14th Annual BIAZA Research Symposium
10th-11th July 2012

Hosted by:

Newquay Zoo Environmental Park

Cornwall College Newquay

Timetable day 1. Tuesday 10th July

8:30 - 9:00	Registration/Tea and coffee		
09:00 - 09:30	Welcome and housekeeping		Stewart Muir *Newquay Zoo*
09:30 - 09:50	Talk	Needing evidence-how do we know if people and animals benefit from getting close?	Sonya Hill *Chester Zoo*
09:50 - 10:10	Talk	What influences zoo visitors to read information signs?	Marie Athorn *CIRCLE, University of York and Flamingo Land Resort*
10:10 - 10:30	Talk	How well do you know your frogs? Interlinking ethology, exhibition and education in the zoo.	Charlotte Evans *Sparsholt College*
10:30 - 11:00	Tea and coffee break		
11:00 - 11:20	Talk	The effects of social group housing on the behaviour of captive cheetahs (*Acinonyx jubatus*).	Carly Tetley *University of Salford*
11:20 - 11:40	Talk	A preliminary investigation into captive owl enrichment: understanding current practice in British and Irish collections.	Chryseida Callanan *Tilgate Nature Centre*
11:40 - 12:00	Talk	Hanging about at enclosures: Enrichment to prolong foraging AND visitor stay time!	Mark Kingston-Jones *Howletts and Port Lympne Wild Animal Parks*
12:00 - 12:20	Talk	It's all about the individual: Improving the husbandry and housing of jaguars (*Panthera onca*) at Chester Zoo.	Suzanne Turnock *Chester Zoo*
12:20 - 13:40	Lunch		
13:40 - 14:00	Talk	An introduction to animal welfare science in zoos.	Sonya Hill *Chester Zoo*
14:00 - 14:20	Talk	Correlating behavioural and physiological measurement of stress in a large zoo-housed mammal; a case study on Rothschild's giraffe.	Jessica Perree *Sparsholt College*
14:20 - 14:40	Talk	Oh what a pain - understanding the effects of pain on zoo animal behaviour.	Sonya Hill *Chester Zoo*
14:40 - 15:00	Talk	Cognitive enrichment for large-brained mammals in zoos.	Fay Clark *Royal Veterinary College and Zoological Society of London*
15:00 - 15:30	Tea and coffee break		
15:30 - 15:50	Talk	Analysis of the parental and offspring behavioural changes over time in a captive population of smooth coated otters (*Lutrogale perspicillata*).	Nicole Sharp *Writtle College*
15:50 - 16:10	Talk	A study into the effect of feeding routine on the behaviours and social interactions between two species of rays (*Taeniura lymma* & *Neotrygon kuhlii*).	Melanie Edgar *Whitely Wildlife Conservation Trust and Durham University*
16:10 - 16:30	Talk	Reproductive cyclicity in female Okapi (*Okapia johnstoni*): the potential role of mate compatibility?	Katherine Cho *Chester Zoo*
16:30 - 16:50	Talk	Molecular management in an *ex-situ* colony of African penguins *(Spheniscusdemersus*).	Lewis Rowden *Whitely Wildlife Conservation Trust and Cardiff University*
16:50 - 17:10	Talk	Aversion to colour in rainbow lorikeets (*Trichoglossus haemotodus*): implications for animal and human welfare during food presentation.	Laura Salanki *Blackpool zoo*
17:10-18:30	Poster session	Poster authors please stand by your posters.	
18:30 – 21:00	EVENING BBQ IN THE ZOO		

Timetable day 2. Wednesday 11th July

8:45 - 09:15	Tea and coffee		
09:15 - 9:35	Talk	Carotenoids and Anurans: The effect of a carotenoid-enriched developmental diet on growth and froglet colouration in the Phantasmal Poison Dart Frog (*Epipedobates tricolour*).	Andy Church *Whitley Wildlife Conservation Trust and University of Manchester*
09:35 – 9:55	Talk	A global survey of captive cheetah diet, faecal consistency and gastrointestinal disease.	Kat Whitehouse-Tedd *Cheetah Outreach, South Africa*
9:55 – 10:15	Talk	How do Zoos Create, Implement, and Review Diets?	Clare Patten *CIRCLE, University of York and Flamingo Land Resort*
10:15 – 10:45	Tea and coffee break		
10:45 - 12:30	Workshop	Diet and Nutrition Research	Andrea Fidgett and Amy Plowman
12:30 - 13:40	Lunch		
13:40 - 14:00	Talk	A crest raising conundrum: investigating the function of crest erection in a captive citron-crested cockatoos (*Cacatua sulphurea citrinocristata*).	Emily Butcher *Whitley wildlife Conservation Trust and Cardiff University*
14:00 - 14:20	Talk	Visual discrimination in hornbills: a cognitive study on the discriminative abilities and sorting strategy of captive *Tockusdeckeni* and *Tockusnasutus*.	Evelien De Groot *Royal Zoological Society of Antwerp*
14:20 - 14:40	Talk	Do butterflies (*Rhopalocera*) have a colour preference when in a captive environment, and do they all share the same preference?	Carl Hamilton *Myerscough College*
14:40 - 15:00	Talk	The influence of odorous stimuli on electro-receptive foraging behaviour of the small spotted catshark (*Scyliorhinus canicula*).	Sarah Roberts *Myerscough College*
15:00 - 15:20	Tea and coffee break		
15:20 - 15:40	Talk	Adaptive management and measuring conservation success: A case study in Tanzania.	Jennifer Archer *CIRCLE, University of York and Flamingo Land Resort*
15:40 - 16:00	Talk	Field conservation by BIAZA zoos - how well are we doing?	Bethan Hindle *CIRCLE, University of York and Flamingo Land Resort*
16:00-16:10		The Journal of Zoo and Aquaria Research (JZAR)	Amy Plowman and Geoff Hosey
16:10-16:40	Closing summary and prize giving		Geoff Hosey

Needing evidence – how do we know if people and animals benefit from getting close?

