12th Annual BIAZA Research Symposium

Abstract Book

7th and 8th July 2010

Chester Zoo, UK

Dear Delegate,

It's a great pleasure to welcome you to the 12th Annual BIAZA Research Symposium, hosted by the North of England Zoological Society, Chester Zoo. This year, we are delighted to welcome delegates from across the BIAZA region and further afield, including our guest speaker, Prof. Geert Janssens, from the University of Ghent, Belgium. Like the previous BIAZA Research Symposia, the programme for this year's conference covers a diverse range of research topics, and includes opportunities for friendly and useful discussions with colleagues.

We hope you have an enjoyable and productive time here at the Symposium, and don't hesitate to ask any of us wearing green Chester Zoo shirts, if you need any help!

Best wishes,

Sonya

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Abstracts for oral presentations

Identifying and reducing the impacts of environmental stressors in western lowland gorillas (*Gorilla gorilla gorilla*)

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This paper presents the results of a two-year study in a group of one male and three female zoo-housed gorillas (*Gorilla gorilla gorilla*). A series of exhibit modifications were implemented while collecting detailed behavioural observations and in a subset of the data the relationship between specific behaviours and faecal glucocorticoid (FGC) metabolite concentrations were investigated. In one female, the time spent staring, posturing and charging in the direction of visitors (termed 'negative visitor vigilance') was higher one day prior to and on the same day as raised FGC metabolite concentrations. These behaviours also increased significantly at high environmental noise levels. Her time spent hair-plucking significantly increased in the two days following raised FGC metabolite concentrations. Other subjects showed low variability in FGCs and relationships between behaviour and FCG were not detected. Stepwise exhibit modifications resulted in significant positive behavioural effects. Addition of clover hay into the daily diet was related to decreased negative visitor vigilance by the male and increased food-related behaviour by the male and one female. Privacy screens on the exhibit windows and inside the indoor area were related to decreased visitor vigilance in the male and one female. Finally, one female showed a marked reduction in regurgitation and reingestion (RR) and reduced her negative vigilance of visitors when a small window leading to the outside of the exhibit was covered. Overall, this paper presents information relevant to gorilla husbandry and demonstrates the utility of combining non-invasive faecal and behavioural sampling in welfare assessment.

It looks like an average antelope, smells like an average antelope; but is it an average antelope?
A review of captive sitatunga (*Tragelaphus spekii*) enclosure use

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Sitatunga (*Tragelaphus spekii*) are a semi-aquatic antelope from central Africa and are kept in many zoological collections around the world. There appears to be limited current information on sitatunga husbandry and behaviour in captivity. Enclosure design is known to be an important aspect affecting species welfare; however ungulates seem to be overlooked when it comes to enclosure design as they are 'just' grazers or browsers, in favour of more 'intelligent' species such as primates. It is well documented that welfare can be measured via the frequency of normal and stereotypical behaviour performance. Common behavioural disturbances exhibited by ungulates include oral stereotypies (such as tongue-playing) and locomotory stereotypies (such as pacing), both of which can be due, in part, to frustration caused by a lack of biologically-relevant environmental stimuli. This research was conducted at Cricket St Thomas Wildlife Park in Somerset; eight sitatunga were observed over a 50-hour period during July 2009. Observations were conducted during three sections each day (morning, midday and afternoon) to allow for behavioural patterns to be assessed over time. The enclosure encompassed both natural (long grasses and waterbeds) and artificial (plain open short grass) zones. The enclosure was zoned according to features that were thought to be of significance to the sitatunga, influencing behaviour and time spent within that zone (e.g. grassy banks, waterfalls and open water pools). The data was analysed using a modified Spread of Participation Index (as per Plowman, 2003) and Chi-Squared analysis. It was found that significantly more behaviours occurred in the natural zones of the enclosure with significant occurrences for three behaviours (standing, sitting/ruminating and eating) between natural and artificial zones, as well as during morning and afternoon observations ($p<0.05$). The time budgets of these captive sitatunga were also noted to follow natural behaviour daily activity patterns as there was similarity with research conducted by Owen (1970), Games (1983) and Starin (2000). All of the results from this study indicate that the natural aspects of the sitatungas' enclosure are highly beneficial to their welfare; no sterotypies were recorded during the observation times and key appetitive behaviours (for example rumination) were performed frequently. It can be seen that enclosure design evaluation provides an effective method of better understanding species' captive needs. Suggestions have been made to apply this system of evaluation to other ungulate species, such as bongo (*Tragelaphus eurycerus*) and okapi (*Okapi johnstoni*), which both inhabit natural environments that can be difficult to replicate in captivity.

Environmental enrichment and its effects on South American fur seal (*Arctocephalus australis*) behaviour

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Environmental enrichment is an important concept within zoos and aquaria and is a valuable concept used to encourage the performance of natural behaviours, increase behavioural diversity and reduce the performance of stereotypic behaviours. The majority of studies documenting the effects of environmental enrichment on animal behaviour are focused on terrestrial mammals with a strong bias towards agricultural animals. There are few peer reviewed papers concerning the behaviour of pinnipeds both *in situ* and *ex situ*. Consequently, this study investigated the effects of environmental enrichment on the behaviour of a group of five captive South American fur seals (*Arctocephalus australis)*. Four different enrichment devices were tested; ice blocks containing fish, a waterfall, a raft provided as a haul out area and seal pearls, a commercial enrichment device produced by Aussiedog™ consisting of three hard plastic balls mounted on a strong yachting braid. The outer balls had holes in them to allow pieces of food to be placed inside. Each device was presented on a random schedule with either a one or two week gap between presentations. Behavioural data were collected during three time periods: 1000-1200, 1200-1400 and 1400-1600 hours. Instantaneous focal sampling was used to record behaviour, every 30 seconds for 10 minutes on each study subject once during each time period, daily. When the enrichment was presented the latency to first use and the numbers of return visits were also recorded. It was predicted that enrichment would 1) change the amount of time the seals spent performing specific behaviours, specifically active and stereotypic behaviours and 2) that subjects would prefer food-based enrichments. Data were analysed using General Linear Mixed Models in SPSS. It was found that the seals spent significantly more time locomoting on land on days when enrichment was present and the performance of stereotypical behaviour in one of two stereotyping subjects decreased when enrichments were provided. The mean latency to approach a device was lowest for the ice block and highest for the waterfall which was also the enrichment with the highest number of repeat visits. The seals were more active on enrichment days and were therefore observed entering and emerging from the water more frequently. It may be suggested that the presence of food increases motivation to interact with a device but once the food is consumed the motivation for interaction with enrichments is lost. These findings demonstrate that enrichment can promote active behaviours and decrease performances of stereotypic behaviours in captive *A. australis*. This study provides evidence that the inclusion of both food based and non-food based enrichments should be considered when developing an enrichment programme for captive pinnipeds.

Bonds between zoo professionals and their animals

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Some human-animal relationships can be so positive that they confer particular benefits in terms of emotional well-being to both partners in the relationship, and can thus be viewed as bonds. Although we are familiar with bonds with our companion animals and other animals, the possibility that zoo professionals form bonds with any of the animals in their care has been largely unexplored. The aim of this study is to identify whether zoo professionals believe that they have established bonds with any of the animals they are in contact with; whether any demographic or occupational variables correlate with perceived bond formation; which species zoo professionals report bonding with, and what they believe the benefits of these bonds to be, both for themselves and their animals. A total of 130 questionnaires were completed by delegates at three different zoo research and training events. Respondents were asked for information about their professional work in the zoo and whether they believed they had established bonds with any animals. They were also asked to indicate agreement or disagreement with several statements about human-animal bonds. Results showed that many zoo professionals consider that they have established bonds with some of their animals; 103 respondents believed that they had a bond with at least one animal, and 80 of these identified that the bond was with a zoo animal. The most frequent bonds reported were with primates (n=24) and carnivores (n=19), although several also reported bonds with marsupials (n=8). Perceived benefits of these bonds to the respondents included both operational (animal easier to handle, easier to administer treatments to) and affective (sense of well-being, enjoyment at being with the animal). Identifying benefits to the animals is more difficult, and several respondents said that they did not know. Most, however, identified similar benefits for their animals as for themselves, i.e. operational (animal responded more calmly, appeared less stressed) and affective (animal appeared to enjoy contact with respondent, seemed more content). This suggests that bonding between zoo professionals and their animals could have profound consequences for the management and welfare of the animals, not to mention the job satisfaction of the people involved.

Visitors in the dark: Studying perceptions and behaviour of visitors at the nocturnal house in Antwerp Zoo

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Nocturnal houses with a reversed night-day cycle are popular zoo exhibits and offer great potential to show zoo visitors the behaviour of unfamiliar animals that are only active at night time. At Antwerp Zoo, the nocturnal house was originally built in 1958 and was renovated in 2005. Several smaller exhibits were combined into seven larger mixed species enclosures, each representing a specific bio-geographical region. Interactive education displays, a computer game, information panels using Braille, text panels and television screens had been added. However, within the zoo, some people believed the nocturnal house was too dark and that more light should be provided. In August 2009, we investigated the effect of increasing the light intensity at the exhibits from 10 to 20%. We measured visitor perceptions by asking 1000 visitors to rate characteristics of the building ("lighting", "decoration", "number of animal species seen" and "accessibility") on 5 point scales (345 visitors under 10% and 655 under 20%). We studied visitor behaviour by tracking the behaviour of 400 visitors (183 under 10%; 217 under 20%). In general, visitors gave highest appreciation scores to "decoration" and "lighting", and lowest scores to "education". Visitors gave higher scores to "lighting" and "decoration" when lighting was increased. Interestingly visitors also gave a higher score to "number of animals seen" and a higher proportion of visitors believed to have seen more than 15 species of animals, while there are actually only 14 species present. In contrast to visitor perceptions, visitor behaviour did not differ significantly under the two lighting conditions: mean residence time was similar under 10% (7 minutes) and 20% (6 minutes), and no increase in attracting power or holding power of the exhibit elements was observed. Animal exhibits were the most popular exhibit elements, together with the interactive education panels. TV-screens, text panels and the Braille information panels were the least attractive to visitors. In general, visitors only stayed 7 minutes in the building, which is probably too short for their eyes to adjust to the darkness. However, when we provided visitors with a form on which they could mark the species they had seen, dwell time doubled, irrespective of the lighting conditions. So when provided with a challenging stimulus, visitor experience could be increased. In conclusion the increase in lighting did not change visitor behaviour, but did change visitor perceptions considerably.

