Please go to www.conbio.org/IMCC

FOR FURTHER INFORMATION
Please email IMCCprogram@conbio.org

9th International **C**onference on **E**nvironmental **E**nrichment to be held in Torquay, UK, **31st May to 5th June 2009**.

ICEE meetings are a biannual conference which began in 1993 and since 1995 in association with the Shape of Enrichment Inc. An ICEE meeting has not been held in the UK since the 4th ICEE held in Edinburgh, Scotland in 1999 so it is a great honour to hold an ICEE back on our continent again.

Contact us; Email: ICEE9@paigntonzoo.org.uk

The 10th Mammalogical Congress
Mendoza Argentina 9. – 14. August 2009

This is the first time for the IMC to be held in South America, and Argentina in particular. It is our deep and sincere desire to congregate the greatest diversity of studies and researchers in the field of mammalogy and to provide a forum for a stimulating exchange of ideas and promotion of collaborative and integrative research among members of our world wide scientific community.

mailto:mammal2009@lab.cricyt.edu.ar, Ricardo A Ojeda, Chair IMC-10

8.2 Reports

8th Annual Sahelo-Saharan Interest Group Meeting
May 30 – June 1, 2007, Hannover, Germany

Since 2000 the Sahelo-Saharan Interest Group meeting has been an annual forum for all those working in wildlife conservation within the arid areas of North Africa.

Contact: H.Engel (engel@zoo-hannover.de) and M. Frerking (frerking@zoo-hannover.de

RZS NSW / ABS Symposium
Biology and Conservation of Australasian Bats
12 - 14 April 2007, Sydney, Australia

The Royal Zoological Society of New South Wales and the Australasian Bat Society were hosting a joint 3-day symposium on the Biology and Conservation of Australasian Bats.

For further information: http://abs.ausbats.org.au and http://www.rzsnsw.org.au

ASAB Summer Conference
5-7th September 2007, Newcastle upon Tyne

"Sex, shopping and sharing: insights from animals to humans and back again"

The aim of the conference was to explore how our understanding of animal behaviour has been advanced by the application of methods, theories and data derived from the study of humans, and vice versa.
For further information: www.ncl.ac.uk/psychology/research/evolution/ASAB-conf.htm

1st International Conference on Genus Cervus
14-17.9. 2007, Fiera di Primiero (Trento), Italy

Further information:www.cervus2007.parcopan.org.

Felid Biology and Conservation Conference, WildCRU
17-21 September 2007 Oxford U.K.

All aspects of the study and conservation of members of the Family Felidae (Order Carnivora), focussing on the fundamental biology and practical conservation of the wild felids.

Further information and contact: www.wildcru.org; felid.conference@zoo.ox.ac.uk

21st IGN-Meeting
Animal Suffering and Well-being
September 20-21, 2007, Giessen, Germany

International Symposim on the State of Science', current knowledge on animal suffering and well-being and the potential and limitations of scientific approaches to the assessment of animal suffering and well-being will be presented and discussed.

For further information: http://www.uni-giessen.de/vet-tierschutz/IGN.htm

"Primate Social Systems Reproduction, and Breeding";
24 – 26.10., 2007, (DPZ), Göttingen, Germany

For the discussion of primate keeping and breeding in captivity the mating systems of different primates were one of the key issues.

Further information: German Primate Centre: http:/www.dpz.eu

"Primate Behaviour, Environmental Enrichment, and Ethical Aspects"
October 29 – November 1, 2007 German Primate Centre, Göttineg, Germany

Primate behaviour and environmental enrichment is a main topic for the welfare of captive primates, followed by sessions on the behavioural needs of the different primate species. Another session is dedicated to environmental enrichment which is essential for the quality of life of kept primates.