Sonya P. Hill and Andrew Moss

Chester Zoo

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Like other industries, modern zoos often use evidence-based approaches, and this contributes to good practice. Evidence varies in form, ranging from circumstantial or anecdotal (which suggests something might be true…even when it might not be), to direct evidence, such as that based on good-quality research findings. There are costs and benefits to both of these ends of the "evidence spectrum". Experience and expert opinion can be valuable if the source is trusted, and an added benefit is that it is usually obtainable within a much shorter time-frame than a more scientific research-based approach. However, expert judgement can sometimes be unreliable, no matter how unintentional. This can be caused by factors such as observational biases (e.g. accidentally interpreting something in a certain way, because it matches a particular outcome that you are hoping for), or by not having a complete understanding of all of the possible interpretations of the outcome (such as interpreting smiling faces as an indicator of success in zoo education, without questioning and exploring other possible meanings). Conversely, direct evidence provides the most robust answers, and should be testable and repeatable, reliable and consistent, but usually takes longer to obtain and analyse. Zoos have an obligation to themselves, and to others, to ensure that not only are their practices sound, but that they can prove it. Opportunities for people and animals to get close in zoos range from the formal "experiences" that can be booked as part of a special, more exclusive, package, or that take place as part of a regular visit, such as a moment of excitement, awe, wonder, horror or apathy that someone might encounter while standing at a viewing window and having an animal seemingly look at them. Zoos are under constant scrutiny in a formal capacity (e.g. zoo inspections), but also in a more *ad hoc* way, by the visiting public and anti-zoo organisations. As visitor attractions, one of the ways zoos make money is by displaying animals, but the costs and benefits of this have to be calculated to ensure the purpose is ethical – what are the values and costs of displaying animals in zoos, and how do we know this? When zoos make claims about their work, such as maintaining that a zoo visit has educational benefits and inspires interest in conservation and the natural world, or that zoo animals have good welfare, they need to be able to substantiate their claims. Zoos should embrace this, as it is an opportunity for them to provide strong, externally accepted, evidence for the work they do. The published evidence in this area is extremely thin and, in most cases, poorly done, and we will make some suggestions for future investigations by zoos.

What influences zoo visitors to read information signs?

Marie Athorn[1,2], Ayshea Seston[1,2], Cat Hickey[1,2], Andrew R. Marshall[1,2]

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With UK government statistics demonstrating the benefits of learning outside of the classroom, and increasing involvement of zoos in environmental awareness, education has become a diverse and substantial role of zoos. Educational activities range from formal classroom sessions to free-choice learning through information signs, animal shows and zoo keeper talks. However research evidence shows that entertaining animals continue to be a significantly greater attraction for visitors than the associated educational information. Zoo educators are hence presented with a significant challenge to get environmental messages across. In most zoos, signs are the only permanent educational tool at animal enclosures, and it is therefore important to understand the factors which influence their use.

Animal enclosure design is often presumed to have a significant influence on the use of signs by zoo visitors, along with animal species and their level of activity. Here we investigate the basic features of zoo exhibits that encourage information sign usage, based on (1) frequency of people reading signs from scan samples, and (2) time spent looking at signs (dwell time) among focal samples. All observations were made at Flamingo Land Resort, North Yorkshire, an attraction best known for its large theme park. The positioning of this study in a mixed attraction provided a unique opportunity to observe a particularly broad demographic of people, including many whose primary appeal was not the zoo itself. We use regression analysis to determine the importance of 13 potential influences on sign usage, including enclosure size, shape, and location, animal species, number and activity, weighted against weather conditions and the abundance of visitors.

No measures of enclosure size/shape were found to influence sign usage. Unlike previous studies we also did not find the behaviour, number, or species of animal had an influence on sign usage. However, there was weak evidence that when animals were out of sight, visitors were occasionally drawn in to determine the inhabitants of an enclosure.

The only strong predictor of sign usage was the distance from zoo entrances, with a higher proportion of people reading signs with increasing distance from entrances. We interpret this to suggest that only those people with a serious interest in fully exploring a zoo are likely to consistently benefit from the presence of information signs. Individual motivation therefore plays the major role in sign usage.

This research was the first step of a comprehensive evaluation process, which has not assessed the level of information transfer, nor the influence of information content or graphic design. These basic results do however have relevance for the improved provision of education to zoo visitors and schools. While zoo information signs are highly successful for those visitors with a strong interest in learning, they cannot hope to convey environmental messages to the majority of zoo visitors. Passive education requires individual motivation. Therefore zoo education programmes must continue to seek novel methods for improving public understanding of the environment.

How well do you know your frogs? Interlinking ethology, exhibition and education in the zoo

Charlotte Evans[1], Paul Rose[1], Ross Miller[2] and Steve Nash[1]

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Amphibians are at risk of global extinction, and the importance of *ex situ* breeding programmes is continually highlighted. In order to raise funds for conservation the importance of public appreciation of species has been researched; previous findings show that "natural" or "unnatural" enclosure design can affect public perception of species within zoological collections. This study therefore explored the effects that enclosure design has upon public perception and dissemination of knowledge of amphibians, as well as exploring how enclosure design affects the behavioural repertoire of amphibians, to determine whether a more visible (active) animal provided a better public message.

Blue poison dart frogs *(Dendrobates tinctoriusazureus)* were identified as a suitable study species and two contrasting enclosures were created at Sparsholt College Hampshire's Animal Management Centre. One exhibit was representative of a naturalistic enclosure often seen at a larger zoo and a second exhibit was based upon a "clinical" style with non-natural furnishings and a bare substrate. A sample size of five frogs taken from the same population was used in each exhibit. Public perception questionnaires were completed by staff and students at the College (n=69), who answered questions based upon observation of either the natural or unnatural enclosure. The questionnaire included an agreement scale for the collection of quantitative data and open-ended questions to gain an understanding of what enclosure design and interpretation had taught participants about the species. Sixty hours of behavioural observation also took place on each frog population using a group scan sampling technique every 5 minutes for 8 hours-a-day for 8 days.

Enclosure design had a significant effect on public perception and knowledge gain about the frogs ($p>0.05$). The naturalistic enclosure had greater public entertainment value with 85% of people saying they found the natural enclosure interesting, compared to 13% when viewing the un-natural enclosure. The naturalistic enclosure had greater educational value and created a more positive perception and interest of blue poison dart frogs. The study highlighted that the characteristics of blue poison dart frogs make them suitable "flagship" species, as their colouration and size are considered engaging by members of the public. Enclosure design also significantly affected the behavioural repertoire of blue poison dart frogs with those in the naturalistic enclosure showing a more diverse activity range ($p>0.05$). The three-dimensional design of the naturalistic enclosure appeared more likely to stimulate activity, compared to the un-natural enclosure that was smaller and two-dimensional in design. This research can be used within the industry to understand how to increase the effectiveness of such exhibits in the zoo. These results can also be used to highlight the importance of enclosure design in increasing the behavioural repertoire of poison dart frogs held in captivity. The need for biosecurity should not necessarily have to reduce spatial complexity in enclosures that hold frogs and a balance between health and "exciting" exhibition could be found. Ectotherms in general can be tricky subjects when attempting to gain public support, and frogs in particular need to be at the forefront of current zoo conservation messages; appropriate exhibition that engages the visitors' attention and provides the frogs with a secure, relevant environment appears to be the best way to meet the needs of both stakeholders in this scenario.