Visitor research, education and collection planning: How can visitor preferences for viewing animals help us?

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As zoos have sought to further their conservation missions, they have become powerful providers of environmental education. Outside of 'formal' education initiatives, such as those designed for school and other organised groups, or structured public talks programmes, much of the learning potential that the zoo has to offer is around the viewing of animals and the response of visitors to them. In this, zoo learning is a very personal construct, and develops from the prior knowledge, experiences and motivations of each. In this paper, we make the assertion that learning potential, although difficult to quantify, is very much related to the attractiveness of animal species and the interest that visitors show in them. Using standard measures of visitor attraction and interest (the proportion of visitors that stop and for how long), we analysed the relative interest in 40 zoo species held at Chester Zoo (n=1863) and the variables that are significant in predicting that popularity. Further to this, we propose that the zoo collection planning process could utilise such information to make more informed decisions about which species should be housed for their educational value. This is particularly apt where a zoo (such as Chester Zoo) employs an institutional collection planning system that attributes 'Primary' roles to the species it houses. If a species is kept primarily for its 'educational' role, then it is proposed that this species be of interest, to some extent, to visitors – or suitable remedial measures are employed to increase this interest. As zoos face criticism over the lack of peer-reviewed evaluation of their educational output, we argue that species should not be brought into collections on an education 'ticket' unless the educational value of a species can be properly evidenced. Using hierarchical and stepwise regression methods, taxonomic grouping was found to be the most significant predictor of visitor interest – that is, visitors were far more interested in mammals than any other group – although body size (length), increasing animal activity and whether the species was the primary or 'flagship' species in an exhibit or not, were all found to have a significant bearing on visitor interest.

Water Therapy: An update on 'Oceans and Human Health' research at the National Marine Aquarium

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Learning about the marine environment can be developed through engagement – Surfers against Sewage is a powerful example of a user group becoming well informed and active as a result of their sport. To this end, encouraging the public to make use of the seas as a leisure or educational resource can yield benefits. The area of Environment and Human Health is a growing field of medical science and the evidence-based approach to highlighting the positive health benefits of outdoors activity is a strand that is being pursued by the Peninsula Medical School. During the past two years the National Marine Aquarium has been engaged in its own 'Oceans and Human Health' research. Our interests focus on how a person's interaction with the marine environment (whether real or simulated) influences their physical and/or mental health and, furthermore, whether these interactions affect their environmental attitudes and behaviours. Working with a number of different organisations including the University of Plymouth and Natural England, the NMA has been involved with a range of different studies and initiatives. These have included investigating the perceived restorativeness of aquatic environments using photographic images; exploring the effect of an aquarium visit on pro-environmental attitudes and behaviours; establishing a walking group around Plymouth's maritime waterfront; involvement with the Blue Gym and a mass-participation event, the Blue Mile. Working with University's psychologists and sport scientists we have also examined the health profiles of children in the South West, their participation in marine-based recreation and whether this links with their environmental concern. An overview of progress to date will be presented.

GUEST LECTURE

A carcass a day keeps the vet away

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Carnivores often show metabolic disorders in captivity. Especially felids have a high incidence of gastro-intestinal and renal diseases. These problems are hardly seen in the wild, showing its captivity-related origin. Malnutrition is often perceived as a cause, yet often without particular proof. For commercial mixed diets, typical differences with wild diets are obvious, e.g. carbohydrate level. Yet, problems also occur in zoos where fresh meat is offered. This raises the question which differences are still left with nutrition in the wild. To correct for the lack of bone intake when feeding only meat, calcium is commonly supplemented. Still, our study in cheetahs, comparing complete rabbit with supplemented beef meat, demonstrated that apart from being a calcium source, bones and other indigestible parts clearly affected intestinal fermentation. Meat feeding vastly reduced the fecal acetate:propionate ratio in comparison with rabbit feeding. This suggests that fermentation is more rapid when lacking "animal fibre" (bone, skin, connective tissue, hair,...), and is likely to be associated with a much faster transit time. Carcass feeding thus seems to behave bolus-like on the provision of energy between daily meals, whereas only-meat feeding might give rise to a quick drop in satiety. On the one hand, it is therefore warranted to evaluate the interaction between the application of a fasting day in many zoos and the type of feeding, especially in view of possible hunger stress. On the other hand, the lack of satiety might lead to overconsumption, leading to the known adverse aspects of obesity including diabetes, cardiovascular disease and inflammatory status. An additional problem of overconsumption is the fact that part of the meat that would otherwise be enzymatically digested will now end up as substrate for intestinal bacteria. Meat feeding in the cheetahs indeed increased the fecal indole concentration, as an indication of bacterial protein degradation, with a concomitant increase in plasma indoxylsulphate. The latter is known as a nephrotoxic substance. It thus suggests that the absence of "animal fibre" in combination with large meals might stimulate the emergence of kidney failure. Seen the high incidence of deaths because of kidney failure in captive carnivores, especially certain felid species, the potential impact of diet choice for carnivore species on kidney health deserves more attention. Satiety is commonly associated with dietary fibre. It has indeed been demonstrated in dogs that dietary fibre type can affect voluntary food intake. Yet, the role of dietary fibre – whether of plant or animal origin – in carnivore diets is still not fully understood, at least knowing that endocrinological signalling clearly differs from other species. The recent finding that propionate from intestinal fermentation can save amino acids from being catabolised as energy source in domestic cats, points to diet-modulated mechanisms that can affect the carnivore's energy balance and eventually feeding behaviour. Even if carcasses are fed, differences with the wild still remain, simply because the nutritional composition of live prey in the wild still differs from production animals, e.g. higher content of omega-3 fatty acids (anti-inflammatory support), differences in trace elements and different bacterial contamination. Nevertheless, each step forward in the understanding of carnivore digestive physiology will serve their conservation.

An overview of carcass feeding: Health, behaviour and public perception

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The provisioning of carnivores in captivity is a highly controversial subject due to the nature of their wild diet; most species actively hunt live invertebrate or vertebrate prey or will scavenge other kills. Many zoos cannot provide a 'real' hunting experience due to the need to consider the welfare of the prey animal and legal obligations. One way in which zoos can provide a more 'natural' foraging/feeding experience is to provide captive carnivores with whole animal carcasses. At the 7th International Conference on Environmental Enrichment (ICEE), New York, a number of authors contributed to the symposium 'to carcass or not?' As part of this symposium a number of issues were addressed, and research conducted. An overview of three of the main findings will be presented here.

1. Health implications:

A questionnaire was sent to a total of 192 zoological collections worldwide in order to establish the extent to which whole carcasses are fed to a range of felid and non-felid carnivore species. Fifty-two responses were received (26.5%) and 171 separate data sets were obtained. Quantitative data collected included, (1) Feeding method, (2) species, (3) enclosure size, (4) enclosure complexity, (5) amount of non-food enrichment, (6) frequency of keeper observations, (7) frequency of vet observations, (8) frequency of parasite testing, (9) wild prey caught, and (10), sourcing, (11) screening and (12) storage of carcasses and meat (13) the incidents of disease occurrence (14) parasite occurrence and (15) any injury directly attributed to feeding from whole carcasses such as perforation. Results suggest that feeding whole carcasses does not impact on the health of zoo-housed carnivores. However screening and storage methods of other feed types may influence the occurrence of health problems.

2. Behavioural benefits:

Both environmental enrichment (EE) and carcass feeding have been found to elicit natural feeding behaviours in captive carnivores. A review of the current published literature was conducted in order to collate all studies where either carcass feeding or EE was implemented into carnivore feeding regimes. In total there were eight carcass feeding & 14 carnivore EE papers. The results showed that, i) current research is heavily biased towards felid species, ii) neither carcass feeding nor EE have been shown to elicit 'all' the range of natural feeding behaviours, however when used together in an integrated feeding programme they could.

3. Public perceptions:

A negative public reaction is often cited as a reason for not providing zoo-housed carnivores with carcasses. In order to address this issue data were collated; on visitor perception of carnivore feeding methods, a standardised questionnaire was developed and sent to zoos that were previously studied during the carnivore health study. The questionnaire asked zoo visitors to respond to various questions/statements on a Likert scale, e.g. zoo housed carnivores should be fed live prey, do you 1) strongly agree, 2) agree, 3) neither agree or disagree, 4) disagree, 5) strongly disagree. Surveys were conducted on site by staff members from each institution. One hundred and seventy-two surveys were returned from institutions throughout Europe and Australasia. The results indicate that the general public were opposed to live prey feeding on-show, however most would watch whole carcass feeds. There was a general trend that as the carcass species relative size went up i.e. from fish to horse, members of the public would be less inclined to watch. The most effective way of informing the public about the benefits of carcass feeding would be through keeper talks.

