

Presenter abstracts

Living Links to Human Evolution: The first year of a University Research Centre in a major Zoo

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The Living Links to Human Evolution Research Centre is an exciting new venture between the Royal Zoological Society of Scotland and the Scottish Primate Research Group. The principal function of the Centre, which houses mixed-species groups of capuchin monkeys (*Cebus apella*) and squirrel monkeys (*Saimiri sciureus*), is to facilitate world-class scientific research on our living relatives and what this can tell us about our nature and origins. Situated within Edinburgh Zoo, the Centre capitalises on the expertise of zoo staff to care for the primates, and the number of visitors that the zoo attracts to engage the public in the science conducted by researchers in this purpose-built facility. In this presentation I shall briefly describe the Centre, which not only has large naturalistic indoor-outdoor enclosures, but also research cubicles for individual testing, and argue that it will change the type of research that can be conducted within a zoo. The welfare of the monkeys living in the Centre is fundamental to the philosophy behind high-quality zoos, and also to good public engagement, valid and reliable results of research conducted, and it facilitates care staff in their daily routines. I shall present data evaluating the welfare of the monkeys in the Centre, in response to their enclosure, the mixing of the two species and how they respond to the visitors, and public talks. I conclude that the Living Links Centre showcases the possibilities for pure and applied research within a zoo setting and that such collaboration between zoos and universities is a partnership that others should consider following.

An ethological study of the captive timber wolf family (*Canis lupus*) at Colchester zoo.

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The keystone timber wolf species (*Canis lupus*) ranges throughout many terrains across the northern hemisphere where it maintains the health and balance of its surrounding ecosystem. An ethological study was undertaken on 12 captive timber wolves at Colchester zoo to understand their daily routine, differences between individuals and discover the hierarchy within the pack. Behavioural observations were recorded onto the time budget analysis sheets every 3rd minute for all 12 wolves throughout the day between 8:00 am and 16:00 pm with the assistance of the pre-prepared ethogram. Raw data values were converted into percentage occurrence where normality tests were performed in SPSS, the data was non-parametric therefore mann-whitney U and Kruskal-walis tests were carried out. There were differences in the daily routine where the wolves were largely inactive throughout the morning, becoming more active in the afternoon before, during and after feeding time illustrating an adapted response to the keepers' daily routine. Differences were observed between each individual that had noticeable comparisons between the parents, the first generation and the second generation of wolves. Wolf 1 and 2 differed between preferred sleeping areas for example wolf 2 preferred occupying the platform top (PT) where it had a significant value of $P=0.004$ compared to standing activity (S) preferred by wolf 1 with a significant value of $P=0.004$. The wolves 7-12 spent most of their time in the den (D) with $P=0.063$ for wolves 3-7 and $P=0.001$ for wolves 8-12 significance values showing that there was a difference between the two litters. In comparison wolves 3-6 were observed to be the most active, more so, than the parents and some of the second generation of cubs. The cubs 8-12 were inactive for a majority of the day where they would sleep for long periods at a time with a significant value of $P=0.030$ demonstrating individuality and personalised traits between individuals and different age groups. Agonistic interactions displayed by the wolves were used to classify them into a hierarchy ranking where wolf 1 directed aggression 20 times and wolf 2 directed aggression 14 times showing they were the most aggressive whilst receiving very little in return thus illustrating their dominance and alpha status. In comparison wolf 4 received aggression 16 times and directed very little to others therefore this wolf was thus allocated the omega status. The 12 captive wolves' did not demonstrate any abnormal behaviour throughout the period of the study and appeared rather content within their social family unit where they exhibited a lot of natural behaviours observed by wolves' in the wild with the exception of the cleaning and feeding cues due to the keepers daily routine.

Keywords: *Canis lupus*, Keystone species, Ethology, Hierarchy, Time Budget Analysis sheets, Non-parametric, Agonistic interactions

Do Tigers Like Friends? Qualitative & Quantitative Assessment of Captive Tiger Welfare

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Tigers (*Panthera tigris*) are usually regarded as being solitary but they may not be as solitary as previously thought. In captivity, tigers can be housed in a variety of group situations and there is debate surrounding the issue of social housing being enriching. Collections often take the stance that tigers should be housed individually, as they are known to be solitary in the wild. This investigation was carried out to determine the effect of housing (individual, pair or group) on tiger welfare. Urinary cortisol analysis and behavioural observations were conducted on 15 animals across three methods of housing in four collections across the UK and Republic of Ireland.

The specific behavioural categories investigated were pacing, active and resting as these showed the highest level of variation between the sample groups. Casual observation showed that individually-housed tigers paced for double the amount of time (26.4%) compared to socially-housed tigers (12.3%), with the group-housed tigers showing no occurrence of pacing. However no significant difference was found due to the large variation in behaviour between the tigers. Collectively, the tigers housed socially showed more occurrences of both active and resting behaviours than the individually-housed tigers. Pair-housed tigers performed active behaviours for significantly more time than the group-housed tigers ($P < 0.001$) whilst the group-housed tigers spent significantly more time resting than the pair-housed tigers ($P < 0.001$). Cortisol concentration for each type of housing was generally lower for the socially-housed tigers although this difference was minimal and not significant ($P > 0.05$). The results suggest that housing tigers with conspecifics may improve welfare as it promotes the occurrence of more desirable behaviours and reduced occurrence of stereotypic behaviour. It is recommended that further study be undertaken to expand on the overall results, specifically inaccuracy in the urine collection method caused cortisol results to be inconclusive. Should cortisol testing be used in further study, faecal analysis could be used instead of urine analysis as this can be a more appropriate measurement for captive big cats. It was considered, however, that the results showed little variation as cortisol analysis may not be applicable to this type of investigation as it is primarily used for measuring short-term stressors.

What do the BIAZA inventories say about our commitment to conservation?

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Flamingo Land

There are several ways in which the conservation input of zoos can be measured, including the amount of funds raised to support in-situ projects, education input, research to benefit the conservation of species and their involvement in conservation breeding programmes. Keeping and breeding threatened species appears in the mission statements of many zoos as a main contribution to conservation. It is often not clear what proportion of the species we keep are actually classed as threatened. Recent interest from other bodies has highlighted the need to be aware of the situation regarding how many threatened species are kept and managed in BIAZA collections, and whether simply keeping these species represents conservation. This presentation includes the results of a review of the 2006 BIAZA annual inventories. These figures show that only 15.3% of all taxa held by BIAZA members in 2006 were classed as threatened and approximately the same amount (15%) were part of a managed European program (EEP or ESB). In 2006 approximately 23% of mammal species held in BIAZA zoos were classed as threatened and 31.6% managed at the European regional level. The comparatively low numbers of both threatened and managed species within BIAZA zoos indicates that a large amount of cage space is being used by non programme species, and this situation may need to be addressed if regional collection plans are to succeed and BIAZA members meet their own conservation goals. Also, the time may be approaching to review the role of our animal collections and place greater emphasis on other ways in which our collections benefit conservation, such as raising awareness, generating funds to support in-situ efforts, etc.

**‘The identification of current husbandry methods within the Eastern Bongo EEP
with a view to producing husbandry recommendations’**

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The aim of this study was to identify current husbandry practices within institutions that participate within the Eastern bongo EEP. The focus of this study was Eastern bongo because it is an extremely rare forest antelope: wild populations have plummeted and population estimates are inferential with less than 100 believed to remain within four fragmented populations. It was felt that captive populations could offer a genetic reserve for the future management of this critically endangered antelope, and as such, it is essential that this species is managed appropriately in captivity. Ultimately, it would benefit from a husbandry manual collating current and best practice. The aim of the research was not to set specific inflexible or ridged management techniques, but to provide a reference source whereby generic management practices, based on current management techniques and the natural ecology of this species, could be established.

A husbandry questionnaire was sent to 49 institutions within Europe. Only 14 institutions responded and based upon this information an evaluation of husbandry techniques including enclosure design, social management, nutrition and parturition management was conducted. It was immediately evident that bongo management within the EEP was extremely varied. Social groupings generally reflected wild conditions with herds of 4-6 individuals managed, although larger herds of 7-10 were also successful. Although still relatively in its infancy, bachelor herds appeared to be successful and bongo had been mixed successfully with a variety of taxa including birds, ungulates and primates. Many institutions managed this species communally, although many still separated individuals during parturition, which was felt not to be representative of conditions in the wild. Splayed legs were a common problem noted in calves and had been linked to inappropriate enclosure substrate. It was evident that a juxtaposition of deep substrates, including straw and sand which enable better traction, was critical. Nutrition was found to be an area that requires considerable attention since feeding practices varied immensely. Bongo are classified by many authors as browsers and thus, this should be reflected in the captive diet. Generally, diets offered by institutions consisted of forage (lucerne or hay), commercial pellets and fruit and vegetables. However, no standard diet was evident and many institutions offered diets that were not wholly appropriate consisting of bread, lettuce and high amounts of fruit.

A Survey of Eastern Bongo (*Tragelaphus eurycerus isaaci*) Feeding Practices in UK Zoological Collections.