The effects of social group housing on the behaviour of captive cheetahs (*Acinonyx jubatus*)

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The cheetah is known to reproduce poorly in captivity, which is detrimental to conservation efforts and might indicate underlying welfare concerns. One important aspect of captive cheetah management is social group housing. This study attempts to identify behavioural correlates of social group type so that recommendations can be made with a view to improving social housing arrangements and thus, potentially, breeding success in this endangered species. In the wild, adult females are solitary unless accompanied by cubs, whilst related males remain in stable groups, or coalitions, throughout their lifetime. Housing animals in appropriate social groups is a further effective way of improving animal welfare by providing animals the context in which to express wild-counterpart behaviour. Thus, knowledge of captive cheetah social interaction is crucial if zoos are to provide optimal conditions for welfare and breeding. This paper presents the preliminary findings of the effects of social housing on the behaviour of captive cheetahs. Behavioural observations were carried out on 31 cheetahs housed at eleven UK zoos between May 2011 and May 2012. Among group housed individuals, affiliative behaviours were more frequent than aggressive behaviours. Related males groomed each other more and were less aggressive than unrelated males. No difference was observed in the rate of aggressive interactions between related and unrelated females. The implications of these findings are discussed in relation to cheetah breeding and management.

A preliminary investigation into captive owl enrichment: understanding current practice in British and Irish collections

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It is argued that responding to change is a strongly selected trait in nearly all animals. However, the closed nature of captivity limits the opportunity for captive owls to experience environmental uncertainty, express species-specific behaviours and exhibit wild-type activity budgets. With care, enrichment can be implemented to create a more dynamic environment but the study of raptor enrichment is still in its infancy and guidelines for owls do not exist. Therefore, a multi-zoo research project was undertaken from January to June 2011, supported by the BIAZA Research Group, to gain insight into current practice and the beliefs or attitudes upon which it is based. Findings reveal a highly significant association between enrichment types (food based / physical / social / sensory) and frequencies of use ($p < 0.001$). While limited keeper time is perceived as the greatest constraint on provision, a highly significant proportion of collections incorporate enrichment with set goals into routine husbandry ($p < 0.001$), demonstrating a commitment to captive owl welfare based on elements of good practice. Building upon the predominantly positive attitudes expressed, significant progress in the field of owl enrichment is likely to require an increased awareness of the taxa's physical and psychological needs as persistent knowledge gaps serve only to restrict the level of welfare animal collections can offer. Of equal importance, is a need for detailed and systematic studies that seek to assess the efficacy of current provision with valid findings disseminated and used to inform future practices. Thus, it is hoped that the presentation of information in this report will not only create a reference point to facilitate the exchange of ideas between institutions but may also result in fresh perspectives on the subject of owl enrichment and ultimately, advances in the captive management of this taxa.

Hanging about at enclosures: enrichment to prolong foraging AND visitor stay time!

Mark Kingston-Jones

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Browse hangers have been in use at Howletts Wild Animal Park in Kent for the last 13 months, with both gibbons and langurs. These devices employ a simple pulley system on the outside of the enclosure, designed to raise large pieces of browse or a mesh feeder containing smaller food items to an appropriate height, encouraging arboreal feeding. In addition, positioning them on the outside of the enclosure should prolong foraging time thus aiming to replicate the 70% of the day these species spent engaging in this behaviour in the wild. The final goal to the positioning of this device is that it brings the animals to the front of the enclosure in full public view, enhancing the visitor experience.

Anecdotally, these devices have achieved these goals, as evidenced by the food still being consumed after an hour or more of using the mesh boxes, and for up to 6hrs when holding browse. Talk attendance at the gibbons was also seen to increase from an average of 3.7 people to 25.9 people when the device was in use. In order to keep enrichment programmes effective and constantly developing however, it is important to assess how successful devices have been in order to maximise long-term use. As time for both keepers and educators is extremely limited, direct data collection was not possible. One suggestion to mediate this problem was the use of time-lapse cameras as an alternative method of collecting a large amount of data, which is quick and easy to analyse.

The aim of this study was, therefore, to assess the use of one of the hangers currently mounted on an enclosure housing a family group of 2.2 Javan gibbons (*Hylobates moloch,*) and the effect this has on visitor numbers at the enclosure. This study is currently being conducted entirely using time-lapse cameras, with one pointing at the enclosure to record at 30sec intervals the presence and number of gibbons. The second camera is pointing at the public fence to record visitor numbers at the same 30sec interval. Statistical analysis will compare the day the mesh box hanger is in use to the day before, in order to keep temperature and other variables as constant as possible. This presentation will report the results of this study and discuss the use of this type of data collection method for future projects.

It's all about the individual: improving the husbandry and housing of jaguars (*Panthera onca*) at Chester Zoo.

Suzanne Turnock and Sonya P. Hill

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In-zoo research can be a very useful tool for evidence-based management of the collection. For example, if specific issues have been identified with a species then research can be used to not only identify probable causes of the problems but also help to determine possible solutions. Any changes in husbandry can then be monitored and assessed "as you go", to determine if the desired outcomes have been achieved and to refine the changes where necessary. Thus, research can provide us with evidence to help us ensure we are meeting both the needs of the animals (e.g. for good welfare), and the needs of the visitors (e.g. for conservation education, and a positive experience of their visit).

In 2011, Chester Zoo staff raised some problems they had observed with the jaguars (*Panthera onca*), namely stereotypic pacing, and poor visibility of the jaguars from the public viewing areas. Following internal meetings with the curator, animal team and research staff, it was agreed that we would initiate an in-house research project to investigate these issues and to provide scientific evidence for possible solutions for changes to the jaguars' husbandry and housing. This was a multi-phase study over the course of one year, and regular meetings were held with all relevant zoo staff during the investigation, to ensure we could address the findings as we went along, and not delay implementing any changes that would hopefully be beneficial. The first phase of the project involved the collection of baseline data on the activity budgets and enclosure use of each jaguar, under their current husbandry and housing conditions. In the phases which followed, we monitored the effects of: building work in public areas (incorporated into the project opportunistically); moving jaguars between enclosures to provide them with more space; and introducing a new, targeted environmental enrichment programme on each jaguar's behaviour and enclosure use. Three methods of behavioural data collection were used; (i) focal, continuous observations in the on-show enclosures, (ii) instantaneous scan sampling using the security cameras in the off-show dens and (iii) jaguar visibility "scans" to reflect visitor experience. Throughout the year, the results of the project have been regularly fed back to the Curator of Mammals and the keepers, and we used the data collected during each phase of the study to help us design the next phase. This has enabled staff to make changes to the management of the jaguars when required, based on the evidence the study has provided, as the welfare of the jaguars was paramount to zoo staff throughout the project. We will present some of the findings of the jaguar study and show how these have assisted with making evidence-based changes to the management of this species at Chester Zoo.