Oranges for orange monkeys? Fibre intake & food preference in captive Javan langurs (*Trachypithecus auratus*)

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Javan langurs (*Trachypithecus auratus*) are a folivorous primate that can suffer from health complications and shortened life-spans linked to inappropriate captive diets, as seen from anecdotal data. As *T. auratus* has a specialised gastrointestinal tract (to enable digestion of structural carbohydrates found in plant materials), it is important that captive diets promote the health of commensal gut microflora integral to optimal gastrointestinal function. The diets of four groups of *T. auratus,* housed at four UK zoological collections were analysed to determine average (group) intake, fibre content and the impact of food preference on fibre intake. Samples of both feed and faeces were collected from each zoological collection to perform analysis to determine percentage of ADF (Acid Detergent Fibre) and NDF (Neutral Detergent Fibre) ingested, excreted and utilised by the langurs. Captive diets consisted of a mix of commercial primate pellet, commercial fruit, root vegetables, eggs, leafy greens and some browse. Both food given and food remaining were weighed to determine group consumption. Behavioural observations were carried out to determine each of the *T. auratus'* food preference through use of a tally chart recording the first ten choices of food item. Finally photographs of faecal samples were taken to enable comparison of faecal consistency between the four sample populations. Although diets were not standard between collections, results suggest that there is a relationship between the total diet offered and preferred food choice. The four collections all provided diets with significantly different fibre content (one-factor Chi-Squared, $P<0.05$). Zoo B was found to show the highest NDF content (23%) compared to the remaining zoological collections (A =19.33%, D = 10.99%, C =6.16%). However, this is partly due to the food preference which was further examined. Leafy greens made up 34% of the supplied feed at Zoo C instead of a high percentage of vegetables provided at the other zoological collections such as Zoo D with over half of the diet (52%) consisting of beans. Despite these differences, all animals still showed a preference for highly fermentable foods. The food preference data was found to be different at each zoological collection with only one zoo showing a representation of what would be expected in wild, free ranging langurs (and nearing suggested captive nutrition guidelines). Comparison of faecal scoring showed that there is a slight correlation between dietary % NDF and faeces quality. Zoos A and B (with the provision of a diet with higher NDF compared to Zoos C and D) were found to have better faecal scores, compared to a poor/loose faecal quality at C and D. This was also found to correlate with low % NDF in the diet; however, these results are subjective. Overall it is concluded that there appears to be a relationship between type of food provided and faecal quality. As stated in published literature, there is a trend for diets based on commercial produce to cause faeces of poor consistency; this should be further investigated, indeed all collections provided dietary fibre below recommended values.

Temporal distribution of feeding and its effect on activity patterns of zoo-housed Blue-eyed Black Lemurs (*Eulemur macaco flavifrons*)

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The blue-eyed black lemur (*Eulemur macaco flavifrons*) is a critically endangered species whose main threats in the wild include habitat loss and hunting. Much of the captive population is overweight, a factor which may be affecting reproductive rates. This includes the pair at Edinburgh Zoo – the average wild weight for this species is 1.9 kg; the male and female at Edinburgh Zoo are 2.9 kg and 3.5 kg respectively. This is thought to be partly due to the high energy content of cultivated fruit and vegetables in their captive diet, but also due to their inability to perform natural activity patterns because of when they are fed. The species is a cathemeral one which, *in situ*, would normally spread its foraging behaviour over the entire 24-hour day. At Edinburgh Zoo, the pair is fed three times between 9am and 6pm each day and spends the rest of its day mainly inactive. The aim of this study was to encourage activity patterns similar to those seen *in situ* by spreading feeding more evenly over the 24-hour day. Automatic feeding devices were used to dispense the lemurs' normal diet in portions throughout the day and night. The overall amount of food the lemurs received each day did not change. The battery-powered feeding devices consisted of trapdoor compartments controlled by pre-set timers which drop food into a chamber at pre-set intervals. Each feeder was housed within a wooden box which could be raised to any level in the enclosure using pulleys. Three feeders were used; one in the lemurs' house and two hanging from pulleys in the outside enclosure. The dispersal rate of the feeding devices alternated every two days between the original 9am to 6pm regime and the new 24-hour regime. Both regimes involved five separate feeding events. This cycle continued for six days. Behaviour and spatial use of each lemur was recorded between 9am and 6pm. It is expected that the pair will perform active behaviours more frequently and use more of the enclosure area during the new 24-hour feeding regime than during the 9-6 feeding regime. It is also expected that high-energy behaviours such as locomotion and climbing will increase during the new feeding schedule. If successful, this system of feeding will be of great benefit to keepers by allowing them to cater for the lemurs' natural activity patterns without changing their own working hours. Some extra time was needed to distribute the animals' daily rations amongst the feeder compartments and to hoist each feeder into position but once this was done, the animals required little extra attention during the day. If successful, automatic feeding devices may offer a relatively low cost and low effort solution to the welfare problems of cathemeral species in zoos.

Anxiety in mother-infant relationships in hamadryas baboons (*Papio hamadryas*)

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It is known that the relationship between mother and infant can be stressful (Altmann, 1999). This study looks at the effects of various factors, including infant age, mothering style and relationship quality on anxiety in mother-infant relationships in hamadryas baboons (*Papio hamadryas*). This observational study focussed on eight dyads within the troop of 63 hamadryas baboons housed at Paignton Zoo Environmental Park, Devon, UK. Data collection was carried out between Nov 2008 and Feb 2010 as part of a longitudinal study for the baboon group. Five 10-minute continuous focal follows on both the mother and the infant's behaviour were carried out on each individual per month for up to ten months. Rates of self directed behaviours were used as indicators of anxiety for both mothers and infants. The effect of a series of variables (parenting style, mother-infant relationship and social interaction scores) were calculated from the data and their effect on anxiety levels tested. Generalized Linear Mixed Models were used to analyse the data. Initial findings of this study suggest that there was a significant effect of infant social interaction quality on the self directed behaviour of the mothers (Wald χ^2 = 12.302, d.f = 1, $p < 0.000$). As infants interact more frequently with other individuals, the mother becomes more anxious. This may be suggestive of increased distance between mother and infant as the infant interacts with other group members. Infant anxiety was not significantly affected by any of the factors we tested. This result suggests that self directed behaviours may not be a suitable indicator of anxiety in infants of this age group and indicates the need for further research into the relevance of self directed behaviours as indicators of anxiety in infants.

How the death of a herd member affects social dynamics and influences PC training of the Asian elephant herd at Blackpool Zoo

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Elephants are a particularly difficult species to maintain in zoos due to their high intelligence and complex social systems, and studies regularly report behaviour such as stereotypic swaying, head bobbing and aggression (Irwin & Wells 2008). Elephants in zoological gardens or other captive environments are usually kept in un-natural, non-kin groups and evidence has shown that female Asian elephants may form special relationships known as dyads (Garai 1992). Few studies have reported the long-term effects of death or removal of one member of a special relationship on the remaining individual and on the social dynamics of the remaining herd. The behaviour of three captive Asian elephants was studied to investigate the change in social dynamics and in particular, agonistic interactions between two individuals, after the loss of a herd member. The data collected will be used in a long-term study which began in February 2009 when the decision was made that one of the four herd members would be euthanased due to severe, degenerative osteoarthritis. The herd of four elephants comprised two dyads, of which the deceased individual was the special companion of the dominant female. Shortly after this loss, the training method of the three remaining elephants changed from Free-Contact training (elephants and keepers share the same space whilst training) to Protective-Contact training (all the training is performed through a reinforced steel wall). An increase in aggressive behaviour within the herd, notably by the dominant female to the most subordinate female resulted in night-time separation of the two individuals and separation when the third individual was removed for training. The elephants' daily activity budgets were studied to determine differences pre-separation, during separation and post-separation. Observational data were collected using continuous focal sampling of behaviours. Each elephant was observed for 5 minutes within each 15-minute interval, totalling 20 minutes within each observational hour. The duration of thirteen behaviours were recorded: feeding and foraging, enrichment feeding, training, stereotypy, locomotion, resting, social, investigation of conspecifics, investigation of objects, aggression, urination and defecation, dust-bathing and vocalisation. The individuals were observed in a set routine to reduce bias from over sampling of desired behaviours. Behavioural data totalled 250 hours over 59 observational days. Preliminary results indicate aggressive behaviour exhibited by the dominant female towards the most subordinate female decreased once all herd members were re-integrated and had full outside access at night but were still separated when the third individual was taken out of the group for training. Further analysis is required.

Bookkeeping for bonobos: Short and long term reciprocity in grooming

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Reciprocation has been found for several behaviours in both human and non-human primates. There is however still a debate going on regarding whether non-human primates are able to keep track of previous interactions and on what time-scale they are able to do this. Are they able to remember on long term bases or can they only reciprocate on very short term bases? While several studies in monkeys found only short term reciprocity, chimpanzees seem to be able to reciprocate significantly more symmetrically on long term bases than on short term bases. According to previous studies using matrix correlations, bonobos as a group groom reciprocally on a long term basis, in groups with a relatively shallow dominance hierarchy. No information on reciprocity at a dyadic level nor on short term reciprocation have been published so far. We collected data on grooming reciprocity in three groups of captive bonobos (*Pan paniscus*) at Planckendael Wild Animal Park, Belgium. We monitored all grooming bouts and agonistic encounters using all occurrence sampling for a total of 751 hours. Observations were made from a total of nine adults and two subadults. We 1) studied reciprocity over different time periods, 2) look at factors (grooming received, sex, kinship, dominance, proximity and age) that might influence the duration of grooming that is given, and 3) discuss the variation in reciprocity in relation to age, sex, kinship and dominance relations of the different dyads. Reciprocity in grooming was analyzed on four levels (within episodes; within bouts; on a daily basis; across periods). Preliminary analyses show symmetrical reciprocation on long term and very short term bases. The results will be further discussed in the light of current theories on biological markets and cognitive abilities.

Distress prevention by grooming others in crested black macaques

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Allogrooming is probably one of the most common and most studied social behaviours in a variety of animals. Whereas the short term benefits for the groomee have often been investigated, little is known about the effects for the groomer. Our study focused on the short term effects of grooming another group member in seven adult female crested black macaques (*Macaque nigra*). We found reductions in self-directed behaviour, an indicator of anxiety, and aggressive tendencies, soon after grooming, when compared to matched-control periods. These findings can be interpreted as evidence of distress prevention, possibly mediated by an increase in tolerance. Indeed, a former groomee was more likely to be the nearest neighbour of a former groomer in the 10 min after grooming ended. Thus, the role of grooming in short term distress alleviation can be applicable to the groomer as well as the groomee. These short term effects, together with the longer term effects of large and/or strong grooming networks confirm that grooming, as well as receiving grooming, has great importance for social dynamics.