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The Eastern bongo (*Tragelaphus eurycerus isaaci*) is a rare antelope restricted to the Afromontane forests of central Kenya. Its wild feeding strategy is unusual, poorly understood and few captive feeding recommendations are currently available to zoos. Adequate nutritional husbandry is vital to the success of captive animal populations. However, most zoo animal diets have been developed through trial and error as data regarding their wild diet selection and nutrient intake is often scarce (Bond, 2001). The captive Eastern bongo is fed predominantly upon a diet of forage (hay) and browse (trees) (Ganslosser & Brunner, 1997), but no published studies have investigated the diet variability between different zoos. Thus the aims of this research were; (1) to investigate the use and nutritional quality of forage and browse as components in bongo diets across a range of UK zoos, (2) to provide useful data on bongo diets for improving captive nutritional husbandry and (3) to highlight areas requiring further research

A diet questionnaire was used to document the complete bongo diet in 8 UK zoos and was completed by the personnel responsible for their nutritional husbandry. Each bongo was then scored for body condition (BCS) using a standard scoring system and herd scores were calculated. Forage and browse samples were collected. Using keeper experience and questionnaire data it was possible to obtain samples representative of bongo feeding selectivity. The samples were then analysed for crude protein, modified acid digest fibre, lignin, organic matter and *in vitro* digestibility. Browse samples were also subjected to total extractable polyphenolic analysis. Student's T-tests, one-way ANOVAs and Tukey tests were utilised for statistical analyses.

This research provides data (Wright *et al.*, in prep.) which may be useful in establishing bongo feeding guidelines. No direct correlations were made between the dietary components analysed and BCS, as a full diet analysis (including concentrate feeds, produce and supplements) was not possible. However some recommendations can be made. Browse provision and species variety should be increased. Regular forage quality analysis should be undertaken where this is not already commonplace. Lucerne (*Medicago sativa*) may be more suitable as bongo forage than meadow hay. The results suggest that feeding produce (fruit and vegetables) is unnecessary. There is a strong requirement for further study of wild bongo nutritional ecology and captive husbandry. Specifically, research into the fermentation characteristics of the bongo rumen, digesta retention and passage rate, dietary energy requirements and wild diet nutrient characteristics is necessary. This will aid in the formulation of an improved captive diet that corresponds more effectively to the digestive capabilities and nutritional requirements of the Eastern bongo.

References

- Bond A. (2001). Practical problems with data collection for nutritional analysis: a study of animal diets at Bristol Zoo Gardens. *EAZA News (2001) Zoo Nutrition Special Issue 2*: 20-22
- Ganslosser U. & Brunner C. (1997). Influence of Food Distribution on Behaviour in captive Bongos, *Taurotragus eurycerus*: An Experimental Investigation. *Zoo Biology* **16**: 237-245.

A Multi-Zoo study of the babirusa (*Babyrousa celebensis*)

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As part of a PhD study, a multi-zoo approach was used to investigate normal steroid changes in the female babirusa during estrous cycling and pregnancy. Non-invasive faecal steroid analysis was used to study eleven females from Surabaya Zoo in Indonesia, 1 each from Chester Zoo and Southlakes Wild Animal Park, and one non-reproductive female from Edinburgh Zoo. It also incorporated raw data collected from four females in the St Louis and Los Angeles Zoos in North America. The study resulted in estimates of reproductive maturity and senescence in the female babirusa, as well as identifying the typical changes in progesterone seen during estrous cycling and pregnancy. These are important parameters to consider in planning conservation breeding of the species, and to inform the potential use of artificial reproductive techniques (ARTs) in the future.

The obvious benefit of using a multi-zoo approach is to increase subject numbers, thus allowing increased reliability of combined data, and also to allow comparisons to be made, e.g. in different geographical regions or under different husbandry regimes. The difficulties mainly arise from getting access to the zoo community, and knowing who to contact, and also in the standardising of procedures between institutions for sample collection and storage, and the recording of additional data such as behavioural observations.

Formal Learning in Informal Settings

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Blackpool zoo

Presently, the educational role in zoos is placed at the forefront of most collections mission statements and business agendas. An estimated 800,000 individuals attend UK zoos and aquariums on an education visit each year, with around half of these have some form of formal tuition.

This presentation looks at the different values placed on education within zoos, current methods of learning, teaching and assessment, and future research questions.

Public perceptions of zoos: conservation or entertainment

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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.

Psittacine Beak and Feather Disease (PBFD): a review of the disease in captive Rainbow Lorikeets (*Trichoglossus haematodus moluccanus*) at Edinburgh Zoo

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Psittacine beak and feather disease (PBFD) is caused by a circovirus and has been reported in more than 35 psittacine species, in both wild and captive populations. Clinical signs of the disease depend on the time of infection, but commonly include feather and beak abnormalities. The most accurate form of diagnosis is through PCR (polymerase chain reaction) testing of blood samples. A variant of PBFD has been identified as being almost exclusively associated with lorries and lorikeets. This variant is termed PBFD-virus 2, or Psittacine circovirus 2 (PsCV-2).

A review of the occurrence of PBFD in rainbow lorikeets (*Trichoglossus haematodus moluccanus*) was conducted. The study identified that between 2005 and 2008 112 rainbow lorikeets were introduced into the collection at Edinburgh Zoo. Of these 66 tested negative, and remained negative for the presence of PBFD. 21 birds tested positive for PBFD, and 3 birds initially tested negative for the disease but after contact with positive birds later became PBFD positive. The PBFD status of 22 birds was unidentified due to death prior to sample collection.

The study identified that the veterinary protocol was to euthanase PBFD positive birds, however when birds began testing positive, but showing no clinical signs, and having had no contact with positive birds this protocol was revised. Two of these PBFD positive birds were isolated and re-sampled a further three times over 6 months. Tests identified that the birds had PBFD variant-2 and that antibodies were also present. After 6 months of isolation and at a year of age the two isolated birds tested negative for PBFD.

The management of birds arriving from the second half of 2007 onwards changed as a result of the death of 22 birds. Birds were quarantined in smaller groups. A procedure of having all birds tested prior to export to Edinburgh Zoo was implemented in addition to the testing upon arrival at the zoo. This protocol resulted in no further addition of PBFD positive birds into the collection from outside sources.

The study identified that all birds that tested PBFD positive, and all birds that died prior to testing were under 18 months of age, supporting the theory that PBFD is a disease that younger birds are more vulnerable to contracting. There were no findings to support gender selection preference of the disease, with an equal number of positive male and female birds.

The 10 things we now know about our visitors

Andrew Moss

Chester Zoo

If 21st century zoos are to fulfil their role as Environmental Education providers, they need to understand exactly what makes their visitors 'tick'. Research into visitor behavior in zoos and zoo exhibits is a key part of this. Without it, we lay ourselves open to criticism to outside organisations who, rightly, suggest they we cannot accurately evidence our impact on visitors.

23 years ago, Stephen Bitgood and his colleagues published an intriguing insight into the behaviour of visitors to American zoos (Bitgood et al., 1986). At Chester Zoo, we patiently waited until 2004 to start finding out about our own visiting public!

This paper explores the visitor research that has been conducted at Chester Zoo over the past 5 years and evidences the '10 things we now know about our visitors' that we could only guess at before. How do visitors prefer to view animals? How do visitors respond to other visitors? Which species get visitors excited? How do visitors actually spend their time in exhibits? All of this and more will be revealed.

As visitors are, sometimes unwittingly to be sure, essential components of modern zoo missions, we feel that good quality research into visitor response to zoos is now becoming increasingly important. What we present here is only the beginning of our understanding and it is hoped that all zoos can invest some of their research effort into this field and help further our collective knowledge.

References

Bitgood, S., Patterson, D., & Benefield, A. (1986). *Understanding Your Visitors: Ten Factors that Influence Visitor Behavior*. Jacksonville State University. Psychology Institute.

Did it Work? Evaluating a Behavioural Husbandry Workshop

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In August 2008 the International Primate Society held its congress at Edinburgh, and this gave us the opportunity to run a 5-day workshop on Behavioural Husbandry in the week before the conference. The workshop was aimed at primate keepers in countries where such workshops were not normally available, and we were able to offer fully-funded places to sixteen delegates from Africa, Asia, South America and Eastern Europe. The workshop consisted of some theory sessions on animal learning, environmental enrichment and animal welfare, and practical sessions involving role play, a training simulation, computer use, and the use of environmental enrichments, taking advantage of the facilities available at Edinburgh Zoo. We evaluated the workshop to test its effectiveness in achieving our stated learning outcomes, which included raised awareness and knowledge in the delegates, and enhanced ability to undertake their role and to disseminate their new knowledge and skills on their return to their own institutions. All delegates completed a questionnaire testing their awareness and knowledge before the workshop started, and then again at the end of the course. In addition they were asked to rate various aspects of the course, so we could evaluate the form and content of the workshop as well as its effectiveness. Results showed that delegates' knowledge of enrichment was better than their knowledge of welfare or animal learning at the start of the course, but knowledge of all three was higher at the end of the course. At the end of the workshop delegates were able to offer a reasonable explanation of what was involved in behavioural husbandry, and were able to identify how they intended to implement it on their return to their own institution. Their ratings of the course were high, with highest ratings being given to "explanations given in the lectures" (9.2 out of 10) and lowest to "opportunity to work with animals at the zoo" (8.2 out of 10). When asked for the best and worst aspects of the course, delegates particularly valued the practical and lecture sessions, but some thought sessions were too long and there wasn't enough practical work. The workshop was deemed a great success and a follow-up of the delegates is planned to see how well they are implementing behavioural husbandry one year on.