Contact; Deutsches Primatenzentrum (DPZ), German Primate Centre, http:/www.dpz.eu

17th Biennial Conference on the Biology of Marine Mammals
29 11. - 3.12.2007 Cape Town, South Africa
Sirenia Workshop: 27 November 2007

The survival of all four extant species is considered to be in jeopardy at a global scale. This symposium will present and synthesize current understanding of the research base for developing scientifically robust and socially, economically and politically achievable strategies to conserve dugongs and manatees in their 85+ developing range states and in indigenous communities within all range states.

Contacts: Dr. B. Morales, C.Taylor: benjamin@ecosur-groo.mx; taylor@wildlifetrust.org

20th Annual North American Wolf Conference
April 8-10, 2008 , Montana

Information ranging from ecological and genetic research,nonlethal techniques to reduce livestock conflicts, to economic and environmental effects of wolf restoration.

Contact:
http://www.defenders.org/wolf/conference/
Brenda Davis, Rocky Mountain Region Coordinator, Defenders of Wildlife, at bdavis@defenders.org

1st International Wildlife Reintroduction conference, Applying Science to Conservation, 15.-16.4. 2008, Lincoln Park Zoo, Chicago,

It will be the first international, broad-ranging, open conference to be held on the science of reintroduction.

Informations: www.reintroduction.org.

Shape-Regional and
The Regional Environmental Enrichment Conferences UK and Ireland REEC
20-22nd April 2008 Bristol Zoo

informations (www.reec.info).

Florida Marine Mammal Health Conference
April 22 - 25, 2008, Marineland, Florida

The purpose of this conference is to address issues bearing on the health and well being of the four principal species of wild marine mammals found in Florida waters: manatees, bottlenose dolphins, pygmy sperm whales and Northern right whales, as well as captive marine mammals at theme parks, aquariums, and zoos.

Information and contact:
http://conference.ifas.ufl.edu/marinemammal; Ms. B. Miller-Tipton; bmt@ufl.edu

4th International scientific and practical conference on keeping, feeding and treatment of the wild animals

25 to 26 April 2008, Kyiv Zoo Poland

A collection of materials will have been published.

Contact., P. Cwiertnia Ph.D., Scientific officer, EEP Dalmatian pelican coordinator, Poznan Zoo, Poland, pelecanus@interia.pl, kyivzoo@zoo.net.ua

4th International Tapir Symposium, IUCN/SSC Tapir Specialist Group (TSG)
24.4.-1.5. 2008, Cancún, Mexico

Tapir field research and conservation, population management, re-introductions and translocations, husbandry and captive management, environmental education and outreach, training and capacity-building, involvement of local communities, marketing, fundraising, governmental regulations and permits, veterinary issues, human-tapir conflicts and many others.
Information and contact: Patrícia Medici, E-mail: epmedici@uol.com.br or medici@ipe.org.br
Web IPÊ: www.ipe.org.br, Web IUCN/SSC TSG: www.tapirs.org

Canine Science Forum 2008
5.-9. July 2008 Budapest, Hungary,

This conference aims to bring together all those scientists, researchers, professionals whose work involves canine subjects, from all possible fields.

Information and contact:http://csf2008.elte.hu/, csfc2008@gmail.com, Dr. Ádám Miklósi,

pre-conference workshop prior to the XXII Congress of the Internat. Primat. Society
30th July-3rd August 2008, Edinburgh

This workshop aims to proactively promote the welfare of captive primates by providing employees from habitat country zoos and/or sanctuaries with the knowledge, skills, motivation and management skills to implement behavioural husbandry in their home institutions.

Further information: www.reec.info/ips2008.htm.