Research needs and the needs of researchers: how can we join them up?

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The importance of zoo research has been emphasised in several recent documents (e.g. WZACS, 2005; The EAZA Research Strategy, 2008; van Eysendeyk, 2010), all of which highlight how valuable research can be in improving all aspects of zoo and aquarium operations including husbandry, visitor services, education and conservation. However, within BIAZA this value does not appear to be universally recognised; for instance only about 15 of BIAZA's 100 members regularly send delegates to this symposium and these are rarely senior staff members in a position to implement change in response to research results. One reason for this appears to be that zoo-based research is often not seen, and indeed is not, relevant to the immediate needs of the zoo. This is demonstrated by the huge taxon bias in zoo-based research towards large mammals; e.g. in the first 10 BIAZA research symposia there were nearly four times as many presentations on primates as on reptiles, amphibians, fish, invertebrates and plants combined. This bias cannot possibly reflect the needs of zoos and aquariums. Not all zoo-based research is in an applied area so by nature will not be relevant to zoo practices and we encourage the use of living collections as scientific resources for the pure advancement of knowledge. However, much apparently applied research is conducted in zoos that still does not appear relevant to the zoo and/or has no outcome in terms of impact on zoo practices. Improving this situation needs more active direction from zoos about what research is needed and better communication between the zoo and research communities. Priority research areas must be identified by zoos. Within BIAZA, in terms of animal husbandry and conservation, the people best placed to do this are the members of the Taxon Working Groups (TWGs) who work directly with animal and plant collections. These are also the people who are able to incorporate recommendations from research into husbandry practices. Better communication is needed between the TWGs and the Research Group in order to set research priorities, make the wider research community aware of these priorities and feedback research results to those who can make a difference. To achieve this each TWG now has a named research representative who will attend the TWG annual meeting, help the TWG to identify problem areas and convert these to research questions and report back on any research relevant to TWG. The BIAZA research database is an essential tool to enable them to do this and we encourage all zoos to contribute details of any research carried out or hosted by them to this database. We hope that these new initiatives will improve the relevance and impact of zoo-based research, enhance mutually beneficial collaborations between zoos and external researchers and help zoos to achieve the goal of integrating good research into all areas of zoo operations.

Tortoises go green

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The primary aim of this study was to decrease the energy used to, and thus cost of, heating enclosures. When reducing costs it was imperative that the animals' environmental requirements continued to be met. Several animals were studied, but this presentation will focus on the Aldabran tortoise *Geochelone gigantea*. Their indoor enclosure is heated by three heat lamps, under floor heating and a fan heater, two UV lamps also provide some heat. The three heat lamps alone if constantly switched on require 7218.38 kilowatt hours per year at a cost of approximately £649.74 per year. Observations of the tortoises with access to outside areas and during different seasons were carried out to provide an indication of: the temperature range they choose to be in, and whether there are opportunities for reducing the heating provision to this enclosure. Instantaneous scan sampling of all seven individuals was used to record, 'Feeding, Locomotion, Resting in Contact with Another Tortoise and Resting Not in Contact with Another Tortoise', location within the enclosure and proximity to a heat lamp (thermal zone) every 30 minutes, for 24 hours during three conditions: winter with (five days) and without access (10 days) to the outdoor area (during December and January 2009/2010) and spring with access to the outdoor area (10 days, April 2010). Data loggers recording the surrounding temperature at 10-minute intervals were attached to the study subjects. Data were used to construct activity budgets and calculate spread of participation indices (SPI - a measure of enclosure use). There was a significant difference in mean percentage time spent in various state behaviours (repeated measures $F_{[8,18]} = 5.314$, $P < 0.01$). Post- hoc pairwise comparisons showed differences between mean percentage time spent feeding, resting in contact with another tortoise and resting alone over the different conditions. SPI values showed minor differences between winter access and spring access even though enclosure size nearly doubled. Thermal zone 4 i.e. the outside area, was used significantly less in winter (with outdoor access) than in spring (matched paired t- test $t_{[6]}= -17.446$, $P<0.001$). The data loggers recorded mean highs of 30.94ºC in winter no access, 30.32 ºC in winter with access and 40.58ºC in spring with access. Mean low temperatures were recorded at 23.43 ºC in winter no access, 15.04 ºC in winter with access and 17.58 ºC in spring with access.

Our results indicate that the tortoises spend a higher mean percentage of their time outdoors during the warmer months of the year (23.04% in spring with access compared to 3.10% in winter with access); it may therefore be possible to make changes to the heating systems used to regulate the temperature in their indoor area. A thermostat could be used, or the heating switched off during the day time which would result in a reduction of energy used and money saved. The results from this study have large ramifications for wasting less energy and implementing systems which would be more environmentally friendly and cost effective, whilst still meeting the welfare needs of the animals.

Birds under the spotlight: how does the red bird of paradise *(Paradisaea rubra*) respond to the instillation of an ultraviolet light source?

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Chester Zoo has several aviaries where birds are enclosed in temperature controlled environments without outside access and light is provided through transparent roofs or artificial sources, thereby eliminating exposure to Ultraviolet (UV) light. Evidence is emerging that birds require light at ultraviolet (UV) wavelengths for their health and well being. Birds are able to see UV wavelengths (300-400nm) which they have been shown to use for mate selection, foraging, and the control of circadian rhythms. UV light is also important for vitamin D3 synthesis in birds. UV can be added using specialist bulbs. The UV light exposure from a bulb diminishes as you move away from the light source, up to a distance of approximately 2m from the bulb where the UV wavelengths can no longer be detected. The light source is at its most effective at 60cm from the recipient. These aspects considered, if the bird showed preference for the UV light, you would expect to find the bird in close proximity to the light source. At Chester Zoo, Islands in Danger is one area where birds are housed entirely indoors. It is an exhibit containing tropical island species that are endangered in the wild, including the red bird of paradise *(Paradisaea rubra*). A drive to make the bird's environment as naturalistic as possible has led to the instillation of UV lights. Does the spatial use and behaviour of the red bird of paradise change under different lighting treatments and specifically, do the birds perch close enough to the ultraviolet lights to derive any benefit? In this study, we observed the red bird of paradise under the baseline condition of light from ambient sources (e.g. what filters through roof panels which are not UV transmissible). Experimental treatments were: 'new' Osram™ Ultra Vitalux mercury vapour lamps inside the enclosures, close to suitable perching and providing a source of UV wavelengths but also heat. Used 'old' Osram™ Ultra Vitalux mercury vapour lamps were also trialled. Since the birds have never had bulbs in their enclosure before, this last treatment tests whether changes in behaviour are a response to the heat emitted by these powerful bulbs. Behaviour and spatial use were recorded at 3-minute intervals over an hour-long period, twice a day for three weeks per treatment, with observations from April-June 2010. The preliminary results will be presented and implications for management of the birds discussed.

The development of an enzyme immuno-assay to non-invasively measure adrenal activity in the okapi (*Okapia johnstoni*), black rhino (*Diceros bicornis*) and Asian elephant (*Elephas maximus*)

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There are many problems associated with health and reproduction that are often related to adrenal activity. Endocrinology can be used to assess adrenal activity and lead to measures which resolve such problems. This study has developed an enzyme immuno-assay to non-invasively measure adrenal activity in okapi faeces, Asian elephant faeces, black rhino faeces and black Rhino urine. In order to establish an accurate and repeatable method, a range of factors were manipulated to produce a high quality assay. Nunc maxisorp II and Immulon II plates were both tested, as well as the direction and amount of light during incubation, plate loading temperature, substrate reagent temperature and the addition of a non-specific IgG. The assay has been validated both chemically, using a parallelism and interference assessment, and biologically through individual responses to a challenging event. The optimum assay conditions include room temperature substrate reagents and dark incubation. This enzyme immuno-assay to measure glucocorticoids provides a comprehensive method which can be utilised for a potentially vast range of species.

Introducing mate choice in captive breeding programs: Opportunities and challenges

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Zoos are starting to consider incorporating mate choice in breeding recommendations that now are based almost solely on pedigree analysis and genetic and demographic parameters of captive breeding programs. Anticipated advantages of allowing mate choice include increased reproductive success and enhanced animal well-being, and possibly even improved maintenance of genetic diversity for captive breeding programs in zoos. However, at a recent meeting in Saint Louis Zoo, USA, mate choice specialists and researchers from within the zoo community recognized that we currently lack sufficient information about how mate choice might operate in the wide variety of species represented in zoos. Obviously, this knowledge gap creates great challenges and opportunities for zoo and university researchers, and students working in a zoo setting. Apart from basic research into how mate choice works in most species, the main question that needs to be addressed is whether incorporation of mate choice in captive breeding programs can increase the reproductive output in managed programs without compromising the genetic health of each species population. This presentation aims to give a concise overview of the mate choice related issues at hand and to propose some research opportunities for zoo-based research projects.

Birth sex ratios in captive cotton-top tamarins *(Saguinus oedipus)*: The effect of mother's age, parity, group size and group composition

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The Local Resource Enhancement (LRE) hypothesis predicts that females of cooperatively breeding species will bias their investment towards the production of the more helpful sex. LRE has been used to explain the male bias in cooperatively breeding callitrichid species such as the cotton-top tamarin *(Saguinus oedipus*) as male non-breeding helpers (alloparents) invest more in infant care than females (Silk & Brown, 2008). This study aimed to test the predictions of the LRE hypothesis and to determine how other factors might contribute to biased sex ratios in this species. Data were extracted from the international studbook and, using a questionnaire design, were also gained directly from institutions housing this species. Results from 46 institutions and 86 mothers suggested that parity and age do influence the sex ratio at birth; young primiparous mothers produced more male biased litters than multiparous mothers. Older mothers were also more likely to produce sons than middle-aged mothers. It is suggested that young mothers may benefit from producing sons following dispersal and the formation of a breeding group containing no alloparents. Older mothers may benefit from producing sons in order to compensate for their reduced ability to successfully rear offspring to weaning age. Further analyses using systematic, robust statistical procedures such as GLMMs are required to eliminate confounding variables.