Feeding behaviour and digestibility in captive grey-legged owl monkeys (*Aotus griseimembra*)

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Owl monkeys (genus *Aotus*), which are native to South America, are the only nocturnal monkeys. They usually live in primary and secondary forests where they mainly feed on fruit. Several species have been identified, including *Aotus griseimembra*, which is classified as Vulnerable on the IUCN Red List. There are currently 11 individuals of this species kept in 4 UK zoos. As in many other primate species, captive owl monkeys can show marked increases in body mass compared to their free-ranging relatives. Problems such as diabetes, reduced lifespan, and reproductive failure can follow. Obesity is multifactorial and is thus difficult to tackle. This study aims to assess whether the behavioural and digestive characteristics may be predisposing factors for the development of obesity in owl monkeys.

A behavioural study was carried out in Bristol Zoo Gardens on a group consisting of one adult male, one adult female and their 1-year old male offspring, kept in an enclosure with a reversed-light cycle. During the active nocturnal period, the mean time spent on foraging and feeding per day was 37%. The foraging and feeding activities were spread over the entire nocturnal period. Overall the animals were active for 88% of this time. As for the diurnal period, no active behaviour was displayed and the animals stayed in their nest box, either resting or showing vigilant behaviour. Furthermore, this study showed the importance of food presentation to enhance normal behaviours such as foraging activity and food interactions: both were mainly displayed when the group was feeding on fruits and vegetables, especially when these were scattered on the ground. In Marwell Wildlife and ZSL London Zoo, 1-week digestibility trials were conducted with 2 groups of 3 and 2 individuals and with a single male. One of the groups was exclusively kept indoors. Food intake and faecal output were recorded daily in order to calculate apparent digestibility of different nutrients. The analyses are currently under way. The digestibility trials will determine the amount of energy available to the owl monkeys from their diets. Daily total food intake averaged 160g per individual or 17% of body mass, on an as fed basis. Faeces quality was variable from diarrheic to well-shaped, especially in the 3-individual group. Also, Marwell's owl monkeys were highly selective: they ate around 70% of the diet, avoiding pellets and consuming almost exclusively fruits and vegetables. These food preferences resulted in large differences of nutrient composition between offered and consumed diets.

This study highlights several traits displayed by owl monkeys, which must be taken into account when formulating diets in order to reduce the incidence of nutritional disorders: nocturnal feeding, dietary preferences and food sharing and the possible ability to effectively utilise high-fibre foods.

Social dynamics in ring-tailed lemurs (*Lemur catta*) following a dietary review

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Animal collections need to create baseline behaviours for exhibit groups; hence an understanding of social relationships can be important. A majority of research has concluded that agonistic encounters are likely to reduce amongst groups of a smaller size. This research is focusing on a family group of ring-tailed lemurs (*Lemur catta*) kept at Marwell Wildlife to gain a better understanding of the effect of diet on social dynamics and whether the removal of a high sugared food could have an effect on overall group behaviour. The lemur's behaviour was split into states and events, depending on the duration of the behaviour; aggressive behaviours were all recorded as event behaviours. Activity budgets were constructed using instantaneous scan sampling every two minutes for 6.5 hours over 14 days. Results found that during Treatment 2 (banana removed) the group spent more time huddling (65%) than during Treatment 1 (non-adjusted diet). Analyses suggested that during the phases Treatment 1 and Treatment 2, a significant difference in the amount of aggression was observed ($P < 0.05$). Social interaction within the group changed between Treatment 1 and Treatment 2 (a significant increase, $P < 0.000$). Food preference was also investigated, however this could not be statistically analysed. It was observed, however, that individual lemurs did show a food preference, particularly to high-sugared fruit; during the study banana was chosen more times than any other fruit given. This study shows that the removal of a high-sugared fruit could potentially have an overall effect on the aggressive and social behaviours performed by captive lemurs; thus concluding that monitoring social dynamics and the use of reduced sugar diets could decrease dispersal situations that cause future relocation problems in captive lemur populations. Further research should continue to monitor the lemur's behaviour when other food items are removed from their diet, as a more 'natural' diet is something Marwell Wildlife wants to achieve. Extension of this study would increase knowledge on aggression amongst captive ring-tailed lemurs and determine whether high sugared food items are the predominant cause of aggressive encounters in this specific species.

Quantification of Dietary Intake in Captive Woolly Monkeys through N-Alkane Analysis

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Woolly Monkeys (*Lagothrix lagotricha*) are large New World Monkeys that are endangered due to habitat loss in the wild, hunting pressures, and being captured to enter the pet industry. In captivity, they have a notoriously short life-span and this is thought to be due to health issues centred on hypertension and diabetes. Studies have indicated that Woolly Monkeys may be sucrose intolerant, however, the link between any dietary components and ill-health have yet to be fully expounded. This is due, in part, to the lack of quantitative analysis of Woolly Monkey nutrition.

While observational studies provide a guide to dietary preferences and intake, in group housed animals this approach can be challenging and cannot provide reliable quantification of intake. An approach widely used to quantify intake in grazing animals is the analysis of N-alkanes in the faeces. N-alkanes are inert compounds found in the waxy coatings of plants and fruit which pass through the digestive tract unaltered making them a natural marker of dietary intake.

The aim of this pilot study was to investigate the potential of using faecal N-alkane analysis as a possible method of investigating captive Woolly Monkey food choice and intake. The diet and feeding-behaviour of a group of 7 captive Woolly Monkeys at Twycross Zoo was observed and the following morning, 4 faecal samples of varying consistencies were collected. Faecal samples collected were of hard, medium, soft and very loose consistency. Following collection samples were stored at -20°C prior to freeze drying and grinding. For analysis, duplicate aliquots of 500mg sample were processed in the laboratory to allow extraction of N-alkane prior to analysis by gas chromatography.

Total N-alkane concentration ranged from 0.36 - 0.92 µg/g with considerable variation in the distribution of the wide range of individual N-alkanes detected (13 in total) indicating considerable variation between monkeys in individual intakes of specific feed ingredients. The most abundant N-alkane detected was C29 (almost 70% of total content), which is found in apples which formed a substantial part of the diet and are eaten preferentially.

This study has confirmed that faecal N-alkanes can be successfully measured in Woolly Monkeys and that individual monkeys exhibit considerable variation in their faecal profiles. Furthermore, the distribution of N-alkanes appeared to accurately reflect dietary intake suggesting that this technique can be used to quantitatively monitor dietary intake in group housed primate species.

Softly, softly, catchy monkeys

Yvonne Owen

Writtle College

Traditional techniques used to capture New World monkeys, such as net captures, can induce high levels of acute stress resulting in physiological and behavioural responses detrimental to welfare. Alternatively, training animals to voluntarily participate in husbandry and/or veterinary practices using operant conditioning via positive reinforcement training is accepted as a humane process which can reduce stress and improve welfare. Although studies have revealed that training programmes are not common practice in laboratories and, within zoos there is a lack of published studies regarding the training of non-human primates. The author found no journal articles regarding operant conditioning for red-bellied tamarins (*S. labiatus*), although had identified a practical application for training of red-bellied tamarins at Paradise Wildlife Park, Hertfordshire. This dissertation takes the form of a case study to establish whether it was possible to use operant conditioning to train a family of five red-bellied tamarins to voluntarily enter a transportation box and remain calm for one minute. It also sought to ascertain whether this technique could be used to reduce their experience of stress during capture and containment.

An ethogram was constructed and behavioural observations were made of the study group of tamarins to establish 'normal' behaviour, their time in behaviours, and to gain an understanding of the relationship within their social hierarchical group. Training was planned using a 'shaping plan' which incorporated a series of approximation goals towards the goal behaviour. Training sessions were no longer than ten minutes in duration and occurred over 25 days. The training goal was first achieved in training session 54, after which training continued until the actual capture date on 23rd September 2008. Behaviour observation records and evaluation of progress towards the training goal were collated and analysed using descriptive statistics. In addition, a benefits assessment of the time investment needed to train the tamarins was provided.

A pilot study of two separate net capture processes was conducted and measures of locomotion and vocalisations were recorded as indicators of stress behaviour. These were compared to the same measures of stress recorded during the capture of the trained tamarins. This case study demonstrated that it was possible to use operant conditioning to train a family of five *S. labiatus* to voluntarily enter a transportation box and remain calm for one minute, and this was used to capture and contain them for relocation to a new enclosure. Whereas the net captured monkeys from the pilot study exhibited rapid and erratic locomotion and emitted long, sustained and high frequency vocalisations during capture, the trained tamarins exhibited minimal locomotion and emitted only four brief vocalisations at RMS -35 dB for 1.68% of the capture duration. Therefore, this study indicates that the use of operant conditioning via positive reinforcement training can considerably reduce potential for stress and improve welfare during the capture and containment of the study group.

Side Preference in trunk and foot movements of captive Asian elephants

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Behavioural lateralisation or side preference has been studied in a wide variety of animal species, although relatively few studies have investigated laterality in unpaired appendages. To date, trunk movements in Asian elephants (*Elephas maximus*) have been the focus of two published laterality studies; one in the wild and the other in captivity. The current study has expanded on this research by investigating side bias in patterns of foot use and suckling, as well as bias in trunk movements, categorised to reflect the properties of the movement and the nature of the task and/or object involved. Subjects were 15 Asian elephants at Chester and Whipsnade Zoos, comprising three males and 12 females aged between 6 months and 50 years. Twenty-one behavioural categories were defined; nine of these were feeding-related behaviours. Data were collected as bouts, using a switch focal subject sampling method from October through December 2006 (Chester) and August through September 2007 (Whipsnade).