An introduction to animal welfare science in zoos

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Animal welfare science emerged as a discipline in its own right in the latter half of the last century, and it is still a growing field. The importance of good welfare in zoo (and other) animals is well-recognised in many parts of the world, including the BIAZA region, but good welfare is not always achieved for every individual at every point in time. Thus, scientific assessments of animal welfare are of huge importance in zoos, especially those assessments that cover the whole spectrum from poor to excellent welfare: investigating an animal's biological needs for excellent welfare is just as useful to us as studying cases where welfare is not good. This enables us to work towards continuous improvement in welfare, and to assess it at the species level (e.g. thermoregulatory or dietary needs), as well as case-by-case, at the individual level, such as investigating and trying to improve behavioural problems that some individuals may show. Using advancements in animal welfare science in other settings, including farms, BIAZA's new Animal Welfare Auditing Sub-group has been tasked with developing a standardised method for auditing the welfare of zoo animals, with the auditing to be carried out by zoos themselves in the future. This will contribute to the evidence-based management of BIAZA collections, and assist them with monitoring and recording their continuous improvement. In this themed session, we will hear about a variety of approaches to studying animal welfare, all of which can help fill some of the gaps in our knowledge about zoo animal welfare, and highlight some of the areas where future research would be useful.

Correlating behavioural and physiological measurement of stress in a large zoo-housed mammal; a case study on Rothschild's giraffe

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In a captive environment, many animals are integrated with other species from the same geographical range to enhance the educational and visitor-experience qualities of an exhibit. Alongside of this, removing "barriers" between animals and people is also seen as a way of providing a more positive feeling within zoo visitors. Interactions between animals in mixed-species enclosures (MSE), as well as the potential for increased visitor interaction if enclosures are "opened up" should be studied to determine any overall effects on species kept in such a scenario. The giraffe is a popular zoo-housed species often kept in MSE and when in a safari park set-up, a species that could potentially be affected by visitors. The Rothschild's giraffe *(Giraffacamelopardalis rothschildi)* is listed as "Endangered" and hence *ex situ* conservation programs have an important role to play; this animal's place in the zoo is useful in promoting the conservation and educational potential of zoo-housed species.

Research was conducted into the effect of inter-animal interactions and visitor numbers using both physiological and psychological measurements of stress, in the form of faecal cortisol and behaviour retrospectively. The research was conducted at Longleat Safari Park, Wiltshire by comparing days of fewer visitor numbers, interaction between species and Rothschild's giraffe cortisol levels over a four week period. The use of non-invasive physiological measurement of stress was attempted because this would ensure that stress levels would not be affected by the procedure. Data were collected for 20 days at Longleat on a herd of 14 giraffe. Faecal samples were collected from seven of the giraffe. Analysis of faecal metabolites of cortisol was conducted by Beaufort Cottage Laboratories. Results suggest that cortisol concentrations are significantly different over the four weeks of recording for all seven giraffe ($P=0.009$).

The husbandry protocol and interaction of keepers with the giraffe remained the same throughout the study, with the giraffe being bought down from the house to the paddock by the keepers at 09:00 and returned to their house at 19:00 daily. Factors were recorded that could have influenced the cortisol response of the giraffe including the numbers of cars driving through the exhibit per day (found to have no effect on analysed cortisol response of the giraffe, $P=0.565$). Alongside of any exogenous factors, individual giraffe did not have significantly different cortisol levels when statistically evaluated against each other ($P=0.342$), showing that the factor which affects the cortisol levels affected the herd not just on an individual basis. The other species in the exhibit were not a major factor effecting cortisol concentration change, as no specific interactions between species were observed throughout the duration of the study. Individual giraffe behavioural analysis suggested that time budgets were very similar over the four weeks observed. It is believed that the main factor that affected cortisol concentrations over the four week period was the loss of one member of the herd, which increased the mean cortisol value dramatically over a 24hour period. This study also supports some previous research that documents giraffe having close bonds between mothers and daughters, and between sisters of different ages. Further research to continue to investigate giraffe socialisations well as the possible effects of interspecies interactions across collections and a potential visitor effect on a giraffe's quality of life in the zoo is suggested.

Oh what a pain! - Understanding the effects of pain on zoo animal behaviour

Sonya P. Hill

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Animal behaviour can be a very useful indicator of an animal's welfare, for both short- and long-term responses to stimuli. Behavioural signs can sometimes make it quite "obvious" to the observer that an animal has a problem, even if the cause of that problem has not yet been identified. However, there are many different ways in which an individual can behave in response to a particular stimulus, and we need a greater understanding of the variation we might expect to observe, if we are to help improve welfare more effectively. Assessment of the effects of pain on zoo animal behaviour is one such area that has been neglected in research so far. Behavioural indicators of pain in some individuals might involve increasing the amount of time they spend doing abnormal behaviours, whereas in others there might be an increase (or reduction) in resting, or others might show hyperaggression, or postural or locomotory changes, for example. In this presentation, I will discuss the issue of pain and behaviour in more detail, using information from animals in non-zoo settings, and a case study on spectacled bears, and will make some suggestions for future areas of research.

Cognitive enrichment for large-brained mammals in zoos

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Great apes and cetaceans are often described as 'cognitive cousins' because they share a number of high physical and cognitive skills. There are hundreds of great apes (particularly chimpanzees, *Pan troglodytes*) and cetaceans (particularly bottlenose dolphins, *Tursiopstruncatus*) living in zoos worldwide, and while 'environmental enrichment' is commonly used to enhance animal well-being in captivity, 'cognitive enrichment' has received little attention. This talk will describe research undertaken at the Royal Veterinary College and Zoological Society of London, working at the interface between animal cognition and well-being. Cognitive challenge devices (focussing on physical cognition) were designed for chimpanzees and bottlenose dolphins, taking into account their natural history and evolved cognitive skills. These devices were implemented and evaluated in three experiments (two chimpanzee, one dolphin) in zoos in the UK and USA respectively. We will critically evaluate our results thus far, and whether our devices can indeed be classified as cognitive enrichment. More broadly, we will discuss how cognitive studies on great apes and cetaceans can help guide the design of cognitive enrichment devices in zoos, and how such devices can be evaluated using both positive and negative indicators of well-being.