Does it matter if you're dull?
What role does carotenoid based colour play in nocturnal tree frogs?

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Tree frogs of the family Hylidae are notable for their bright colouration, however there have been anecdotal reports of muted colouration in captive anurans, particularly with respect to yellow, orange and red pigmentation. Carotenoids are pigments that confer yellow to red colouration in many taxa, however vertebrates are incapable of *de novo* synthesis and must obtain them through their diet. Colour degradation in captive anurans may therefore be caused by limited carotenoid availability in the diet. Carotenoids are known to function in cell signalling, immunomodulation and antioxidant systems in many taxa, however their importance for anurans is poorly understood. Furthermore, carotenoid-based colouration is often used for sexual or anti-predator signalling. Reduced colouration in captive anurans may therefore have important implications for *ex-situ* conservation of these species, as dull individuals may have reduced fitness and would therefore be unsuitable for reintroduction to the wild. We assessed orange flank and leg colouration in a wild population of *Agalychnis moreletii* tree frogs. Sexual dichromatism has not been reported in this species, however we found that males had significantly redder legs than females. Furthermore, males that had successfully formed amplexant pairs had redder legs relative to all males, which suggests a possible role for leg colouration in sexual selection. There was also evidence of assortative mating by colour, with brighter males preferring to mate with brighter females. We speculate that this evolved to prevent wasted breeding effort with a phenotypically similar sympatric species (*A. callidryas*). This is the first study to indicate that colour may function in mating behaviour in this species. This presentation will report on studies currently ongoing with *ex-situ* populations of *A. callidryas* tadpoles and *A. moreletii* to investigate the importance of carotenoids to growth, development, colouration, overall health and reproductive success.

Pair bonding behaviour and associations within a captive group of citron-crested cockatoos (*Cacatua sulphurea citrinocristata*)

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Citron-crested cockatoos (*Cacatua sulphurea citrinocristata*) are critically endangered, cavity nesting birds endemic to the South Indonesian island of Sumba. Cockatoos are gregarious, flock living birds and it is thought that this social system facilitates the formation of pair bonds between adult birds. In captivity cockatoos are traditionally housed with parent birds until being established in a breeding pair. This has resulted in low breeding success and high incidences of aggression within the pairs. Paignton Zoo Environmental Park has established an experimental colony of young birds (two male and three female). The birds will be kept together for 5 to 6 years to allow for pair bonding behaviours to occur before being split into breeding pairs. This research is the beginning of a longitudinal study focusing on the identification of pair bonding behaviours and associations within the colony. Instantaneous focal sampling has been carried out in 10 30-minute sessions (sampling on minute intervals) for all six birds. As well as behaviour, data on nearest neighbours were also collected to allow assessment of associations between individuals. All-occurrence scan sampling of affiliative behaviours was also undertaken during the 30-minute sessions. During this, the initiator of any affiliative interactions was noted as well as the duration of any interactions so that investment data could be calculated. Activity budgets were developed and the effect of individual and season were tested for significance using a PERMANOVA model. It was found that there were no significant differences between individuals. Differences between seasons were found to be approaching significance ($F = 2.77$ $p = 0.083$) which was not expected at such an early stage. Association indices were developed for the two data periods and this data was combined with investment data to show which individual was investing in the relationship. Associations between individuals within the group are already apparent and the level of investment can be defined. This research demonstrates that we can monitor associations between individuals in a flock situation. These associations will be followed as the birds mature, allowing predictions of mating preference and informing management decisions to improve breeding success.

Reproductive behaviour and physiology of social mongooses: From field to zoo research

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Social mongooses have emerged as excellent model organisms to study conflict and cooperation in mammal societies, thanks to long-term field projects on meerkats and banded mongooses. These studies offer rich baseline data on both behaviour and physiology which can be used to investigate the responses of social mammals to captivity. Here we present background information from our long-term field research, and describe our plans to carry out a cross-zoo study to explore the impact of the captive environment on stress, behaviour and reproduction. As a result of over 15 years research in the field on banded mongooses, we have a good understanding of how an individual's social environment influences its breeding success, behaviour and physiology. In particular, this data shows that infanticide in response to reproductive competition is a major source of pup mortality; that subordinate females synchronize birth to the same day to avoid infanticide; and that the failure of infanticide threats to enforce reproductive suppression leads to the periodic violent eviction of subordinate females from the group. Comparison of this field data with measures of behaviour condition, and hormonal in captive groups will help to understand the impact of captivity on within-group conflict and individual state, and how to ameliorate potentially deleterious welfare impacts. We discuss more generally potential synergies between field studies and zoo-based research.

Lights, camera, action: A multi-organisational partnership with a zoo, university, and wildlife filmmakers

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EAZA's Research Strategy emphasises the need for collaborations between zoos and external organisations to benefit from a wide range of specialities and resources. Working together can provide access to trained scientists, field researchers, and aimal care staff, reference libraries, specialised equipment, and organisation-specific target markets that might not be available within a stand-alone organisation. The Chimpcam Project brought together university researchers, zoo staff, and wildlife filmmakers to create a documentary about the chimpanzees of Budongo Trail as they started to participate in a cognitive research programme. Tasked by the funding body to provide chimpanzees with a video camera to see what they would do with it, a schedule of training and studies was developed to help the chimpanzees learn more about the properties of video, while also using video to better understand chimpanzee cognition at the same time. The studies began with an exploration of self-recognition using live video feeds of themselves, then progressed to training the chimpanzees to use a touch screen monitor, in order to identify patterns and preferences in choices of different live video feeds offered (of familiar places and chimpanzees within Budongo). While the initial focus of the research was on cognition, it ultimately covered a broad array of topics including animal welfare, assessment of the documentary broadcast and public engagement with science. The Project was a successful collaboration between three organisations: the University of Stirling, the Royal Zoological Society of Scotland's Edinburgh Zoo, and Burning Gold Productions (a wildlife film company under commission of the BBC and Animal Planet). We present a behind the scenes perspective and discuss how the needs and expectations of all organisations were met throughout the project in terms of design, research implementation, and outcomes, and present preliminary findings of the impact of the documentary.

POSTER ABSTRACTS

Testing the "artificial sisterhood" hypothesis in a newly formed group of bonobos (*Pan paniscus*)

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Bonobos have a reputation of being a female-bonded species. Studies from captive colonies stressed that females prefer to groom, support and associate with other females rather than males. From a socio-ecological point of view this is puzzling, since female bonobos are the migratory sex. Thus, when they migrate to a new group, they generally meet unrelated females with whom they form apparent bonds. It has been suggested females use this bonding to dominate males in the group. A somewhat caricature picture of "artificial sisterhood" arose, in which female bonobos form only close bonds with other females. Recent studies from the wild and from some captive studies indicate however that bonds between males and females are as strong as bonds between females. It has been proposed that the earlier studies reporting strong female bonding were probably biased, since these groups were only recently formed, or contained only one male, which is in contrast with later studies. In the current study we investigated the extent of female bonding in a newly formed group of bonobos at Planckendael Wild Animal Park Belgium, during two periods. Three months before the first period, a female together with one adult son, an adolescent son and a female infant had been added to the group. At the start of the second period a male was added to this group, and one of the adult females died. Under the "artificial sisterhood" hypothesis, we would assume that the remaining females would tighten the bonds amongst them, against the new male intruder. We found however that in both periods, grooming, proximity and proximity maintenance between females was not significantly more common compared to other sex-combinations. In fact, for half of the females, total duration of grooming decreased after the introduction of the new male. Only sexual interactions were more common between females than between other sex-combinations, but their frequency also decreased in the second period. There was no increase in female-female bonding after the arrival of the new male, but aggression from females towards males did increase. In both periods, we found a significant correlation between rank and grooming, indicating that dominant individuals receive more grooming than others. Moreover, the results show that individuals tend to reciprocate the grooming received. In general, these results challenge the "artificial sisterhood hypothesis". The relationships between female bonobos seem to result more from political strategies, which can include bonds with males as well as females. This warns us against any generalization concerning the existence of close bonding between female bonobos.

The stability of personality in captive chimpanzees (*Pan troglodytes*)

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The stability of personality in chimpanzees is a relatively understudied area; therefore this study aimed to assess the stability of personality in captive chimpanzees *(Pan troglodytes).* As methods of assessment of chimpanzee personality vary between studies, a secondary objective of this study was to test the effectiveness of two personality measures. Twelve subjects housed at Chester Zoo were observed by two raters for a period of approximately four months, allowing inter-rater reliability to be examined. Post-observation, each rater completed the two personality questionnaires: the Ten Item Personality Inventory (TIPI, Gosling, Rentfrow & Swann, 2003), measuring scores on the Five Factor Model personality factors, and the Murray Personality Measure (MPM, Murray, 1995), where chimpanzees were rated on 28 personality traits. Mean ratings from these questionnaires were correlated with results from previous studies of the same sample using the same scales (Murray, 1995; James, 2005; Simcock, 2006). Both personality measures indicated reliability as they showed the same pattern of trait stability over time. While there was evidence of considerable short-term stability in TIPI personality factors, it was found that the longer the time-span between trait ratings, the fewer personality traits correlated, suggesting that chimpanzee personality is changeable over time. This pattern supports most previous literature relating to chimpanzee personality stability; however, it rebukes a large amount of human research. Although most research suggests that many chimpanzee personality traits change as time passes, evidence for the direction of change of these individual traits is conflicting and requires more research. The current study found that the MPM traits which were stable over all time periods were Intelligent and Slow. The traits Equable, Gentle, Insecure, Maternal/Paternal, Permissive, Predictable and Popular, however, were not stable over any time periods suggesting that they are particularly changeable personality traits. Ratings for the TIPI factor Conscientiousness also did not correlate over any time periods suggesting that this is also a changeable personality factor. Emotional Stability ratings, however, correlated significantly over all time periods suggesting that this is a stable personality factor. The time period over which the TIPI ratings were made was considerably smaller than that of the MPM ratings, and so more research is needed to determine the long-term stability of TIPI factors.