Results showed that not only did all 15 subjects exhibit significant side preferences for the same five trunk movements, but the preferred side for each individual was consistent across all five behaviours. Moreover, the number of individuals with a left trunk preference was significantly higher than those with a right trunk preference. However, there was no evidence of lateralisation for either foot movements or suckling. Whilst no significant relationship was found between age and strength of bias for the lateralised trunk movements, the only locomotor-related movement was significantly weaker in strength of side preference than the other four manipulative movements. As well as supporting previous findings from wild and captive individuals, the current investigation has provided new information regarding lateralisation in different aspects of Asian elephant behaviour, and in doing so has reinforced the existing evidence for lateralisation in unpaired appendages.

How the Loss of a Group Member Affects the Behaviour of an Established Herd of Female Asian Elephants (*Elephas maximus*)

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Blackpool Zoo established a small non-breeding herd of four adult female Asian elephants in 1999. The herd was formed by introducing two former circus elephants to the two former wild orphaned individuals already present. These orphaned elephants had been together since 1972. The group remained the constant for 10 years, with one of the orphaned individuals assuming the role of matriarch.

Throughout this period, the health of the second orphan unfortunately deteriorated through osteoarthritis. In February 2009 the difficult decision was taken to euthanise this elephant as her condition was deemed by a team of specialist vets to be very severe. This study was designed to assess the affect that this loss had on the behaviour and dynamic of the remaining group. This was achieved through the exploration of the individuals' daily activity budgets and how these changed over time.

Data was collected for a total 100-hour study period. The results from the preliminary analysis of this complex data set show, at the simplest level, there to be little difference in behaviour before and after the loss of the elephant. However, on further more detailed examination, changes can be seen in the activity budgets of individuals around specific events. This includes during the period immediately surrounding the loss of the group member.

Using science to answer husbandry questions: Chimpanzee DNA analysis

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Our last chimpanzee infant was born 10 years ago in 1999. After this, all the females were contracepted whilst the European population was assessed and recommendations made. In September 2006 our group of 11 chimpanzees were moved out of the old chimpanzee house at Edinburgh zoo and moved to temporary quarters whilst a new exhibit was built on the old site. The opportunity was taken to give each chimpanzee a full health check and blood samples were stored for DNA work. The European population of chimpanzees is a mixed bag, with all the different subspecies represented and many of them having hybridized in the past. The current recommendation is to try to move towards managing the Western Chimpanzee *Pan troglodytes verus* under an EEP. Research into the records held at Edinburgh showed that there was a good chance several of our chimpanzees were *verus*, and so we sent blood samples away to 2 laboratories to test for paternity and to test for subspecies. 2 museum specimens were also tested. Paternity testing was eventually completed by 2 separate labs using different sets of markers; one set of bloods were genotyped at 16 autosomal microsatellite loci; the other at 11 different loci. First these markers were compared to the dams genotype at the same loci, and then to the potential sires. Then a calculation of likelihood of paternity in each case was made. Both tests gave the same results. Combining the records research with the laboratory results, of the 7 chimpanzees born at Edinburgh still present, 4 had their paternity determined, and the remaining 3 each are left with just 2 possible sires.

Currently the only genetic test of subspecies in chimpanzees is based on a region of mitochondrial DNA. Mitochondrial DNA is only inherited from the mother which limits its use in this context. By comparing the genetic sequences found in our chimpanzees to those confirmed from wild chimpanzees in previous studies and combining this with our now much clearer picture of paternity within the group we were able to make a number of deductions. Of the 11 chimpanzees, only 2 males could be confirmed as pure *verus*, with another 1.1 chimpanzees born to *verus* dams, but whose paternal line remained unclear. All others were proved to be subspecies hybrids or to have a matriline from another subspecies than *verus*. Based on this information and on discussion with the EEP coordinator, our non-*verus* males were then vasectomised and non-*verus* females are to continue on contraception. A recommendation is due shortly to move pure *verus* females to Edinburgh's new facility for integration into the group, so that breeding can recommence and a good social structure be maintained for the future.

Quantitative assessment of skeletal problems in Callitrichids

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While continuous progress has been made in improving the diets of captive Callitrichids, they continue to be linked with dietary health issues. Studies on natural diet have found digestive adaptations that suggest gum is an important dietary constituent, supplying high levels of calcium which can reduce the occurrence of issues such as metabolic bone disease. In order to monitor the benefits of particular dietary interventions it is important to establish a reliable method of quantifying any beneficial effects.

The aim of this investigation was to establish a scoring system to use in the assessment of callitrichid x-rays for bone health. The system developed looked at 4 areas; femur, tibia, humerus and tail vertebra which were scored from 1 (severely demineralised) to 6 (normal) for bone density and from 1 (severely abnormal) to 4 (normal) for bone conformation.

Individual x-rays from Geoffroy (n = 34) and Silvery (n = 32) marmosets were scored on two separate occasions to test repeatability. Results showed good repeatability ($P < 0.01$) between the first and second scores. Medical records on the x-rayed animals were used to access data on age, sex, and calcium and phosphorus levels in order to allow comparisons to be made with x-ray score. The majority of calcium levels were within the acceptable range and there was a negative relationship between circulating calcium and x-ray score, with higher circulating calcium associated with poorer scores. Furthermore, there was no deterioration in score with increasing age. X-rays taken during the winter showed poorer ($P < 0.05$) scores than those taken during the summer suggesting a seasonal influence on bone density. In addition scores were poorer ($P < 0.01$) in Geoffroy than Silvery marmosets indicating a species difference.

In this study we have established a repeatable method with which to quantify bone health in Callitrichids. Using this method we have identified seasonal and species differences in bone health. In animals with acceptable circulating calcium levels lower calcium was associated with better bone health though it is likely that in calcium deficient animals this relationship would be reversed. The observation of a species difference suggests recommendations on dietary management of bone disorders should be dealt with in a species specific manner.

Mother-infant relationships of Hamadryas baboons (*Papio hamadryas*) and their impact on social interactions in adulthood

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In many primate societies, the initial socialisation between mother and infant forms the foundations for all future social roles and bonds. This is believed to be true of the Hamadryas baboon (*Papio hamadryas*). An infant baboon makes all of its early perceptions from the confines of the mother's ventrum. This places a limit on the infant's early social interactions and it is fully dependent on the mother's status within the group for the type of interactions available. Once an infant begins to explore its surroundings and move away from the mother an element of control is introduced to the relationship. As the infant becomes more independent, the relationship within the dyad will change as mother and infant needs alter. An increase in independence will lead to increased social interaction outside of the dyad. A number of studies have looked at all these aspects individually but rarely as interacting factors (Poirier, 1977; Altmann, 1980; Kummer, 1995; Clarke and Snipes, 1998; Weaver and de Waal, 2003 Bentley-Condit, 2003; Hernandez-Lloredo and Colmenares, 2005). The aims of this study were to determine whether infant age and gender or mother's previous experience had an effect upon parenting style, dyad relationship quality and an infant's social security. This initial data set is the beginning of a longitudinal study following the infants through to adulthood. It is hoped to determine the impact these early experiences have socially through life.

This study followed five mother-infant dyads in a captive troop at Paignton Zoo Environmental Park. The dyads were studied from two weeks of age up to 5 months. Maintenance of proximity was studied to determine where control in the relationship lay, with the mother or infant. This also links to the relationship quality between mother and infant. Social interaction quality was studied to determine the security of relationships between the infant and other troop members. Five 10 minute focal follows were conducted once a month on both mother and infant giving an overall sample with five data points per dyad. Maintenance of proximity and mother-infant relationship quality used all 10 samples from one month for the whole dyad combined whilst social interaction quality used the five samples specific to either mother or infant only. For each month, the parenting style was noted as relaxed or controlling. Relationship quality and social interaction quality were labelled as secure or insecure. Statistical analyses and results will be discussed at a later date.

The reproductive cycle in spider monkeys. Are cyclical bleeds the norm or an abnormality?

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A number of the female spider monkeys in the primate collection at Twycross Zoo suffer regular bleeding from the reproductive tract. Both the zoo vet and keepers are unsure whether this is the norm or an abnormality which may indicate the presence of an underlying disease. The hypothesis of study therefore is 'cyclical bleeds in the spider monkey, *Ateles*, are the norm in captive spider monkeys in the UK'.

To investigate the subject firstly the history of the spider monkeys at Twycross was researched and a literature review was carried out. This literature indicated that cyclical menstrual bleeding does occur in spider monkeys but only in relatively small amounts rarely visible with the naked eye.

A questionnaire was sent to those UK zoos holding spider monkeys to establish whether other zoos had encountered bleeding in their relevant females. If so, respondents were asked whether bleeding was cyclical in nature or a singular event with an underlying cause. The results from this survey indicated that cyclical bleeding had been observed in 4 out of 10 relevant zoos in 34% of all relevant females. However, respondents from each zoo observed bleeding in either all relevant females or none; it is therefore likely that results were influenced by external factors such as bias and methods of observation. Out of the relevant females, 19% had suffered bleeding as a singular event but, as clear, natural reasons for bleeding such as miscarriage were attributed to most, only one animal showed undiagnosed bleeding for which no further investigation had taken place. No definitive conclusions could be drawn from the questionnaire alone.

Looking at possible alternative causes for excessive bleeding, little information was available on spider monkeys in particular but literature on other primate species suggested both pathological and non-pathological causes including stress, metritis, adenomyosis and vaginitis. Environmental factors such as enclosure design and social grouping may also play a part but would warrant focused studies into these specific studies to draw valid conclusions.