Analysis of the parental and offspring behavioural changes over time in a captive population of smooth coated otters (*Lutrogale perspicillata*)

Nicole Sharp and Carlos J. De Luna

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Captive environments may drastically modify the natural behaviour presented by a species in the wild. An example of this is parental involvement during and after birth and the behaviour of the offspring during the first months after birth. Parental cooperation after birth is common among some mammal taxa, however, few studies have been conducted in captive species. The smooth coated otter (*Lutrogale perspicillata*) has been classified as vulnerable; therefore it is important that captive populations are studied to understand the behaviour of both parents and offspring during the critical first months after birth in order to understand the involvement of parents and to establish a time when the young reach a degree of independence. In this study, the behaviour of a captive group of smooth coated otters (one male, one female and four cubs 1:3 respectively) housed at Colchester Zoo was observed to establish the age at which the young are no longer dependant on parental care and to determine the parental behavioural changes regarding parental involvement in offspring care over time. Over a ten week period, the group were observed using scan sampling at one minute intervals and it was concluded that five of the six behaviours analysed were highly statistically significant ($p<0.001$). The cubs became considerably more independent at four months of age which is similar to their wild counterparts. However, it was also found that the male played an important role in parental care in contrast to what has been recorded in the wild. The results of this study can be used to establish strategies on the management of the breeding of smooth coated otters.

A study into the effect of feeding routine on the behaviours and social interactions between two species of rays (*Taeniura lymma* and *Neotrygon kuhlii*)

M. J. Edgar[12], S. D. Twiss[1] & H. L. Farmer[2]

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Although a large number of aquariums and zoos house ray species, relatively little research has been conducted on how captive housing routines affect behaviours. Living Coasts currently houses one male blue-spotted ribbontail ray (*Taeniura lymma*) and three blue-spotted stingrays (*Neotrygon kuhlii)* (2.1) in a large tank with a group of blue-stripe snapper (*Lutjanus kasmira*). The aim of the research was to determine the effect of different feeding routines on behaviour; in particular social interactions and pre-existing stress-indicator behaviours in both species of ray. The baseline feeding schedule consisted of three daily feeds (0930, 1230 and 1600 hours). The study investigated four additional feeding routines; 1) a single feed at 1230; 2) two feeds at 0930 and 1230; 3) two feeds at 1230 and 1600 and 4) two feeds at 1230 and 1600 plus an enrichment session at 0930 hours. Instantaneous scan sampling was used to collect behaviour and enclosure use data for all individuals and all-occurrence sampling was conducted to record all event behaviours; including social interactions and aggressive displays, for three 15 minute sessions per day. In addition, data was collected for 60 minutes around each feed to determine the effect on behaviour of the feeding regimes. Behavioural data collected was analysed using Generalized Linear Mixed Models and enclosure use determined through calculation of the Spread of Participation Index. The results of this research will be discussed and findings aim to contribute to husbandry guidelines for both species and provide evidence for developing an appropriate feeding routine for this exhibit.

Reproductive cyclicity in female Okapi (*Okapia johnstoni*): the potential role of mate compatibility?

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Endocrinology techniques can help gain an insight into the under-studied reproductive physiology of endangered species. Hormone analysis has been successfully utilised to track reproductive cycles and pregnancy in a wide range of species using oestrogen and progesterone metabolites. The current target for the okapi captive population is to hold 215-270 individuals, yet only 174 animals are held in AZA SSP and EAZA EEP collections. Population growth in the European collection is lagging behind that of the American. More reproductively active females are needed to sustain population viability and understanding the link between reproductive cyclicity and mate compatibility could prove a useful management tool. Female okapis exhibit reproductive cycles approximately 15-16 days in length and are thought to reproduce between the ages of 3 and 16 years in captivity.

A female okapi, born in July 2005, was moved to a new collection in September 2006 and hormone monitoring commenced in September 2007. Almost daily faecal samples were collected and analysed for progesterone metabolites by enzyme immunoassay. The technique was validated to track cyclic patterns and the resulting data combined with keeper observations from ARKS and veterinary records (MedARKS) to explain the hormone concentration patterns seen. Aged 2 years and 2 months at the start of this period, and accompanied by an unproven male ("Male 1"), this female showed erratic progesterone metabolite concentrations, followed by a period of prolonged acyclicity lasting 6 months. When a second, proven male ("Male 2") arrived in the collection, erratic progesterone metabolite concentrations recommenced, but again were followed by prolonged acyclicity of 6.5 months. Only on arrival of a third proven male ("Male 3") did regular cyclicity begin and continue at approximately 2-week intervals.

It has been well documented that females are the more choosy sex when it comes to selecting potential mates as they invest more in their offspring and have more to lose if they choose unwisely. In captivity, the availability of mates does not usually mirror mate choice as presented in the wild. Could our observations reflect mate compatibility influencing reproductive cycles or is it demonstrative of the onset of puberty? Further exploration in older individuals may shed more light and prove useful in the captive breeding management of the okapi.

Molecular management in an *ex-situ* colony of African penguins *(Spheniscusdemersus)*

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Ex-situ conservation, or the act of preserving aspects of biological diversity away from an organisms' natural range, is a significant facet of the global conservation effort. A key part of this is the establishment of viable captive populations. Research in *ex-situ* facilities is an integral part of conservation efforts and an increasing trend is towards the application of works involving atypical techniques and multiple institutions. Molecular techniques have revolutionised biological studies over recent years and their application has been steadily increasing. This study aims to incorporate these two fields, focusing on the genetics of an *ex-situ* colony of the Endangered African penguin (*Spheniscus demersus*) using 6 microsatellite markers for analysis. There were three aims: first, to determine the success of current population management practices with respect to genetic diversity, using heterozygosity as the principle measure. Secondly, to evaluate the parentage relationships within the colony in order to understand the accuracy of records made as well as the reproductive system in captivity. Thirdly, to carry out molecular sexing of the colony in order to assess the reliability of current gender assignment methods (behavioural observations) and to understand the offspring sex-ratio.