A Madagascan mixed species introduction with crowned lemurs (*Eulemur coronatus*) and narrow-striped mongooses (*Mungotictis decemlineata*) at Newquay Zoo

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The use of mixed species exhibits in zoological collections is now a common way to mimic a natural environment. A successful mixed exhibit provides an enriched environment for all species involved. Specific goals may include increased activity levels, as the species interact directly (through social interaction or avoidance) or indirectly (through olfaction of scents left by a contra-specific). Some negatives involved in mixed-species exhibits may include aggression resulting in injury, inhibited reproduction, disease transmission, or nutritional problems. Furthermore, the species chosen must not disturb each other, especially during times of rest, as this may cause stress. In order to ensure a mixed species exhibit is successful, it is necessary to monitor polyspecific introductions. At Newquay Zoo a Madagascan exhibit was completed in March 2010. This included a mixed species enclosure housing *Eulemur coronatus* (1.1) and *Mungotictis decemlineata* (1.1), a combination of species not documented in any other zoological collection. The novelty of the crowned lemur/ narrow striped mongoose exhibit meant it was important to document the introduction and any behavioural changes that occurred as a result. The crowned lemurs were introduced to the enclosure on 19/03/2010 and observations began the following day. At this time the narrow-striped mongooses were housed in quarantine, due to restrictions this meant data could not be collected on this species. Therefore only the behaviour of the crowned lemurs was observed for the duration of this study. The behaviour and enclosure use of the male and female crowned lemurs was evaluated using 30-minute instantaneous focal observations. Scent marking was recorded as event behaviour and tallied throughout the observation. There were four conditions during this study; 1 - pre-introduction of the mongooses, 2 -'disruption' period, 3 - introduction, and 4 - post introduction. Recorded behaviours were separated into general categories; solitary active, social active, solitary inactive, social inactive and out of sight. Most notably solitary active behaviours increased from Condition 1 to Condition 4 for both the male (Mean ± Standard Error Mean) (21.86% ± 2.15799 to 35.97% ± 4.38466) and female (21.86% ± 2.36018 to 35.97% ± 3.76281). Enclosure use was analysed using the spread of participation index (SPI). The SPI decreased from pre-introduction to post introduction for both the male (0.963 ± 0.1804 to 0.803 ± 0.04115) and female (0.950 ± 0.02382 to 0.842 ± 0.03526). This indicated that both lemurs used the enclosure to a greater extent as the study progressed. The average scent mark count per observation increased from Condition 1 to Condition 4 for the male (6.98 ± 1.12538 to 8.92 ± 1.30153) and female (0.05 ± 0.04714 to 2.12 ± 0.80330). The significance of the aforementioned values is yet to be determined. Randomisation tests will be carried out and the findings will be available by July 2010. After further analysis, if crowned lemurs spend significantly more time carrying out active behaviours, significantly increase enclosure use and rate of scent marking; this will indicate that the introduction of mongooses provided mixed-species enrichment. However, extrinsic factors will have to be taken into account, most importantly a seasonal change in the weather.

The effect of a novel flying stimulus on the behaviour of a captive group of suricates (*Suricata suricatta*)

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Suricates kept in captivity can produce anti predator behaviours observed on their wild counterparts. There is concern that animals bred in captivity have a limited repertoire due to the unnatural environment and lack of predators. In this study, captive bred suricates (*Suricata suricatta*) were investigated to see whether they could produce the same anti-predator behaviours documented in wild groups in response to a novel flying stimulus: a helium balloon was used to represent an aerial predator. Over a period of eight weeks the suricates' behaviour was recorded using instantaneous sampling every minute within half hour periods; with the presence of the helium balloon and without it. A Wilcoxon's signed-rank test was performed on the data; once it was identified the data was non-normally distributed. The results of the study found that 50% of the behaviours recorded were highly significant ($p<0.01$). Out of the 10 behaviours recorded (locomotion, foraging, sentry duty, 'out of sight' (not visible to the observer), rest, non-alert scanning, babysitting, basking, scanning on hind legs and running to shelter), five showed a highly significant difference in the amount of behaviour performed while the novel stimulus was present and not present ($p<0.01$). Locomotion and scanning on hind legs increased in performance, whereas foraging, sentry duty and non-alert scanning decreased in the presence of the novel flying stimulus. Out of the remaining five behaviours, 'out of sight', babysitting and running to shelter were significant ($p<0.05$). Rest and basking were not significant. On one occasion during the study it was noted that a light aircraft flew overhead, and that the suricates performed their anti-predator behaviours (scanning on hind legs and running to shelter). In the eight weeks of study, while recording behaviours, this was the only observation of an aircraft flying over. The suricates saw this as a threat. As this only occurred once, it was deemed unusable within the study. Although it was noted by the observer that the captive suricates had become habituated to seagulls that flew overhead, the suricates had identified them as a non-threat. Wild suricates have also been shown to habituate to bird species which they know are not a threat. It has been concluded that captive bred suricates can produce anti-predator behaviours observed on their wild counterparts without prior experience; therefore, the results suggest that several generations of captivity has not altered their behaviours. Although the duration of the behaviours was shorter, the performance of these behaviours was similar to studied wild suricates. These results suggested the presence of a predator is not necessary to preserve behaviours in captive bred suricates. The behaviours are believed to be innate, although evidence from previous studies does show an element of learning from adult individuals is needed to refine the behaviours. Further studies can be conducted at other establishments to determine whether similar results can be found. This can also be extended to establish whether captive bred suricates can display other innate behaviours seen in wild suricates.

Foot problems, stereotypies and substrate type in Asian elephants: a European survey

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Foot problems are very common in captive Asian elephants (*Elephas maximus*). The purpose of this study was to investigate whether an association exists between floor type, the occurrence of repetitive behaviour and foot problems. For this research project, information about the enclosure floor type, the occurrence of repetitive behaviour and the occurrence of foot problems was collected for adult (older than 11 years) Asian elephants in European zoos, using a brief questionnaire (response rate = 38.09%). Data on indoor and outdoor housing were pooled for statistical purposes. Information was obtained for 87 adult individuals, out of the 254 adult elephants that are incorporated in the EAZA European Studbook. Most of the elephants had access to areas with sand (87.36%) or concrete (71.26%) flooring. A considerable proportion of the animals (72.41%) displayed repetitive behaviour (stereotypies). The most common type was weaving (37.93%). The respondents observed foot problems in 59 individuals (67.82%). Within the latter group, 53 elephants displayed repetitive behaviours, of which weaving was the most common type (34.38%), followed by nodding (18.75%) and pacing (15.63%). The statistical analysis showed that elephants that had access to an enclosure with straw flooring had less chance of displaying stereotypic behaviour than elephants that were kept on other floor types (Prevalence ratio (PR) = 0.12; $P < 0.01$). Elephants partly kept on dirt were less likely to have foot problems than animals standing on other substrates (PR = 0.67; P = 0.01). It was shown that elephants in this study that showed stereotypic behaviour were 337 times more likely to have foot problems than elephants that showed no stereotypic behaviour (PR = 3.37; $P < 0.01$). However, the results of this study should be interpreted with caution. Adhering to the advice of the EEP coordinator, questionnaire length was restricted and, consequently, certain factors (e.g. distribution of time spent indoors and outdoors, enclosure maintenance, elephant sleeping patterns) were no longer included. Future research elaborating on the development of stereotypic behaviours and foot problems should account for these factors.

Clash of the queens: the introduction of a powerful female bonobo and her daughter into an existing group at Stuttgart Zoo

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In the wild, bonobo females usually migrate when they reach adolescence, at about 9-10 years old. There are no reports of adult females with depending offspring migrating to other communities, but behavioural data from the wild are scant. The EEP for bonobos tries to mimic these natural migration patterns and generally recommends transferring females between zoos at adolescence. However as a result of a larger master plan in 2007 the decision was made to regroup some of the bonobos in European Zoos to maintain a genetically healthy population in the long term. Monitoring of these transfers and the consequences for bonobo welfare are important to evaluate and take into account for future transfer proposals. Here we describe briefly the introduction of a 32-year old female, Hermien, and her 3-year old daughter Huenda from Planckendael Wild Animal Park (Belgium) into the bonobo group at Wilhelma Zoo, Stuttgart (Germany). In the literature only one similar case has been published so far. At Planckendael, Hermien occupied a high ranking position and had been alpha female for the last 9 years. It was uncertain how she would react to the migration into an unfamiliar group of nine bonobos (one adult male, three adult and two adolescent females and one male and one female juvenile). A stepwise introduction procedure was proposed, in which Hermien and her daughter were first introduced to the group's alpha female with her 4-year old daughter, and other bonobos were added later the same day. After some initial displaying by Hermien, both alpha females calmed down quickly and the others were added without problems. Over the next four days, it became apparent that Hermien could claim food without much protest from the others. She would ignore most sexual initiatives from the other females. Rather she would insist on being groomed by them, without grooming them. After two days Hermien started to briefly groom some of the other females, and even responded to a play invitation by one of the younger females, while she was rarely seen playing in her old group. In conclusion the introduction of Hermien and Huenda into the existing group seems to have been a success. Aggression was minimal and the resident bonobos, including the older female, seemed to accept Hermien's dominant behaviour. This case study shows that a very dominant adult female and her daughter can be transferred and integrated into a new group, without much conflict.