In conclusion, where cyclical bleeding equals menstruation it is the norm for the genus, however only slight bleeding is the norm, therefore the extent of bleeding encountered in some of the specimens at Twycross Zoo would be classed as an abnormality and is likely to have an underlying cause. A number of possible causes are suggested but given the information available and given the scope of this study, definitive causes were not identified here.

The application of technology within Edinburgh Zoo's penguin colony

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Edinburgh Zoo has the largest established colony of Gentoo penguins (*Pygoscelis papua*) in Europe. During each breeding season detailed and accurate records are kept of each individual bird and their breeding history and over the years these records have formed a valuable resource for research and further study into the breeding success and behaviour of Edinburgh Zoo's Gentoo penguins.

With approximately 100+ adults of breeding age, 80+ eggs and potentially 30+ chicks each year to record information on, the volume of information collected during each breeding season is substantial. Whilst the high-level information is input into ARKS, the remainder remains on paper and is therefore not readily available for reference or analysis. The aim of the study was to automate the information collection and reporting systems used during the Gentoo breeding season to support the collection of standardised and accurate information in a format that is easy to retrieve and manipulate.

The requirement to record nest check information *in situ* meant that it was necessary to use a small handheld computer as a means of collecting the information for subsequent downloading into a database for checking, analysing and reporting purposes. A second database was also designed and developed to store information on the eggs laid and the chicks hatched during each breeding season. This database provides extensive reporting functionality. The advantages gained from the new systems are discussed and examples are provided of some of the data being collected.

The provision of environmental enrichment for African penguins to increase water-based behaviours without changes to the current feeding regime.

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Environmental enrichment has been shown to modify the activity budgets, increase enclosure use and enhance the display of naturalistic behaviours in a number of different species. The penguin beach enclosure at Living Coasts houses both African penguins (*Spheniscus demersus*) and macaroni penguins (*Eudyptes chrysolophus*) in a mixed species exhibit. The macaronis are highly active in the pool area of the enclosure, however the African penguins spend little time using the pool and are mainly located on the beach. The aim of this study was to stimulate the African penguins to perform greater activity in the water by providing and investigating the responses of the birds towards five enrichment devices: a mirror ball, a bubble machine, a penguin raft, ice blocks and a bubble curtain.

Due to the size of the group (84 African penguins) a sub-group of 12 (10 adults and 2 juveniles) readily identified individuals were chosen as study subjects. The study consisted of two phases; during phase one all enrichment items were presented for a 30 minute period. Results from this phase indicated that the African penguins did not perform greater activity in the water after the provision of the enrichments. Therefore a 2nd phase was carried out increasing the amount of time the devices were present and the number of ice blocks provided. During both phases instantaneous focal sampling was used to record location in the enclosure and behaviour of the subject every 30 seconds for 10 minutes. A 10 minute data collection session was carried out on each study subject once during each of three time periods during the day: 08:00-11:00, 11:00-14:00 and 14:00-17:00. Each enrichment device was presented on five separate days in a randomised schedule and with a one and two week gap between subsequent presentations. When the enrichment was provided three possible rapid indicators of enrichment effectiveness were also recorded: the latency to first use, duration of first use and the number of return visits within the first 30 minutes. Data collection is not yet complete but data will be analysed to assess the effectiveness of each enrichment, the best interval between repeated presentations of the same enrichment to prevent habituation and whether any of the rapid measures are reliable indicators of enrichment effectiveness.

Not just a cricket: interspecific variation in gut-loading potential of prey items for captive amphibians

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Frogs of the family Hylidae, such as the red-eyed tree frog, are commonly kept in captivity. Almost all adult amphibians are insectivores, but the diversity of insects available commercially for captive diets is limited. Since those species which are commercially bred have been shown to be a poor source of nutrients (particularly calcium), amphibians require supplementation in captivity to ensure they receive adequate nutrition for optimal health and reproduction. Two methods are frequently used for supplementation of live prey insects: gut loading and dusting. In the former, insects are reared on a high-nutrient diet so that the target species consumes both the prey itself and any of this diet that remains in its gut. Dusting involves shaking a powdered supplement onto the prey species in order to externally coat the insect. Dusting is inefficient because grooming behaviour by the insect or moist conditions can remove the supplement before it is eaten. For this reason, gut loading is often a preferred method.

Many studies have explored the effectiveness of gut loading in crickets, however, these have mainly been conducted in North America, where the house cricket (*Acheta domesticus*) is the most commonly used species. As a result, almost all studies of gut loading have used house crickets. In Europe, black (*Gryllus bimaculatus*) and brown crickets (*Gryllodes sigillatus*) are used more regularly than house crickets, and it has previously been assumed that these have the same nutritional value. Reviewed as part of a PhD study, the composition of all three species has revealed interspecific variation in gut loading potential for carotenoids. Do other nutrients also show variation between cricket species, and what effect does rearing diet have on this variation?

Third instar crickets of all three species were maintained for four days on one of three different diets (bran, fish food mix, and vegetables). Following this, half of the crickets from each treatment were starved for two days, whilst the other half continued to be fed. The experimental period replicated a typical interval between the crickets being shipped out from the supplier, arriving at the collection, and being maintained before feeding to the target species. Generally, zoos will receive crickets once a week and feed them to species as needed. The starvation treatment was designed to simulate the fate of crickets placed in the tank of the frog, which may live for up to two days without food before being eaten. All crickets were frozen at the end of the experimental period to await mineral analysis. Before this analysis was carried out, the mass and body length of each cricket was measured.

The results of this study will be presented and the implications for the husbandry of hylid frogs in captive collections will be discussed.

Behaviour and welfare of captive Burmese pythons (*Python molurus bivittatus*)

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Despite a long history of maintaining Burmese pythons (*Python molurus bivittatus*) in captivity relatively little research has been conducted on the effect of captivity on their behaviour and welfare. Although there is no single measure which can provide a complete picture of an individual's well-being several indices have been shown to provide an insight into animal welfare. Unfortunately, the study of welfare has for the most part been undertaken on mammals and there is a lack of information on what may be a good indicator of welfare for snakes; this is especially true when interpreting behaviour. The aim of this study was to determine how enclosure changes affect python behaviour and to consider whether this may have welfare implications.

Five captive Burmese pythons, housed in an enclosed vivarium at Paignton Zoo Environmental Park, were studied during three conditions: "control" without a simulated thunderstorm, "experimental" with a simulated thunderstorm and "enclosure" after enclosure modifications. During this latter condition plants and perching were added to the enclosure, providing retreat space and increased useable space. The snakes' behaviour and enclosure use was recorded using instantaneous scan sampling every two seconds during six 10 min observation sessions, from 0900-1700 on five consecutive days. This was repeated up to four times for each condition.

Preliminary results indicate that there was no significant difference in behaviour between conditions. However repeated measures MANOVA indicated a highly significant difference between individuals ($F=2.75$, $p<0.001$).

These results may indicate that other husbandry events, such as the repeated removal and introduction of individuals to the social group, had a greater impact on the snakes' behaviour than the enclosure conditions. This has interesting ramifications for the impact of social group composition on the behaviour and therefore welfare of snakes.

The spy who loved Biaza: how attending Biaza Research Symposia has influenced behavioural research at the Royal Zoological Society of Antwerp

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As in many European zoos, the Royal Zoological Society of Antwerp has had great interest in doing research at its two zoological parks: the Antwerp Zoo and Wild Animal Park Planckendael. Collaboration with Antwerp University resulted in the official foundation of a research group in 1989, which focussed mainly on the academic study of mostly primate behaviour, although applied research was sometimes also done. However, after I attended my first BIAZA Research Symposium, back in 2002 at Bristol Zoo, we started to structurally develop applied research in our Behavioural Research Group, focussing on research topics discussed on the BIAZA meetings. In this talk I will briefly outline how each of the BIAZA meetings has inspired us for research topics, and I will discuss some of the results of the different studies.

Nutrition studies were the topic of my first BIAZA meeting, back in 2002, and recently inspired us to do a nutrition study on of Sulawesi Crested Black Macaques. The topic of the 2003 meeting, visitor studies, has inspired us for many visitor studies on seals, cracids, penguins, chimpanzees and most recently okapi. The results of the latter study will be discussed. The okapi at Antwerp did not show increased stereotypical behaviour on days with many visitors at the zoo, but stereotypical behaviour was reduced when the okapi stood in the stables, where public has no access. In 2005 the BIAZA symposium focussed on using zoo records for research, which we have done in analysing studbook data on the bonobo, showing that inbred infants have higher mortality rates. The 2006 symposium dealt with setting up questionnaires, which was of great help in our studies of European black vulture management, and in a survey of ape keepers' opinions on management decisions. The results of the latter will be discussed briefly. The 2008 symposium on research on fish has inspired us to set up studies on the behaviour and location of fish in mixed species exhibits. Results of a recent study on rays in two different tanks, and of aggression in different (sub-)species of angelfish (*Pterophyllum* sp) will also be discussed. In conclusion, BIAZA offers good practical background for undertaking applied research in zoos

Finger length ratios (2D:4D) in anthropoids implicate reduced prenatal androgens in social bonding.