Low observed heterozygosity values (average of 0.153) indicate that levels of genetic diversity have not been maintained in this captive colony. Due to this low genetic variability, it was not possible to identify individuals within the colony using genotype data and so the aim to determine relationships within the colony could not be achieved. Behavioural observations were identified as being moderately successful at determining gender of individuals with 78% of individuals correctly assigned; however molecular sexing achieved greater success rates. The offspring sex-ratio in this colony was defined as statistically even which has positive implications for management. These results hgihlight the potential value of molecular applications in increasing the efficiency of *ex-situ* conservation

Aversion to colour in rainbow lorikeets (*Trichoglossus haemotodus*): implications for animal and human welfare during food presentation

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The welfare of captive animals can be seriously compromised by a range of biotic and abiotic environmental stressors. As many birds show a strong aversion for certain colours, forced exposure to aversive stimuli may elicit a negative behavioural reaction towards conspecifics and humans. A behavioural paradigm was therefore used to determine aversion to colour in a group of 27 captive rainbow lorikeets (*Trichoglossus haematodus*) during public feeding sessions at Blackpool Zoo. Testing involved three volunteers dressed in black, blue, green or red garments entering the birds' enclosure and presenting small pots of nectar to the flock. In total, 28 sessions were performed with each colour tested on seven occasions. Potential aversiveness was measured by recording the latency (seconds) of landings, total number of landings and feeds and specific feeding-related behaviours for each of the four colours. No significant difference was found between the coloured stimuli and latency of initial landings ($F_{3,18}$ = 1.5, P >0.05), the total number of landings ($F_{3,18}$ = 0.22, P >0.05) or feeds ($F_{3,18}$ = 0.49, P >0.05). It was also found that colour did not significantly affect individual feeding behaviour or agonistic behaviour (biting) towards humans. Significant results were however obtained between intraspecific agonistic behaviour and the number of times the birds fed. The results indicate that the behaviour of rainbow lorikeets is not adversely affected by clothing colour during feeding sessions, but supplementary feeding by humans increases the potential for within-group aggression.

Carotenoids and anurans: the effect of a carotenoid-enriched developmental diet on growth and froglet colouration in the phantasmal poison dart frog, *Epipedobates tricolour*

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Carotenoids are a class of natural, fat-soluble pigments absorbed through an animal's diet and utilised in various aspects of the organism, principally body colouration, metabolic pathways and they may also serve as antioxidants. Colouration of body areas plays a major part in the communication of animals, especially during mating and courtship. Therefore it is beneficial to animals that are involved in complex visual signals to be supplied with a diet sufficient in carotenoids. Ogilvy et al (2011) showed the difference in appearance of adult frogs when they were fed a carotenoid gut-loaded cricket with comparison to a normal cricket, but nevertheless the role of carotenoids in anurans is very poorly understood. *Epipedobates tricolor* is a South American poison dart frog, listed as Endangered by CITES. The frog produces epibatine in the wild, a painkiller 200 times more potent than morphine, which it secretes through its skin – making it a medically important species to preserve. A stable, regularly reproducing population is present at Paignton Zoo Environmental Park, and their offspring were used for this investigation.

Tadpoles from two batches (deposited at different times) were removed from a water bowl in an on-show vivarium. Both batches were separated into two equal groups and placed into separate rearing tubs. The control group were fed a standard Paignton Zoo diet, the other group being fed the Paignton Zoo diet, supplemented with 0.9g of Haith's Carophyll Red™ powder. Tadpoles were monitored biweekly for the entirety of their developmental phase, recording their total length, body length and body width; as well as monitoring environmental factors of the rearing water. Individuals were then transferred to a more terrestrial rearing tub during the latter stages of metamorphosis, all frogs were fed the standard unsupplemented diet at this stage. Froglets were photographed weekly, and these photos were analysed on ImageJ to determine the RGB (colour) values for the whole froglet and for specific areas of the body. The effects of batch and tadpole diet on tadpole growth, froglet growth and froglet colour were analysed using two-way ANOVAs in SPSS.

Carotenoid supplementation of the tadpole diet had no significant on growth of tadpoles or froglets for either batch, although the second batch grew and metamorphosed faster than the first batch. Carotenoid supplementation of the tadpole diet did have a significant on the colour of the froglets (increased red pigment) and this tended to be greater initially but diminished over time. These results indicate that frog colouration can be influenced by diet under normal husbandry routines. Further research should be carried out on other amphibian species and more research on the role of carotenoids in anurans is needed. With a recent emphasis on captive breeding of amphibians, this research could improve diets and conditions in captive-bred frogs, leading to improved captive breeding programmes, and eventually the re-introduction of chytrid-free frogs into the wild.

A global survey of captive cheetah diet, faecal consistency and gastrointestinal disease

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A cross-sectional epidemiological study was conducted to gather information on captive cheetah diet, faecal consistency, frequency of vomiting and diarrhoea, and veterinary treatments or diagnoses. An online survey was developed and tested to ensure ease and speed of answering (i.e. no more than 5 minutes). All institutions listed as housing cheetahs in either the International Cheetah Studbook or ISIS database were contacted via email or post (n = 260). Regional SSP and EEP co-ordinators assisted in the distribution of the survey. The survey was designed to determine if associations existed between faecal consistency (and other parameters of gastrointestinal (GI) health) and a range of dietary factors, or if any dietary parameter could be identified as a risk factor for GI disease. Data was collected from 181 animals (110.71.0), representing 12% of the global captive cheetah population, and 35% of facilities (90/260) known to house cheetahs. Mean age of animals surveyed was 8.0 yrs, ranging from 2.2 yrs to 17.5 yrs of age. The majority of responses were from North American facilities (36%) and European facilities (34%), followed by Africa (12%), Australasia (7%) and Asia (6%), with other contributions from the Middle East (3%) and Russia (1%).

Table 1. Diet type fed to captive cheetahs globally and by region

	Global	Africa n = 19	Asia n = 11	Australasia n = 11	Europe n = 58	Middle East n = 4	North America n = 66	Russia n = 3
Raw meat + supplement	34%	53%	82%	27%	34%	25%	21%	67%
Raw meat - supplement	2%	5%	9%	0%	3%	0%	0%	0%
Whole or partial carcasses	8%	5%	0%	0%	21%	0%	0%	0%
Commercially prepared diet	20%	0%	0%	0%	0%	0%	53%	0%
Mixture of all	35%	37%	9%	73%	41%	75%	26%	33%

The two most common diet types were raw supplemented meat or a mixture of all diet types, although regional differences were detected in the proportional use of each diet type (Table 1).