Comparative Nutrition Society
Seventh Biennial Symposium
8.-12.8.2008, Nova Scotia, Canada,

Information and contact:http://www.cnsweb.org/,
K. A. Bjorndal,Email: kab@zoology.ufl.edu
K. J. Reich,Email: kreich@zoo.ufl.edu

6th International Conference on Methods and Techniques in Behavioral research,
26 - 29 August 2008. Maastricht, NL

Conference Program: All presentations will deal with innovative methods and techniques in behavioral research. Toics: Measuring Behavior 2008 will include a broad range of topics, covering all aspects of the measurement of how people and animals behave.
Contact. Email: mb2008@noldus.nl, Web: www.noldus.com/mb2008

9 Book Reviews

FUNCTIONAL MORPHOLOGY OF THE CHELONIAN GASTRO-INTESTINAL TRACT

Markus Baur has written a superb vet. med. Dissertation on the functional and comparative morphology of the digestive tract of turtles and tortoises. This has been published in Germany by Chinaira Buchhandelsgesellschaft in Frankfurt/M. (Markus Baur: Untersuchungen zur vergleichenden Morphologie des Gastrointestinaltraktes der Schildkröte, 371 pp., 2003, ISBN 3-930612-93-3). As usual in vet. dissertations the first part contains an extensive literature review, including both of illustrations from the mechanics of the jaw to the details of mesenterial development. Following this, we find the results of autopsies of 96 specimen from 39 genera, mostly terrestrial and limnic, representing all types of feeding adaptations from carnivores to grasers. The appendix contains topographical sketches, measurements and comparisons. These, with anatomical terminology at least should be of help to non-German speaking people as well. Markus Baur is currently a leading authority on husbandry and health of chelonians and this book definitely fills a gap in the literature not only for veterinarians but also anyone interested in foraging ecology and ecomorphology of vertebrates.

THE COMPLETE GUIDE TO THE CARE OF MACROPODS

Is a 437 pp. A4 folder, published in 2006 by Lynda Staker one of the leading experts for hand-rearing macropod orphans in Australia. The volume is available from the author at macropodicmania@optusnet.com.au.

The collection of guidelines stems from over 15 years of hand-rearing experience, however, it covers not only hand-rearing. It also contains chapters on enclosures, diets, handling, even rehabilitation and release of older animals. Growth charts and developmental data, together with important natural history information is given for 24 species and in this chapter alone we find lots of colour pictures, distribution maps and tables.

Having seen several hand-rearing experiences of bettongs in our former colony, I can best comment on the chapter on these. I definitely can confirm that Lynda Staker has described it with precision and reflects our own experience. I specifically liked her comments on the fact that joeys change rests and room-in with each other and that these animals, also as adult females, are quite social, which in fact confirms the results from our studies. I am sure the same attention to detail and precise information is found on the other species. One small disappointment not only from my own career start 30 years ago but also because they, in zoos, quite often throw their pouch-young out is the lack of a chapter on tree-kangoroos.

About 250 pp. is dedicated to veterinary issues, from parasites to skeletal trauma, and how to heal them. Another treasure trough of information not easily accessible even for the specialist on the Northern hemisphere! But perhaps the most live-saving chapter is the first one already, on initial treatment and first aid e.g. concerning dehydration, how to detect and how to treat it (not by orally administering fluid!!). Also very helpful for zoo-keeping is a chapter 'What not to feed macropods' (e.g. cabbage, cauliflower, etc., avocado skin, kiwi skin, cooked meat, celery,..). In short this handbook should be available to any vet, curator, nutritionist and keeper of Australian fauna also in those zoos that out of principles never do hand-rearing.

MARSUPIALS (ED BY P. ARMATI, CHR. DICKMAN AND J. HUME

Cambridge UP, ISBN 9780521650748/ £ 75.-/ US 138.-), on 373 pp attempts to cover that enigmatic taxon that most people, including zoo visitors, unjustifiedly indentify only with kangaroos and koalas. 10 chapters each by one or more leading authorities, cover, among others, evolution, genetics, reproduction, neurobiology, ecology, behaviour and conservation. Only one living author (and two eminent, but deceased ones, ie. J. Eisenberg and J. Kirsch) are from the Americas. Nevertheless, American taxa are always included in the reviews. The geographical bias thus probably more reflects the fact that Australians are actively doing research on marsupials. Some chapters (eg. genetics, or neurobiology) include explanations of general principles (eg. “how to map a gene”, cells of the nervous system) before going on to specific marsupials aspects, others directly jump in – both attitudes have their advantages, the former perhaps having merits if you are already a few decades away from university. In the appendices we find complete taxonomic lists including Red List status (unfortunately since 1996 no new assesments or

Action Plan has been written, and 34 pp of literature). The book as a whole can be highly recommended both to curators and educators, and is indeed, as intended by the editors, a worthy successor to Tyndale- Biscoes "Life of Marsupials" from 1973.