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In humans, the second-to-fourth digit ratio (2D:4D) has been linked indirectly to variation in prenatal androgen effects (PAE) and reflects early androgenic-programming on body and brain tissues. High PAE lengthens the fourth digit relative to the second leading to lower 2D:4D ratios in males, although substantial overlap exists between the sexes. These developmental effects have been linked to human behavior; lower 2D:4D (high inferred PAE) in both sexes is associated with increased aggression, promiscuity, and competitiveness. Additionally, polygamous societies have lower 2D:4D (higher inferred PAE) than more monogamous populations. Using an extensive sample of digit measurements from captive primate species we provide the first study to show that relationships between 2D:4D and social behavior in anthropoid primates accord with those found in humans; 2D:4D is lower in polygynous species and higher in pair-bonded species. Humans have ratios that are intermediate between pair-bonded and more promiscuous apes. Old World monkeys have low and relatively invariant 2D:4D, which is coupled with high levels of intra-sexual competition. This contrasts with higher, and more variable, ratios in both great apes and New World monkeys. In humans, low 2D:4D and aggressive behavior is associated with low numbers of tri-nucleotide (CAG) repeats in the androgen receptor gene (ARG), which indicates high sensitivity of the receptor. Most primates (and mammals) have few CAG repeats, but a polymorphic expansion of the ARG in the great ape clade may provide a genetic vehicle for the evolution of the flexible bonding patterns we see in apes and humans.

A comparative case study of the behavioural responses to keepers of the ring tailed lemur (*Lemur catta*), red ruffed lemur (*Varecia rubra*) and black-and-white ruffed lemur (*Varecia variegata*)

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Writtle College

The behaviour of all sentient animals kept in a captive environment should be examined comprehensively to ensure high standards of welfare are maintained, particularly the effect of the humans on the animal's behaviour and overall wellbeing. Considerable research has investigated the way livestock and laboratory animals are affected by stockperson interaction, but very few in a zoo environment. In addition, a number of studies have looked at the effect of high visitor numbers on the behaviour of zoo animals. Therefore this study attempted to compare the effect of keeper on zoo animals by way of a case study involving ring-tailed lemurs (*Lemur catta*), red ruffed lemurs (*Varecia rubra*) and black and white ruffed lemurs (*Varecia variegata*). The behaviour of the three lemur groups, proximity to keeper and keeper activity were recorded for a period of 16 days (8 days per keeper), using instantaneous scan sampling every 60 s, and analysed using chi-square and Mann-Whitney U tests. Additionally, whether a keeper directly talked to the lemurs or not was noted and compared statistically.

This study found that behaviour of the lemurs varied significantly between the two keepers in the ring-tailed ($p < 0.001$) and red ruffed lemurs ($p < 0.001$) and according to the keeper activity of feeding in all three species ($p < 0.001$ for each species). Proximity to keeper varied with keeper activity; all three species close to keepers were feeding the lemurs (ring-tailed lemurs: $p < 0.001$; red ruffed lemurs: $p < 0.001$; black and white ruffed lemurs: $p < 0.05$). Proximity also varied according to keeper with all showing significantly (ring-tailed lemurs: $p < 0.001$; red ruffed lemurs: $p < 0.05$; black and white ruffed lemurs: $p < 0.05$) more time close to keeper B. As the more familiar keeper, keeper B, also spent significantly more time talking to the lemurs, so the exact cause of this difference in behaviour is unknown, although keeper activity at the time is unlikely. Possible reasons for these behaviour variations are discussed. Further research is required to investigate the effect of keeper in a wider range of zoo animal species and to explore the reasons for any behavioural changes found.

A case study of visual discrimination with Abyssinian ground hornbills (*Bucorvus abyssinicus*) and Von der Deckens hornbill (*Tockus deckerii*)

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With the possible exception of some primate species cognitive research has been a neglected discipline in zoos despite the range of species held. The development of cognitive research compatible with the goals of zoo management allows us to extend our knowledge of the species we care for and also investigate the use of cognitive testing as potential enrichment. Previous research into the ability of bird species to discriminate visually between different stimuli has suggested they use a multi-dimensional, similarity based approach (e.g. Herrnstein and Loveland, 1964). However, recent work (Lea et al, in press) suggests that pigeons might adopt a more uni-dimensional sorting strategy. Despite a long history of caring for hornbill species in captivity and previous indications of their high intellect (Lombardi, 2000; Watanabe, 2001; Mendonça-Furtado and Ottoni, 2008) there is still very limited knowledge about the cognitive abilities of this interesting family. This study investigated the discriminative abilities of two hornbill species commonly held in zoos, *Tockus deckeni* and *Bucorvus abyssinicus*.

Birds were presented with two stimuli each with three dimensions (shape, colour and pattern) using a standard ‘poke box’ design to provide a reward if the correct stimulus was selected. The stimuli were then manipulated so that one dimension (shape, colour or pattern) was replaced by its equivalent from the other stimulus. The choices made when presented with these manipulated stimuli indicate the most influential dimension and overall sorting strategy used by the birds. In addition, general behavioural data was collected on cognitive testing and non-testing days allowing the assessment of using the poke box as a potentially enriching experience for the hornbills.

Data collection is not yet complete but preliminary results indicate that all the individuals have a uni-dimensional sorting strategy but not all used the same dimension. The Abyssinian hornbills (67% of trials for both the male and female) and the male Von der Decken’s hornbill (66% of trials) selected primarily by colour, whilst the female Von der Decken’s hornbill selected primarily by shape (77% of trials). The cognitive testing appears to have relatively little effect on the behaviour of the hornbills with no significant differences seen in the behaviour of the Von der Decken’s hornbills between testing and non-testing days. Both Abyssinians performed significantly more self-preening and less allo-preening ($P < 0.05$) and the male performed less locomotion ($P < 0.001$) on testing days compared with non-testing days.

Feeding enrichment of Waldrapp Ibis (*Geronticus eremite*)

Ashlea Luddington

Harewood Bird Garden

The Waldrapp Ibis, *Geronticus eremite* is a critically endangered species; therefore any positive steps towards successful breeding and away from possible health problems and stereotypes must be encouraged.

The enrichment program I designed consisted of two trials, both 10 weeks in length. The first trial focused on selecting a preferred method of enrichment, the second looks at prolonged exposure to this enrichment. The observation periods for these trials took place twice daily, both consisting of sixty minutes, one in the morning and one in the afternoon. During these periods of observation the behaviour of each Ibis was recorded at five minute intervals, along with their position within enclosure. At the same time data was recorded for weather conditions and the general public. Before the trials began I produced an extensive Ethogram on the Ibis behaviour and from that narrowed down the behavioural data into various categories. I then recorded the data under these categories, which allowed me to statistically analyse the results. The categories I hoped to see a significant difference in when the enrichment was present were; Movement, Stationary, Preening and Foraging. Ideally you would hope to see a significant increase in the Movement and Foraging Behaviour and a significant decrease in the Preening and Stationary Behaviour. The second trial is currently on-going so I will be unable to provide statistical analysis for these results but the first trial did see positive significant changes in behaviour.

An increase in movement and foraging behaviour is positive in many ways for the Harewood Ibis population. Health problems such as Bumble Foot have been known to affect other Ibis populations and the most common cause is an abnormally sedentary lifestyle. Between 1999 and 2003 euthanasia was the most common cause of death for this species in captivity, Bumble Foot and other foot problems accounted for 16.6% of those euthanised. As the treatment of Bumble Foot is complicated, protracted and stressful to the birds, prevention rather than cure is desirable.

Stereotypes are often found to occur when an animal has prolonged exposure to an ecologically relevant problem that it is incapable of solving within its enclosure. In particular the development of oral stereotypes in avian species has been shown to be related to limited foraging opportunities. The Ibis is a bird which is built to forage, in general they will spend more than half the day foraging for food such as spiders, snails and ants. My enrichment program was designed to promote this natural behaviour.

Last year the Harewood Ibis population produced four chicks, this was the first time they had bred successfully for several years. Successful breeding is obviously a priority and any enhancement to their lifestyle and enclosure has got to be a positive step forward to ensure continued success in this area.

The current trial will hopefully give an indication of the best method to maintain the Ibis's interest in the enrichment so the positive effects can continue after my enrichment program has ended.

Is cognitive testing enriching?

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Cognitive research within zoos is gradually becoming more common, extending knowledge of a range of species not generally available in laboratory settings. Much cognitive research is carried out through the provision of apparatus in the enclosure such as poke boxes, with the assumption that the provision of these devices may be enriching for the animals. By undertaking research on the cognitive abilities of a pair of capuchin monkeys, a genus known to have high cognitive function, and incorporating a timetable of enrichment, we hope to gain more information on both the discriminative abilities of Newquay Zoo's capuchins and whether the provision of cognitive devices can be classed as enriching.

This research focused on the bachelor pair of yellow breasted capuchin monkeys housed at Newquay Zoo. Two poke boxes were prepared to test their visual discriminative abilities through the presentation of two stimuli each with three dimensions (shape, color and pattern). The presentation of the poke boxes was incorporated into an existing timetable of enrichment for the capuchins, giving five conditions (three enrichment, one cognitive and one baseline). Data collection consisted of instantaneous scan sampling (every half hour throughout the day) combined with 10 minute focal follows. The results of this research and the implications for continued cognitive research within the zoo setting will be discussed.

Changing social groups in zoo populations

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Animals kept in zoos benefit from living in groups structured similarly to those in the wild. However, aggressive responses and increases in stress when a group changes in structure can cause major management problems to zoos and other ex-situ conservation facilities. The best techniques and protocols for managing introductions of animals in captivity are unclear and the processes involved in social group formation are not well understood. Since many species held in zoos are of high conservation priority, the loss of only a small number of individuals can have a severely detrimental impact on the remaining population.