The incidence of diarrhoea detected within the 6 month period prior to completing the survey was highest in animals fed raw unsupplemented meat (75% of animals in this group), and lowest in carcass-fed animals (8%). The prevalence of GI disease was highest in animals fed commercially prepared diets (20%). No animals fed either carcasses or raw unsupplemented meat had been diagnosed with GI disease at the time of the survey. Animals reported as 'always' having a faecal consistency (FC) of either 'liquid' or 'soft without shape' were most prevalent in the raw unsupplemented meat diet group (25%), and never reported in carcass-fed animals. Cheetahs reported as 'always' having 'firm and dry' faeces were reported with the highest prevalence in the carcass diet group (54%), and never reported in raw unsupplemented meat-fed animals. Although results are still preliminary and risk factor analysis is on-going, these results suggest that carcass-feeding may be protective against diarrhoea in captive cheetahs (odds ratio 0.2).

How do zoos create, implement, and review diets?

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Managing animal diets in captivity is an important but complicated process, essential for maintaining health and well-being. There are many factors that must be taken into account when designing, implementing and reviewing diets, including nutritional requirements, feeding and digestive strategies, and energetic requirements. Practical considerations such as food costs, frequency of food delivery and animal acceptance of food items must also be taken into account. Logistical considerations mean that some factors are likely to influence decisions more than others, while some factors are also not fully understood. Because of these deficiencies, the nutritional needs of animals in zoos have received increased attention in recent years. This is complicated by large gaps in our knowledge of diets of wild animals and their nutritional and energetic needs.

This project reviews how zoos are making dietary decisions for their animals using a variety of published sources and expert consultation. Husbandry guidelines sanctioned by associations (EAZA, AZA, etc.) exist for a number of species, however the information they provide regarding diet management varies considerably. In cases of uncertainty, domestic animals have been used as models for closely related species, while trial and error has also been frequently employed. A combination of sources may be used by zoos when determining animal diets.

Alongside the literature review we will present results from a questionnaire survey completed during site visits to BIAZA zoos. Specifically this questionnaire investigated:

1. The process that zoos use for designing animal diets, including the factors considered, expertise involved, and resources used.
2. How diets are delivered to the animals, how rigidly the planned diets are implemented, and how and when food is administered.
3. Whether diets are reviewed and if so, what processes are undertaken and who is involved.

The questionnaire data were supplemented with a 6 month case study at Flamingo Land Resort, that made a quantitative nutritional review of diet selection for 129 species. This case study evaluated the variation between keeping staff and the frequency of food delivery on the amount of food and variety of food given. Zootrition software was used to analyse the nutritional content of diets and hence to examine the impact of dietary variation on the overall nutritional content.

The data collection for this work is ongoing, with the eventual intention to summarise current animal diet management in BIAZA zoos. This will serve as a baseline to assist in the ongoing attempts of several BIAZA member zoos to evaluate, review and improve captive animal diets.

A crest raising conundrum: investigating the function of crest erection in a captive citron-crested cockatoos, *Cacatua sulphurea citrinocristata*.

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Cockatoos are distinct from their 'True Parrot' counterparts due to the presence of an erectile crest, raised when birds become alarmed and during social interactions (Cameron, 2007). The precise function of crest erection in cockatoos is little studied, although the palm cockatoo (*Probosciger aterrimus*) is said to raise its crest during agonistic interactions, nest site defence and courtship displays (Taylor 2000, Heinsohn*et al*. 2003). This study sought to elucidate the function of crest erection behaviour in a captive group of citron-crested cockatoos (*Cacatua sulphurea citrinocristata*).The citron-crested cockatoo is critically endangered due to high levels of exportation for the pet trade, with low levels of nest recruitment in the wild (Walker *et al.* 2005) and complications when breeding in captivity it is essential to understand the behaviour of these animals to ensure breeding success and individual survival in captivity.

Seven possible functions of crest raising were tested using a range of methodologies including instantaneous focal sampling, all occurrence sampling, post-event matched controls and post-conflict matched controls. Statistical analyses included the use of generalised linear mixed models (GLMM), chi-squared tests and Pearson's correlations.

Preliminary results indicate that the frequency of crest erection varied between individuals (χ^2 = 179.254, df = 9, p< 0.001). A stable hierarchy was found to exist within the group and the frequency of crest erection correlated with rank held by the individual, (r = 0.825, p = 0.043). Losers of agonistic interactions crest raise more frequently immediately after an aggressive incident than during a control period (GLMM: χ^2 = 3.496, df = 1, p = 0.063). It was also found that the number of crest erections of both winners and losers was greater directly after a conflict than during control periods (GLMM: χ^2 = 3.492, df = 1, p = 0.062).

Based on the preliminary results it appears that crest erection could be involved in conflict management situations, it may also serve as a self-directed behaviour and as such increased frequencies of crest erection within the group may suggest raised levels of stress or anxiety. This potential marker could then be used by keepers to monitor stress within the group.

Visual discrimination in hornbills: a cognitive study on the discriminative abilities and sorting strategy of captive *Tockus deckeni* and *Tockus nasutus*.

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Many naturally occurring objects that are important for the fitness and survival of animals vary across multiple and discriminable dimensions (colour, shape, size…). Not all the dimensions of stimuli are vital and can be processed simultaneously. Given the fact that information processing is costly, adopting a sorting strategy to categorize only the useful and important information would be favored. It has been argued that birds can only visually categorize or discriminate between different dimensions using a nonanalytic and less complex cognitive multidimensional or similarity based approach. Humans on the other hand should be able to use both the multidimensional strategy and also an analytic and complex cognitive uni-dimensional strategy. Recent experiments in birds argue against this. In 2009, a study on the discriminative abilities and sorting strategy in Von der Decken's hornbills and Abyssinian ground hornbills was conducted at Paignton Zoo. To enlarge the sample size, we repeated the study in a pair of Von der Decken's hornbills (*Tockus deckeni*) at Antwerp Zoo. We also wanted to complement earlier findings and added another species, the Grey hornbill (*Tockus nasutus*). We presented the 5 birds with series of cognitive tests in which they had to learn to discriminate between different symbols that consisted of different dimensions (colour, shape, pattern). The test apparatus we used was a 'poke-box' to present the stimuli choices. When the correct stimulus was selected, the birds received a reward. To investigate the sorting strategy and the most influential dimensions, the different dimensions of the stimuli were varied. Our results indicate that all but one bird used uni-dimensional sorting, but the importance of the dimensions differed within and between the species. Colour seems to be an important dimension for both Von der Decken's hornbills. Shape was more important for all but one Grey hornbill. Besides the importance for fundamental cognitive research, we also want to emphasize the importance of this simple but ingenious setup as cognitive enrichment for animals in zoos.