FEEDING FROM A NEW PERSPECTIVE

J. M. Starck and T. Wang edited a volume on "**Physiological and Ecological Adaptions to Feeding in Vertebrates"** (Science Publ., Enfield NH., 2005, ISBN 1-57808-246-3, appr. 65 U$, 425 pp.).

This volume, with 15 chapters intends to be a review and a synopsis of ecological and functional morphology of the gastro-intestinal tract. As such, it heavily relies on chemical aspects (from digestion to immunology) as well as biomechanics and in many chapters we also find specific mentioning (or even a whole chapter dedicated to) seasonal changes, fasting or ectothermous taxa, all aspects not usually found in the agricultural/veterinary tradition of classical nutrition science. Thus, this is a volume that is of specific interest also to curators of 'lower vertebrates', with even chapters on fish larvae, but also for anyone designing an educational activity on food-webs, hibernation, evolutionary biology and of course nutritionists looking beyond the calculation of calories and IUs.

GIANT PANDA

Ed by D. Lindburg & K. Baragona (Univ of California Press, Berkeley etc. 2004, U$ 41.95, 308 pp.). This book tries to integrate Giant Panda biology and life history into a broader picture of ursid biology and conservation in Asia.

Particularly interesting in the mixture of regular chapters, brief reports on specific research projects, and reports on panel discussions – though as a whole the book is not a conference report but a well-structured, multi authored monography. Topics in the sections range from phylogeny and palaeontology to modelling of habitat changes and several chapters, e.g. on nutrition, reproduction or biomedics, are clearly of relevance for husbandry and captive management. Even for these that are not intending to keep this charismatic species, because of the general ursid as well as Red panda comparisons the book can be recommended when planning information- and education-related activities. Of particular value for all readers certainly is the great number of contributions from Chinese authors, some even submitted in Chinese and translated, which gives us Giant Panda

INVASION ECOLOGY

by J. L. Lockwood, M. F. Hoopes, M. P. Marchetti, Blackwell Oxford 2007, £ 32.99 is of interest for more than one reason. Invasive aliens are the third – most important reason for species becoming endangered the spread of animals into an ecosystem can be a model for the population dynamics of successful re-introductions and it also demonstrates the importance of preventing the escape of organisms from our collections.

Each chapter starts with an overview and ends with two short reading lists, one called 'further complexities' which provides for in-depth coverage to the topic, and 'companion papers' that somehow provides additional information. Boxes with case studies or general principles are included in most chapters, and can provide detailed mechanisms for understanding the dynamics of the invasion process. The comprehensive literature list is about 30 pp., and an index helps to locate reference to specific organisms as well as general principles.

SOUTH AMERICAN CAMELID RESEARCH

A volume ed by Martina Gerben and Carlo Renieri bpubl. By Wageningen Acad. Publishers (2006, € 60, 308 pp.), contains the proceedings of the 4th European Symposium on Sustainable development of Camelid products and services in the Andean region. However, the chapters are not only agricultural in orientation. Several sections on breeding, reproduction including assisted reproduction techniques, genetics and nutrition, comparisons between wild and domesticated camelids, diseases, and immunology make this very interesting to curators and veterinarians. Lamas and alpacas are also becoming increasing by important for animals-based human psycho – and physiotherapy, which in many zoos already forms part of their regular services. Thus, getting to know these animals better is highly desirable. Chapters on growth and body dimensions, parasites, milk composition, and herd management can help directly to improve breeding and husbandry. The parts on livestock keeping and wool production again can be used for educational purposes.