There are two components to this project. First, introductions that took place in Dublin Zoo in the orangutan, wolf and elephant groups were observed. This will result in three case studies providing detailed information on three different types of group changes. The observations provided information on whether any types of behaviour changed following a change in the social groups and whether the social interactions of the group changed.

The second component of the project involves collation of information and expertise present in zoos about group changes, through distribution of a survey and follow-up consultation with keepers and curators in a number of zoos throughout the U.K. and Europe. This will determine whether there are common methods and techniques used to carry out group changes and form a database of the success or otherwise of different methods used to change social groups. This will form the basis for a set of guidelines that will be drawn up and made available for use during future changes and introductions in groups of captive animals.

This talk will focus on the results of the orangutan case study and on the questionnaire design. The case study deals with changes in behaviour of the individuals in the orangutan group at Dublin Zoo after three successive changes took place in the group over the period of a year. The social interactions and any changes that occurred will also be described. The methods and design of the questionnaire will then be presented, and the proposed outcome and use of the results of the questionnaire will be described.

**Behavioural analysis of solitary versus socially housed snow leopards (*Uncia uncia*),
with the provision of simulated social contact.**

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Activity budgets of 18 captive snow leopards were analyzed in order to assess the behavioural differences between cats housed singly versus those housed socially. Six solitary snow leopards and twelve socially housed snow leopards were compared. Pacing and activity level were used as indicators of welfare between these two groups. Solitary snow leopards paced more and were more active than the cats from the social housing situation. Additionally, an enrichment study was also conducted on eight of the 18 snow leopards involved. Feliway®, a synthetic analogue of the F3 fraction of feline facial pheromone was used as a means of olfactory enrichment as well as simulated social contact. Pacing, activity level, and percentage of time allocated to scent related behaviours were recorded before, during, and after the enrichment. All eight cats followed a similar behavioural trend throughout the course of the treatment, in which an increase in pacing, activity level and scent related behaviours occurred during the treatment days with Feliway.

Keywords: Snow leopard; enrichment; social; olfactory

Poster abstracts

An introduction of a male African lion (*Panthera leo*) to the existing Blackpool Zoo pride

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Blackpool Zoo

A study was carried out to determine the success of the introduction of a new male African lion (*Panthera leo*) to the existing Blackpool Zoo pride. All three females and the new male were captive born. Wallace arrived from Longleat Safari Park in August 2008. The introduction process began in September and occurred in three stages including visual contact, gradual interactions and full social contact. In February 2009, a behavioural study began, recording the behaviours of the four lions over a four week period. Observations showed that females engaged more in social behaviours, whereas solitary behaviours were more commonly seen in Wallace. Over the four weeks, aggression decreased within the group and social behaviours became more apparent. Many of the social behaviours occurred between Wallace and Gillian. This is most likely because Wallace has recently fathered her new born cubs, again showing enhanced group cohesion. The introduction has therefore been a success, with Wallace becoming increasingly accepted by the females as the study progressed.

Anti- predator Training in Black Lion Tamarins (*Leontopithecus chrysopygus*)

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The Black Lion Tamarin (*Leontopithecus Chrysopygus*) is a small, new world monkeys belonging to the Callitrichid family found in the Atlantic Rainforest of South-East Brazil. The captive black lion tamarin population is around 120 animals and it is managed as part of a subpopulation that is integrated with the wild population by reintroduction and translocation. Reintroduction of tamarins into the wild is an important part of the conservation of the species though current success rate is only 11% due to loss of the animals to predation. Thus predator training prior to release from captivity is an important issue in the management of reintroduction programmes.

Studies were carried out over two summers (2007 & 2008) in a free living family group (breeding pair and offspring) at the Durrell Wildlife Conservation Trust. During the investigation the behaviour, direction of vigilance, height from the ground distance from hut and vocalisation were recorded at specific times throughout the day. Animals were observed on a series of “control” days with no predator scare and on days when either an aerial (a bird shaped piece of wood painted as a bird of prey) or terrestrial (a large tiger shaped soft toy) predator was introduced. On some days, introduction of the predator was accompanied by the playing of a pre-recorded tamarin “death scream” to emphasis the scare effect.

Considerable variation in the various behaviours was observed between different control days (no predator scare) emphasising the complex nature of tamarin behaviour. However, it was still possible to identify a range of different responses following predator introduction. During the terrestrial predator scare the tamarins showed piloerection, mobbing behaviours, and gathered above the terrestrial predator which they then ‘chased’ out the woods while emitting a variety of alarm calls, trills and whines. During the aerial predator scare the tamarins were observed to display piloerection and emit alarm calls and remained close to the huts. Furthermore, during both predator scares the tamarins were observed to spend a decreased amount of time participating in foraging, feeding and social behaviours.

While the studies yielded considerable insight into anti-predator responses, the complex patterns of behavioural responses necessitate complex statistical analysis approaches which are still ongoing. However, current results show clear aversive responses to artificial predators and suggest this may be a viable approach to improving survival post release.

A Nutritional Assessment of Captive Psittacines Based at Twycross Zoo

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The nutritional welfare is important in captive psittacine management. At this current time the nutritional requirements of large psittacines are non-species specific and extrapolated data for poultry is currently used (Harrison et al., 2006a). Knowledge of the nutrient intake of captive psittacines is essential in preventing nutritional-related disorders such as obesity, fatty liver syndrome and hypocalcaemia, which is essential in good zoo management.

Therefore the expansion of knowledge into the true nutritional needs of captive psittacines is required in order to improve their nutritional welfare. In this dissertation the current diet offered to these species has been analysed in relation to the recommendation amounts. The digestive capabilities of each species was also analysed through the collection of excreta and diet samples.

Throughout the course of this dissertation it has been concluded that the nutritional requirements of each individual species are different, which was shown by the differing nitrogen retentions. This may be due the differing geographical locations, to which these species are native.

If a freshly prepared diet procedure were to continue at the zoo then the addition of various seeds, pulses and nuts should be considered along with a reduction of sunflower seeds, to encourage a balance between dietary fat and protein, which is essential for the health of the bird. However, if the zoo were to adopt the use of a formulated diet specifically manufactured for large psittacines it would be good practice to offer each species a selection of formulated diets and encourage the species to utilise its 'natural wisdom' and dictate which diet is the most suited to its individual needs.

The dietary intake of captive psittacines can be monitored by the use of natural internal markers, such as AIA and nitrogen content and can be utilised to observe the digestibility patterns of varying diets. The use of n-alkanes found naturally within the foodstuffs could

also be utilised as an inert marker for digestibility, which may be more beneficial than AIA.

The combination of the methods could therefore lead to an increased nutritional welfare standing for the captive psittacines currently housed at Twycross zoo.

Harrison GJ, and Lightfoot TL, (2006a), **Clinical Avian Medicine**, Volume 1, Spix Publishing Inc, Palm Beach Florida, USA, Chapter 3: Nutritional Considerations, Section I- Nutrition and Dietary Supplement, pages 86-103.

A study into the apparent dry matter and crude protein digestibility in four captive female Asian elephants (*Elephas maximus*) with reference made to nutritional requirements

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Due to a lack of knowledge on captive elephant diets ^[1], the main aim of this study was to investigate apparent dry matter (DM) and crude protein (CP) digestibility and determine any differences which could be attributed to age and pregnancy.

Four captive female Asian elephants were used. All samples were subject to freeze drying and nitrogen analysis. Acid insoluble ash and N-alkanes (C₃₁) were then used as internal markers to determine apparent DM and CP digestibility.

No significant differences in results obtained for each elephant were found for DM digestibility between elephants. However acid insoluble ash experiments indicated that one elephant (Noorjahan) did have a significantly higher apparent CP digestibility (0.80 ±0.02), figure 1, than the other three elephants (P<0.001).

The current study highlighted that digestibility coefficients obtained do tend to agree with the published values of approximately 0.50 ^{[2][3]}, with age appearing to have no significant effect on DM and CP digestibility, but speculation that pregnancy (in Noorjahan) could have an influence on CP digestibility. This could therefore be the focus of future investigations

^[1]Savage, A., Leong, KM., Grobler, D., Lehnhardt, J., Dierenfeld, ES., Stevens, EF., Aebischer, CP. (1999) Circulating Levels of α-Tocopherol and Retinol in Free-Ranging African Elephants (*Loxodonta Africana*). *Zoo Biology* **18**: 319-323.

^[2]Ullrey, DE., Crissey, SD., Hintz, HF. (1997) Elephants: Nutrition and Dietary Husbandry. *Nutrition Advisory Group Handbook Factsheet 004*: 1-19.

[³]Hatt, JM., Clauss, M. (2006a) Feeding Asian and African elephants in captivity. *International Zoo Yearbook* **40**: 88-95.