Effects of new housing on the behaviour of iguanas at Chester Zoo

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In early 2010, three species of Caribbean iguana were moved from their separate vivarium-style enclosures in Chester Zoo's *Tropical Realm* into new 'open-plan' enclosures in its *Islands in Danger* exhibit. This provided a good opportunity to collect pre-and post-occupancy data to assess the effects of housing changes on the iguanas' behaviour and welfare. The subjects of this study were a female rhinoceros iguana (*Cyclura cornuta*); a pair of Lesser Antilles iguanas (*Iguana delicatissima*); and a pair of Utila spiny-tailed iguanas (*Ctenosaura bakeri*). The new enclosures have been designed with the aim of providing a more complex, species-appropriate environment. For example, they are larger than the previous enclosures and offer a greater variety and quantity of structural enrichment (e.g. climbing opportunities for arboreal species). The different iguana species are now also able to see, hear and smell each other, although they are in three separate, adjacent enclosures. The larger enclosures also offer greater temperature gradients than the previous enclosures, which are expected to enable the iguanas to regulate their body temperature more easily, as they would in the wild. Pre-occupancy data were collected for six weeks between September and November 2009. Behavioural data were collected over multiple 30-minute sessions, and a combination of methods was used: in some sessions, instantaneous scans were taken of animals in each group at 1-minute intervals, while in other sessions, continuous data were collected on focal animals. The same methods were used in the new enclosures as soon as the move had taken place in February 2010. We predicted that the new enclosures would promote the expression of a wider range of natural behaviours, as well as greater, more species-appropriate enclosure use, with the aim of benefiting the iguanas' welfare. Statistical analyses of data from the first three weeks following the move have revealed a significant reduction in the time spent at the window, interacting with it or actively looking out of it, and a significant increase in the time spent in the higher levels of the enclosures by the arboreal species. We will present the results of this study, including data collected beyond those first three weeks in the new enclosures. Very few pre- and/or post-occupancy studies on captive animals have been published and husbandry practices, such as housing changes, are not often assessed scientifically. Moreover, reptiles (and other non-mammals) are highly under-represented in the published literature on the effects of housing changes and other enrichment efforts. As well as contributing towards filling a gap in our knowledge of the effects of husbandry changes on reptiles, the results will have practical implications for the husbandry and welfare of these species and can be taken into account for future animal moves and enrichment efforts at the Zoo.

Assessing the impact of olfactory enrichment on the behaviour of captive chimpanzees (*Pan troglodytes*)

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Chimpanzees (*Pan troglodytes*) in their natural habitat use olfactory cues to establish rank, mates, and territorial boundaries. For this reason, it is important to encourage the natural use of olfaction within a captive setting. Olfactory enrichment has been overlooked as a valuable enrichment, education and conservation tool for captive chimpanzees. This study looked at the effect that olfactory enrichment, in the form of animal scents, had on the behaviour of captive chimpanzees. Scents were introduced to a captive chimpanzee group, housed at Twycross Zoo in Warwickshire, using cloths that had been hung in an animal's enclosure. Baseline and post baseline behavioural observations were taken of six chimpanzees using zero-one scan sampling, recordings were made every three minutes for a total of thirty minutes for four hours, over a three-day period. The same procedure was followed for each scent with four days between each scent presentation. Cloths were impregnated with animal odours; these were chimpanzee (*P. troglodytes*) (from another chimpanzee group at Twycross Zoo), gorilla (*Gorilla gorilla*), woolly monkey (*Lagothrix lagotricha*), leopard (*Panthera pardus orientalis*) and control cloth (chimpanzee group's own scent). The introduced animal scents significantly increased behavioural diversity ($F= 3.20$, $df= 11$, $p<0.01$), with the control scent showing the highest display of behavioural diversity. Movement behaviour results show a significant difference in activity levels within the group ($F= 4.48$, $df= 11$, $p<0.001$) between different scent conditions. The increase in movement behaviours could indicate that the subjects were mimicking the behaviour of their wild conspecifics by patrolling their area while the scents were present and ceasing to patrol when the scents were removed. Social behaviours ($F= 4.20$, $df= 11$, $p<0.001$) also significantly increased with the introduced scents, which could be due to the strengthening of social bonds and cooperation within the group when the scents were present. A significant increase in solitary behaviours ($F= 15.73$, $df= 11$, $p<0.000$) was also found. The main solitary behaviours expressed by the group were sitting, resting, sleeping, foraging and self-grooming. The increase in solitary behaviours coincides with the increase of movement and social behaviours indicating that the scents promote natural chimpanzee behaviours and increase activity. The performance of these behaviours shows a significant increase with the introduction of each scent and a significant decrease in behaviour after the removal of each scent. Although stereotypic behaviours were not significantly reduced ($H= 5.42$, $df= 11$, $p>0.05$) there was a reduction in stereotypic behaviours displayed by the group with the introduced scents. These results show animal scents can promote natural behaviours with the expression of strengthening social bonds within the group. Olfactory enrichment in the form of animal scents can improve captive chimpanzee welfare without causing extra stress and anxiety in the captive environment.

An assessment of the use of bouts and frequencies to measure lateralised hand use in naturalistically-housed chimpanzees

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Laterality of handedness in primates has undergone intensive study, in an effort to explain the evolution of population-level hand preferences in humans (Hopkins, 1995). However, as research has progressed, doubt has been shed on the validity of the two most common measures used to collect hand preference data: (1) *bouts*, where only the first occurrence of series of movements is recorded until an intervening behaviour occurs; and (2) *frequencies*, where every occurrence of a behaviour is recorded, even if it is performed repeatedly. It has been claimed that recording frequencies causes a lack of independent data points, inflating data and increasing the likelihood of discovering population-level hand preferences (McGrew & Marchant 1997). However, it has also been claimed that bouts could under-represent hand preferences, due to a lack of data, reducing the likelihood of discovering population-level hand preferences (Hopkins et al 2001). The aim of this study was to compare resultant hand preferences for data collected using both bouts and frequencies, and to explore which, if any, behaviours would be most affected by the measurement of lateral bias. Data were collected from ten adult, naturalistically-housed adult chimpanzees (*Pan troglodytes*) (5 male, 5 female), from a group of 29 at Chester Zoo between October 2008 and February 2009. Hand use for spontaneous manual behaviours was recorded in both bouts and frequencies simultaneously. Results show that differences do indeed occur in resultant hand preferences, with more individuals showing significant hand preferences when data were recorded in *frequencies*, with these preferences also tending to be stronger. In addition certain behaviours (such as *Eat*, *Groom other*, *Pick up* and *Scratch*) were more highly affected than others. It was concluded that data recorded using either bouts or frequencies should be interpreted with caution in future, especially for those highly affected behaviours. Ideally, until a more accurate measure is developed and tested, researchers should record laterality data using bouts and frequencies and present results for both measures of lateral bias, in order to ensure that the conclusions of their research are accurate and to enable comparability between studies.

The effects of enclosure novelty and enrichment on stereotypic behaviours of Heck's Macaques (*Macaca hecki*)

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Howletts Wild Animal Park houses the only known pair of 1.1 Heck's Macaques (1.1; *Macaca Hecki*) outside of their native home in Indonesia. In order to examine the effects of a new enclosure and enrichment on their behaviour, a short study took place with observations made prior to and after the pair were moved from their initial quarantine enclosure, to a new, larger and more complex enclosure. Instantaneous scan sampling was used to collect data with and without enrichment present and 10 hours of data were collected over a period of six weeks around the move taking place. Six months later, data collection has resumed in order to determine whether the novelty of the new enclosure was responsible for any changes in behaviour. A decrease in stereotypic behaviour and increase in feeding behaviour was observed in the male Heck's Macaque *(Macaca Hecki)* after the move to the new enclosure. Data currently being collected and analysed will be compared to see if these changes have been sustained over time.

The non-invasive measurement of gonadal activity in male and female blue throated macaws (*Ara glaucogularis*)

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The current study validated techniques to non-invasively measure reproductive steroid concentrations in the critically endangered blue throated macaw (*Ara glaucogularis)*. Weekly, faecal samples from three pairs of birds were analyzed for testosterone (n=3 males) and progesterone and oestrogen conjugates (n=3 females) using enzyme immunoassays. When reproductive pairs, evidenced by the production of an egg during the season, entered the breeding boxes, testosterone and oestrogen metabolite concentrations peaked in synchrony in the male and female, respectively. In the non-reproductive pair, variations in testosterone and oestrogen were not correlated. Progesterone concentrations were uninformative in any pair. Overall, the results from this study demonstrate a valid non-invasive method to monitor reproductive function in this species.

Food intake and time budget in rose-ringed parakeets (*Psittacula krameri*) fed an extruded pellet diet or sunflower seeds *ad libitum*

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Seed mixtures are generally perceived as a natural diet for true psittacine birds (*Psittacidae*). However, typical seeds incorporated into commercial seed mixtures do not represent the food items for which wild parrots naturally forage. Most cultivated seeds either do not originate from the native habitats of parrots, e.g. sunflower seed, or would be impossible to harvest by parrots, e.g. pumpkin seed and peanuts. Moreover, although true parrots are classified as seed-eaters, their natural diet consists of a wide variety of plant parts, insects and larvae and is not limited to ripe seeds and nuts. Further to this misconception of seed mixtures being a natural diet for parrots, the edible part of those feed types is inherently deficient in several essential nutrients. In addition, a multi-component diet enables selective feeding, through which nutritional deficiencies and imbalances are further aggravated. In comparison, the nutrient composition in pellet diets can be formulated to meet available guidelines on nutrient requirements and is not biased by selective feeding. Some reservations exist against pellets, as this type of diet is often presumed to reduce the time budget spent on feeding. Boredom and denial of the natural feeding behaviour, such as manipulation with feet and beak to dehusk food items, is believed to result in overfeeding and aberrant behaviour, such as feather picking. The aim of the current trial is to investigate these reservations by quantifying time budget and voluntary feed intake when parrots are fed a pellet diet or sunflower seeds *ad libitum*. Eight adult rose-ringed parakeets (*Psittacula krameri*) were housed individually in indoor wire cages and were allowed visual and auditory contact with each other. Four cameras and eight infrared lights were installed in the animal room for the entire trial. Lighting period was determined by sunlight. Two diets with which the birds were well acquainted, sunflower seed and pellets (Nutribird P15, Versele Laga Ltd.), were fed *ad libitum* in a 2×2 cross-over design with 14-day periods. After a 12-day adaptation period, time budget was assessed using continuous video-recording for 48-hours. During this two-day recording period, food and water intake were assessed with minimal disturbance to the birds. Disturbance due to human presence in the animal room was accounted for in the video analysis. Daily intake of pellets (11 ± 1 g/d) was significantly higher compared to sunflower seed kernels (8 ± 1 g/d) ($p=0.001$). Still, energy intake was only 175 ± 18 kJ/d when fed pellets, but 213±28 kJ/d when fed sunflower seed ($p=0.020$), as energetic density was 1547 kJ/100 g and 2810 kJ/100 g in respective diets. Daily water intake was comparable between both test diets. Data on time budget were incomplete at the time of submission. These preliminary data contradict overfeeding due to boredom when fed pellet diets, as daily energy intake was not higher compared to feeding sunflower seed. Moreover, voluntary energy intake was even 18% higher when fed sunflower seeds.