RED DEER IN GERMAN

Red deer in many European countries are both a game species and a rare animal. Thus, there is both a wealth of literature on forestry and hunting aspects and of behavioural ecology data. The problem as in many related cases is the lack of syntheses from both areas. In Germany due to a special traditional hunting system, Red deer are

over-abundant in certain isolated areas, forbidden as almost a pest in others, and scientifically based meta-population management is currently not possible. Two volumes on Red deer in German address these issues, including population genetics, micro taxonomy, behaviour, reaction to disturbance and other aspects of interest for zoo keeping. They are available from Deutsche Wildtierstiftung (info@dewist.de, Fx +40-7330278) (der Rothirsch – ein Fall für die Rote Liste, 2002; Ein Leitbild für den Umgang mit dem Rothirsch in Deutschland, 2004; at about € 25 each). For the zoo and population manager Vol 1 seems to contain more interesting contributions because it covers basic biology, ecology and case studies. Vol 2, however, can help to explain how, even in first-world countries, conflicts over wildlife occur and thus help to understand the much more problematic relationship between wildlife and other forms of landuse in poor countries. Thus, Vol 2 can be used well in educational activities.

THE BEAVER

(D. Müller-Schwarze & L. Sun, Cornstock Publ. Cornell UP, Ithaca 2003, 190 pp., U$ 35)

'Natural History of a Wetlands Engineer' is the subtitle of this as the authors rightly state in their foreword, only up-to-date compilation of results on both species of beaver. Even though a slightly emphasis on the North American beaver is admitted, the literature from Europe, even the non-English language one is well integrated. The book roughly follows the direction from individual to family, population and ecosystem with individual including information on taxonomy, evolution, physiology (specifically in winter and diving) and morphology. Parts of the emphasis on the positive role of beavers in ecosystems can be understood from the experience of North America, where beavers are in much more frequent conflict with other forms of land-use. But these parts especially are important for designing educational activities and visitor information. Thus, the book contains a wealth of information complete with references and original data, and is an important contribution.

BOOK REVIEWS: RESEARCH REPORTS AND ACTIVITIES FROM POLAND

Foundation Uroczyslo

This is a foundation targeting research and conservation in the Knyszyn Primeval Forest in NE Poland. Each year a symposium is held, and the last two 2005/2006 were concerned with charismatic species of large herbivores: The European bison 2005 and the Moose 2006. Reports from both with extended English and Russian summaries, lots of pictures (part of them historical photos e.g. about moose as riding animals) and Polish articles.

Both can be ordered via uroczyslo@uroczyslo.pl or Agencya Eco-Partners, ul. Pilsndskiego 58, 16-030 Suprast, Poland

Animals, Zoos & Conservation

The Proceedings of the 2006 Zoo Research Conference in Poznan which meanwhile has been officially adopted as an EAZA Research Conference by the Research Committee have been published by Poznan Zoo. On 216 pp, a total of 33 chapters have been compiled ranging from the programmatic (e.g. G. McGregor Reid on Developing the Research Potential of Zoos, R Perron on the Importance of Outreach activities) to the specific (e.g. lingual papillae in Egyptian fruit bats, breeding of Sugar gliders in Moscow Zoo) from insitu and conservation of rare species (duikers in Kenya) to Zoo and captive breeds (Sumatran rhino, fennec, European bison), from morphology to behaviour. 20 chapters are on mammals 2 on birds, the rest are topical, not taxonomically based, 3 are on genetics, 8 on morphology, 3 on ecology and conservation, 7 on husbandry breeding and zoo management, 6 on behaviour. The value of the book lies in its ability as does the Poznan Conference, to bring researchers from East and Eastern Central Europe into the fold of EAZA's research activities and of giving junior researchers a platform to present their results. Particularly encouraging as a 'shining example' are the many morphological papers giving dead animals a second life for further scientific studies instead of discarding the carcasses after post mortem examination. The book contains many graphics, tables and other original data and it is hoped that it will land in every Zoo library (to be ordered from Poznan Zoo).