Attitudes about Apes I: Visitor perceptions and knowledge

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Antwerp Zoo is planning to redesign the education part of the great ape house. To assess current knowledge of zoo visitors and to evaluate the future changes, we interviewed 300 (Dutch speaking) zoo visitors of Antwerp zoo between February and May 2008. We specifically asked for knowledge (10 true/false questions) and attitudes towards apes (visitors were asked to rate subjective feelings on the apes they'd seen on a 5-point scale). Furthermore we asked them whether they thought the apes were a threatened species. The results of the questionnaire were analysed in terms of visitor's gender, age and education level. Some results to the knowledge questions were surprising. Only 43% of the interviewed answered correctly that "bushmeat" is a term referring to "the meat of animals in tropical rain forests", although 61% believed that "apes are hunted for their meat". The term "bushmeat" may not be a strategic term for future education campaigns in Dutch speaking areas. 50% of the interviewed people stated that man descends from chimpanzees. We did not ask visitors specifically about their religion or believe in evolutionary theory. Only 71% believed chimpanzees to be an endangered species, as opposed to 96% for both orang-utans and gorillas. Upon hearing the correct answer, the majority of visitors said they had never heard about chimpanzees being endangered in the media. This contrast to a study in the US, where respondents believed chimpanzees were not endangered, because they were featured in movies and commercials (Ross et al. 2008, *Science* 319: 1487). In terms of perceptions, visitors gave highest mean scores to the adjectives (I think apes are...) "interesting"; "pretty"; "playful" and "bored", and lowest scores to "dirty", "aggressive" and "ugly". Education level did not influence perceptions about apes, but age of respondents had some influence in rating some of the adjectives. While the answers to the questionnaire may not correspond to their true beliefs about apes, and comments by the public while viewing the apes have not been scored, our results indicate that visitors at Antwerp Zoo have a generally positive attitude about apes, are unaware of the endangered status of chimpanzees and have difficulties with the term bushmeat.

Attitudes about Apes II: a small questionnaire in ape keepers

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The “Great Ape Talk” is a local group of ape keepers, that organises yearly meetings for Dutch and Belgian great ape keepers. Each year a specific topic is chosen as a base for lectures and workshops. In 2009 we aim to talk about the “ethics” of collection planning in great apes. Ape TAGS or EEP-committees regularly confront keepers with decisions regarding breeding recommendations or transfer of animals. This may also increasingly involve complex management issues such as birth control, castration, hand rearing and possibly euthanasia. To assess how keepers feel about such decisions, we sent a questionnaire to all ape keepers in the Netherlands and Flanders (Belgium). 40 ape keepers have responded so far representing keepers of all great ape species (62% of respondents worked with gorillas; 35% worked with chimpanzees; 24% worked with orangutans; 19% worked with bonobos). 87% of the respondent keepers rated euthanasia of healthy apes as the most delicate issue, but hand-rearing (57%) and castration (42%) were also considered as problematic.

83% of the respondents did strongly disagree with the statement “euthanasia of healthy apes is justified if this animal has had enough offspring”. When adequate housing could not be guaranteed, an increasing number of respondents could strongly agree (17%), agree (17%) or doubt (37 %) with considering euthanasia. In general hand-rearing a male ape was seen as less appropriate than hand rearing a female ape. If an infant had high genetic value, keepers were more inclined to support hand rearing of the infant. Experience of the mother, or species of the ape involved was considered less important for the decision to hand-rear.

Breeding apes as enrichment for adults, with the possibility of euthanizing the youngsters was not acceptable for 78% of the respondents. 85% of the respondents did not agree with the statement “hand rearing apes is a good way of obtaining funds for apes in the wild”. While this survey is very limited, it opens discussions about management decisions of ape populations. The results of this questionnaire will be used to organise a meeting at Planckendael about this topic in the autumn of 2009, inviting guest speakers and organising a workshop.

Chimpanzee coat condition scoring: its uses as a non-invasive welfare assessment method and the factors affecting its outcome.

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Coat condition can be influenced by a wide range of variables and thus the use of a coat condition scoring system provides a useful visual tool for non-invasive welfare and health assessments in wild and captive animals (Berg *et al.*, 2009). Compromised coat condition is a common phenomenon in captive environments due to differing welfare standards in individual zoo and therefore, throughout this investigation the chimpanzees of Twycross and Chester zoos have been compared using a coat condition scoring method to determine if varying coat conditions between these two collections can be explained due to the different management methods employed at either of these zoos.

A two tiered coat grading system was established using a five point condition score and a percentage cover score to allow for maximum assessment of the coat condition displayed by captive chimpanzees. Possible causative variables were also assessed via the use of a nutritional break down analysis and the construction of a keeper's questionnaire. Results showed that the chimpanzees at Chester zoo display, on average, a better coat condition than those in the Twycross collection. Management method comparisons showed that there is most likely a multi-factorial reason behind the varying levels of hair loss incorporating; nutritional, behavioural and environmental factors.

It can therefore, be seen that there are many factors that can influence the coat condition of captive chimpanzees. This implies that for successful eradication of compromised skin conditions in a captive environment many factors must be changed and investigated before the true root cause can be established and treated. The causative reason is most likely to be collection dependent, influenced by the management practises in place by an individual zoo and therefore decreased coat condition cannot be seen to be caused by one universal factor.

Bibliography; Berg W, Jolly A, Rambeloarivony H, Anderianome V and Rasamimanana H (2009) A scoring system for coat and tail condition in ringtailed lemurs (*Lemur catta*), *American journal of primatology*, **71**, 183-190

Dietary and faecal iron in captive black-and-white ruffed lemurs (*Varecia variegata variegata*)

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Previous research has demonstrated that captive lemurs are susceptible to iron storage disease (ISD), with instances of ISD related mortality reported in many collections. Ruffed lemurs (*Varecia spp.*) have previously been highlighted as species especially prone to iron-storage-related diseases. Current monitoring and diagnostic methods are either invasive or conducted post-mortem and very little information is available regarding the appropriate amount of iron which should be provisioned to captive animals. Despite the level of concern surrounding ISD in lemurs, there is a curious lack of species-specific advice with regards to the composition of diets. Indeed, existing guidelines for *Varecia* mimic those of the ring-tailed lemur, *Lemur catta*, a species with a more generalised diet and differing gastrointestinal through-time. The current study was designed as a novel approach to assessing the health of captive black-and-white ruffed lemurs in respect of iron storage, providing information on the composition of captive diets and the levels of dietary, faecal and retained iron across seven collections in six zoological institutions. Atomic absorption spectroscopy was used to quantify faecal iron values. Dietary surveys revealed a total of 41 food items were provisioned during the course of the study, of which 9 were common across 4 or more collections. Fruit accounted for 27.7% - 78.8% of total provisioned food items, vegetables for 17.8% - 47.4% and other and supplementary food items for 3.2% - 13.4%. Browse was available to 3 of the 7 collections and the types and quantities of supplementary foods provisioned were highly variable. The amount of food provisioned per lemur across collections varied significantly (455.3g - 911.3g ($F_{5, 17} = 24.56$, $P < 0.001$)). Significant differences were also observed in levels of dietary iron (2.78mg - 5.44mg ($F_{5, 17} = 9.67$, $P < 0.001$)), faecal iron (0.1mg - 1.07mg ($F_{5, 17} = 15.17$, $P < 0.001$)) and retained iron (2.13mg - 5.31mg ($F_{5, 17} = 14.99$, $P < 0.001$)). The amount of iron retained relative to the total amount of iron in the provisioned diet varied significantly between institutions (68.6% - 98% ($F_{5, 17} = 12.41$, $P < 0.001$)). Of the six institutions surveyed, four reported past instances of ISD-related mortality; two of these institutions subsequently initiated dietary reviews. While all values are stated as being 'per lemur', it is important to note that they are calculated from the population mean, thus allowing comparative analysis across collections. More specific analysis would have required the isolation of individuals, a measure which was not viable in this study. Additionally, though the study cannot – and does not – seek to diagnose ISD via faecal analysis, the results suggest that the use of such a low-impact method can be a useful monitoring aide. The results of the study suggest that captive *Varecia* may be subject to inconsistent and inappropriate feeding regimes with regard to dietary iron. This data highlights the requirement for additional research into, and formulation of species-specific diets and provides a valuable addition to the reference database for lemur diets.

Effects of visitor numbers on the behaviour of Cracidae in Antwerp Zoo

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Cracids are a severely threatened family of Galliformes who are, because of their key role in neotropical ecosystems as seed dispersers and their potential use as indicator birds, of great social importance. In this study five species of cracids were observed for a visitors effect in Antwerp Zoo (*Crax rubra*, *Crax blumenbachii*, *Crax daubentoni*, *Penelope jacquacu*, *Pauxi pauxi*). Each species was represented by a breeding pair with no offspring present. The study was done between August and December 2008, so after the largest peak in visitor numbers, and also outside of the breeding season for Cracids. We compiled an extensive ethogram for the species, focussing on potential welfare related behaviours (pacing, hiding, feeding, use of the enclosure). Each species was observed for two 30 minute intervals on each observation day, using instantaneous scan sampling with 30 second intervals to monitor the behaviour and location of both birds simultaneously. From a total of 18 observation days, we compared behavioural frequencies from 6 days with the most visitors (3022 to 5820 visitors per day) to 6 days with the least numbers of visitors (224 to 852 visitors per day). Visitor numbers were obtained from ticket sales, and we did not count the actual number of visitors in front of the birds' enclosures. For the analyses we used a multiple ANOVA, with frequencies of different behaviours, and the spread of participation index (SPI) as dependent variables. Visitor numbers (high or low), subject species, time of day (morning or afternoon) and were included as independent variables.

The results differ greatly in the five species. Under higher visitor pressure, there was an increase in visibility and movement and a decrease in spatial use on *Crax daubentoni*. *Pauxi pauxi* showed a decrease in foraging behaviour and an increase in investigating behavior and *Penelope jacquacu* showed an increase in visibility, resting behavior and self preening on days with higher visitor numbers. *Crax rubra* and *Crax blumenbachii* showed no differences in behaviour in relation to visitor densities. These results insinuate a rather positive influence of higher visitor numbers on the life quality of the cracids in Antwerp Zoo. More research on the general behaviour and visitor effect on cracids is necessary to correctly interpret the results of this study.