Support use in captive and wild Sumatran orangutans (*Pongo abelii*)

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The Sumatran orangutan (*P. abelii*) is recognised as critically endangered (IUCN, 2008) and is threatened by rapid deforestation and human encroachment of their natural habitat of primary rainforest in Northern Sumatra, Indonesia. Due to continued threat in the wild, *ex situ* and captive populations are becoming increasingly important to the survival of the species, with reintroduction to the wild becoming a realistic possibility (Nellemann 2007). In conserving a species in captivity however, it is not sufficient to simply preserve a gene pool. Behaviour and, for orangutans particularly, locomotion, must also be conserved if captive subjects are to represent wild counterparts accurately. *P. abelii* is large bodied and arboreal, and as a result travelling through the forest canopy necessitates a complex locomotor repertoire to negotiate the flexible branches and lianas (supports) available (Thorpe et al 2009). This study looked at the locomotor repertoires of a captive group of *P. abelii* housed at the North England Zoological Society, UK, in comparison to data for wild counterparts (Thorpe and Crompton 2005). It aimed to establish how closely the captive group resemble wild counterparts in locomotor repertoires and support use and thus establish how successfully the enclosure design elicits natural locomotion. Continuous bout sampling was used to record locomotor mode, age-sex category, contextual behaviour and support variables (number, height, type, diameter and angle). Log linear backward elimination modelling was used to explore multivariate relationships between locomotion. Significant relationships were found between locomotor mode * age-sex * behaviour and between locomotor mode * age-sex category * support diameter. This is comparable with wild models obtained from wild individuals (Thorpe and Crompton 2005) that found support type and diameter formed the strongest associations with locomotor mode. They did not however, find behaviour to directly influence locomotor mode preference as was the case here. Comparisons between frequencies of wild and captive locomotion showed differences in some key locomotor modes. Quadrupedal walk (32%) and sway behaviours (22%) were particularly high in the captive group, which probably reflect support availability rather than ability, since the enclosure has substantial open ground and a considerable number of flexible ropes. However there are also important similarities for example all age-sex groups demonstrated a predominantly orthograde (upright trunk) position in locomotion and a large range of different locomotor behaviours indicating that their potential for locomotion approaches that of wild individuals. Overall, this study suggests that if captive environments can imitate those of the wild (e.g. providing similar support types), captive individuals can maintain key aspects of natural locomotor repertoires, which will be an important factor as reintroduction from captivity to rescue wild populations becomes a realistic possibility.

Visitor study in a public aquarium in Belgium

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We undertook a visitor study in Aquatopia, a public aquarium in Belgium in order to score visitor behaviour and to understand the educational function of the aquarium. One hundred visitors were interviewed concerning the importance of education in the aquarium. Visitors (n=350) were also inconspicuously tracked by means of behavioural observations to score the holding time of the different exhibits. Visitors scored “education” and “conservation” as the most important goals of the aquarium, followed by “recreation” and finally “research”. On average, a visitor spent only 6.7 seconds reading the educational information on screens or boards, and 30% of the visitors claimed “always to read the information”. Overall, visitors spent on average only 40 seconds watching an animal exhibit. The effect of different factors on time spent in front of the exhibits was analysed using a mixed Anova model. There was no significant effect of visitor age-group ($p<0.157$) on holding time of the exhibits, nor of the fact whether there was an increasing or decreasing trend in visitor numbers in an area ($p<0,604$). Gender of the visitor tended to be significant ($p<0.09$), with females staying only slightly longer in front of exhibits compared to males. There was a significant effect of group size: lone persons spent less time watching exhibits than people in groups ($p<0.021$). The identity of the exhibit was a significant factor in the model ($p<0.0001$): some exhibits such as the shark tanks, had a markedly higher holding time. Holding time did not differ between different kinds of exhibit (i.e. aquarium, terrarium, open pond: $p<0.533$). Size of the exhibit had a significant effect on holding time: visitors spent the longest time in front of the large exhibits compared to the small and to the medium exhibits ($p<0.0001$). In general these results confirm other studies of visitor behaviour in public aquaria.

Zoo visitors affect levels of uncertainty in zoo-housed lion tailed macaques (*Macaca silenus*)

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Previous research has established that zoo visitors can influence the behaviour of zoo-housed primates; however, few data have been collected on lion-tailed macaques (*Macaca silenus*). Previous data for this species was conducted on individuals in barren enclosures and visitors had an adverse affect. In order to assess the impact that visitors had on zoo-housed lion-tailed macaques in an enriched environment, a behavioural study was conducted on five individuals housed at Chester Zoo. The behaviour of the macaques was observed across three different visitor conditions: high (≥ 15 visitors), medium (7-15 visitors) and low (6 or fewer visitors). The data were analysed using randomisation tests. We found that visitor category affected the macaques' non-social behaviour, but not their social behaviour. In the high condition the macaques performed more self-directed behaviours, yawned more and monitored their surroundings more than they did under the low condition. The present study was one of the first to identify a visitor effect on lion-tailed macaques in an enriched enclosure and although self-directed behaviours reflect a degree of uncertainty under the high condition, their overall social and feeding behaviours were unchanged by the presence of visitors.

Do you have friends in high places? Social attachment in captive giraffe

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As part of an on-going study, using the giraffe herd at Marwell Wildlife, measurement and assessment of partner-preference and social interaction between male and female giraffe *(Giraffa camelopardalis)* has been undertaken across a three year period. This study hopes to provide evidence for the 'importance' of social bonding to a captive mammal in an apparently artificial situation, and to shed light on a specific aspect of giraffe biology. For many years, it has been assumed that giraffe do not have a structured social system and exist in loosely defined aggregations that collect together randomly. Recent evidence from captive collections in the USA suggests that individual giraffe may not group together randomly, but exhibit favouritism for one cage-mate over another. Results from this research project show that female animals do appear to have an affinity for other specific individuals in the herd and these bonds are maintained over time. Data were collected on key state behaviours (via instantaneous focal sampling) and on proximity to other individuals (determined by animals being within one neck length of each other). Altogether, 180 hours of observation have been documented. The herd under study has fluidly changed in structure and number, but those animals, two adult females, that have been a part of the herd since the inception of the project (in winter 2007) maintain the highest frequency of association. Indeed, statistical analysis for association between these adult females shows a significant non-random relationship. The introduction of an adult male for breeding purposes in 2008 altered the time one of these females spent associating with the other. The death of the oldest animal in the herd appeared to affect the behaviours of those giraffe of a similar age. After the death of their cage-mate, both remaining females altered their behavioural repertoires, spending more time away from the herd as a whole but still associating together for a comparable amount of time to when the deceased animal was alive. Published research shows that giraffe alter time budgets in accordance with social separation or social change; this finding appears mirrored in the work presented here. Finally, to illustrate that social affiliation is indeed very individual-specific, an animal of a comparable age to those often seen associating showed a marked preference for spending time alone rather than associating with any other herd members. This research shows that group composition will affect the behaviour of giraffe in captivity and that individual association is not always random. Consequently, there are implications for future breeding recommendations and herd management that need to be evaluated to ensure that important social bonds can be maintained over time. Movement decisions based purely on genetic foundations do not take into account the social requirements of the species and thus may not lead to success in the long-term.

CIRCLE: A new centre for research, conservation and learning at Flamingo Land

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The contribution of zoos to scientific research has increased since the development of the World Zoo Conservation Strategy (WZCS; IUDZG & IUCN/SSC 1993). This has been assisted through increased partnerships with universities. The Centre for the Integration of Research, Conservation and Learning (CIRCLE) is a new collaborative initiative between the University of York and Flamingo Land (Malton, North Yorkshire). The aim of CIRCLE is to carry out innovative research that will contribute to the conservation of wild animals and places, and to disseminate the information in a manner that is accessible, interesting and fun. Such partnerships help zoological gardens to fulfil the aims of WZCS and the more recent World Zoo and Aquariums Conservation Strategy (WZACS; WAZA 2005). Universities also benefit from such partnerships through diversification of research opportunities and improved outreach to a wide demographic of people. The principle research discipline to be addressed by CIRCLE will be conservation biology, through links with Flamingo Land's conservation project in the forests of Tanzania. The involvement of a field conservation project will ensure that the scientific research will have direct input to habitat management for biodiversity. A second major research aim of CIRCLE will be to assess the effectiveness of education activities for conveying conservation messages. Education research remains a comparatively small field, but is crucial to evaluating and developing the role of the modern zoo. CIRCLE will also provide avenues for research into animal behaviour, through observational studies at Flamingo Land and other parks. This will be useful for understanding the fundamentals of animal behaviour and for continued effects to provide optimal welfare conditions. CIRCLE will officially open in October 2010, when four interns will begin research projects under supervision from Flamingo Land and University of York scientists.

With many thanks to the following organisations for their kind support of the 12th Annual BIAZA Research Symposium:

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