White storks in Poland

Poland is the most important range country for the European White stork, with about 20% of European breeding pairs (~52500 in 2006). Thus, it is everything but a rare species there nevertheless it has been the focus of very diverse research, conservation and education efforts. The results are of great importance to other countries because they at least partly explain reasons for decline elsewhere and thus might help to develop effective conservation projects. Also, they supply good and important background information for educational activities in zoos and outreach programmes. A book on 'The White Stork in Poland', ed. by P. Tryjanowski, T. Sparks & L. Jerzak, has been published by Bogŭcki

Wydawnictwo Naukowe in Poznan, Poland (to be ordered from bogucki@bogucki.com.pl or Fax +48-61-8331468). On 492 pp, the volume is a compilation of nearly all aspects of white stork natural history and conservation. The chapters discuss population trends, reproduction, nutrition (also in zoos), education, but also haematology, toxicology, effects of climate and numerous other aspects and it might well be blueprint for other similar volumes on other species from other countries.

It also demonstrates the importance of studies on 'common' animals for conservation biology, both as models and because todays abundant animal in one country might well be tomorrow's (or even today's!) rare species in another. And many field and zoo conservation projects suffer from detailed knowledge because nobody bothered to study the species enough for statistically meaningful sample views (which does not mean that statistically meaningful data cannot be gathered from rare species!). Thus, the book should be a help not only to educaters and curators of parks with European wetland species but for anyone interested in bird conservation and ecology.

INTERNATIONAL ZOO YEARBOOKS- TWO VERY IMPORTANT VOLUMES HAVE BEEN PUBLISHED SINCE THE LAST ISSUE OF OUR NEWSLETTER:

Vol 41, 2007,

is dedicated Animal Health and Conservation in its special section. On 461 pp, we find the usual collection of very important papers, both reviews and single project papers. In the special section, 10 chapters cover both individual, mostly emerging diseases of importance to the conservation and Zoo community (eg Avian Influenza, West Nile Virus, or Chytromycidosis), chapters providing overviews as veterinary work in conservation (reintroduction management…). All the chapters have a strong emphasis on tools and methodologies for diagnostics and treatment and are written by leading researchers.

Section 2,

the Developing Zoo World, 11 chapters, with 2 on invertebrate breeding, 4 on primates, and two on visitor studies, among others, takes us on a tour through several continents. Socioaltural and –economic studies are becoming increasingly important for zoos, and thus it is very encouraging to find two such contributions here. Bringing up the rear is the usual list of references to zoos and Aquaran of the wordl, studbooks etc. (111 £, published by Blackwell, Oxford).

Vol 42,

to be expected in the Year of the Frog, has its special section dedicated to Amphibia. 170 of a total of 467 pp are reserved for this taxon, 19 chapters in all. 4 of there are more political-PR oriented, 3 cover disease and water management, 7 focus on individual species, and 5 are regionally oriented. Even the use of the Axolotl as a flagship species is exemplified. The emphasis in general is heavy on species/ ecosystems of the New World (6 chapters), and three are on Estern Asia. Only two chapters are directed towards Africa, both overviews. It is to be feared that, once we know more about this continent´s amphibian fauna, the situation will indeed become even more depressing. A minor fault perhaps is that no European or North American species/ ecosystems are targetted. There are many parks dedicated to local fauna in both continents, and these should not be left behind. For Europe, WAZA and a whole group of organizations attempt to fill this gap with publishing a whole bunch of important documents to be found on the WAZA-website.

The Developing Zoo World get 6 chapters, from Komodo dragons to orangs, but also overviews on dental problems, effects of construction noise and again a visitor study (from India). The usual reference section again completes this book (£ 119.-, published by Blackwell).