Do butterflies (*Rhopalocera*) have a colour preference when in a captive environment, and do they all share the same preference?

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The Lepidoptera order is one of the planet's most diverse groups of animals. Among this order are 20,000 described species of butterflies (*Rhopalocera*). All of which are remarkably different from one another. Studies into the visual system of butterflies have determined that they possess excellent colour vision. Further research has concluded that wild butterflies have a preference for a food source. Research in captive butterflies is limited, especially where many different species are housed within the same environment. The aim of this study was to uncover whether species kept within a captive environment, would all share the same colour preference for a feeding platform. The study was carried out over a six week period, commencing on December 5th 2011, and a total of 60 hours of data was collected. Platforms of three various colours were presented to the butterflies through the duration of the study, and a control platform was used. This study collected data on the frequency of visits and length of time each visit lasted. The main results were that individual species do have a colour preference for a feeding platform, for example the striped crow species had a preference for the colour orange (P=0.005). No species apart from the glasswing (P=0.025) spent a significant amount of time on a coloured feeding platform.

The influence of odorous stimuli on electro-receptive foraging behaviour of the small spotted catshark (*Scyliorhinus canicula* (L.))

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Elasmobranch species possess the ability to locate hidden prey by detecting bioelectric fields, using specialised sensory organs known as the ampullae of Lorenzini. Since the discovery of this system and its function, the process of electroreception has received an increasing amount of attention from neuroscientists, physiologists and biologists. Common protocol in ethological studies, implemented to determine the capabilities of this sensory system, involves the entry of a food-derived odour stimulant to initiate a foraging response toward specially designed electrical apparatus. Elasmobranchs have specialised sensory receptors within the olfactory epithelium which respond differently to individual amino acids, yet accurate details about the composition of odorous substances used in electro-receptive experiments remain unpublished. This was the first laboratory study, as far as is known, to examine the influence of odour stimuli in electro-receptive foraging behaviour. Two behavioural experiments were conducted at the Sealife centre, Blackpool, using captive small spotted catshark (*Scyliorhinus canicula*). In one experiment, investigating individual responses (n=27), odour arrival was found to have a significant effect on electro-receptive foraging behaviour, in particular increased interactions with electro-equipment ($p<0.05$) and increased interactions with electrodes ($p<0.01$). Odour type was also demonstrated to have a significant effect on electro-receptive foraging behaviour. No significant difference was found between gender or group dynamics. Theoretical hypothesis, implications and limitations of the findings are discussed in detail.

Adaptive management and measuring conservation success: a case study in Tanzania

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British zoos are becoming increasingly involved in environmental conservation programmes. While this is great news for conservation globally, it is important that projects are able to measure their success throughout their duration. The concept of Adaptive Management uses indicators of conservation success to improve the effectiveness of conservation initiatives through an ongoing assessment and reassessment of methods. Used effectively, Adaptive Management seeks to improve efforts to preserve ecosystems and also communication between researchers and decision makers. The process of development of conservation indicators using Adaptive Management is discussed here, as implemented by Flamingo Land's Udzungwa Forest Project (UFP) using the CMP Open Standards and associated software (Miradi).

UFP is based in south-central Tanzania, and has focussed mainly on monitoring and restoring tropical lowland forest, including socio-economic and livelihood sustainability activities in nearby villages. Tropical forests contain the majority of the world's biodiversity, provide various ecosystem services and mitigate the effects of climate change. They are also declining and degrading at an alarming rate, particularly tropical lowland forests, which are easily accessible to those looking to exploit their natural resources. As a result, tropical lowland forests are now one of the world's most threatened habitats.

Use of the CMP Open Standards has led to the use of 19 indicators of conservation success by UFP. Ecological indicators have shown that conservation efforts in the focal forest have so far been ineffective in achieving their goal of protecting biomass and biodiversity. Monkey populations have nearly halved in size since data collection began in 2005, and the removal of forest products is occurring at an increasing rate. The management potential for restoring deforested or degraded areas is huge, however this kind of active management of tropical forests remains rare. We have found liberation thinning to be an effective method for restoring both biomass and biodiversity.

All ecosystem conservation is dependent on the support of local communities, and hence the CMP Open Standards have also led to the use of various human livelihood indicators of success. Education levels on the importance of forest, sustainable living and forest conservation have increased in the Magombera area. However there are currently insufficient alternative resources available to people in villages surrounding Magombera forest, despite ongoing efforts to plant trees and to introduce fuel-efficient technology.

Our results to date emphasise that conservation management must achieve an effective balance between provision of ecosystem services and protectionist conservation. We therefore emphasise the importance of a holistic approach to conservation that considers the needs of both wildlife and local people.

Field conservation by BIAZA Zoos: how well are we doing?

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The role played by zoos has changed considerably over time, with BIAZA zoos now providing a valuable resource for education, conservation and research. Many zoos now support *in situ* conservation projects in addition to *ex situ* conservation breeding programmes. Data from the annual BIAZA questionnaires was analysed to find out how the investment of zoos in field conservation changed between 2004 and 2010. The annual BIAZA questionnaire provides information on the status of all member collections, including information on the conservation projects supported, and the financial and staff input to these projects.

These data can be used to highlight the important conservation work done by zoos, in order to gain further publicity and funds. It also provides useful information to the BIAZA Field Programmes Committee (FPC), allowing them to determine which zoos require support in their involvement in field conservation and helping to highlight information required beyond that obtained from the annual questionnaire.

The total investment in field conservation has risen year by year since 2007, with an estimated £12 million invested in 2010. The amount invested per BIAZA member was equivalent to 12.5% of the mean zoo admission charge. The proportion of BIAZA member zoos supporting conservation also increased, from 68% in 2004 to 88% in 2007, but then dropped steadily to 82% in 2010. However there is a high level of variation, with at least ten zoos not contributing anything in 2010. The total number of conservation projects supported by BIAZA zoos increased from 336 in 2004 to 636 in 2010, although there was a slight drop from 2009 to 2010. The percentage of zoos employing conservation staff and the total number of conservation staff increased over time, with over 220 staff employed by nearly 70% of zoos in 2010. Expertise for the scientific evaluation of conservation data (and hence the evidence base for conservation success) is also thought to have increased, as inferred from an increase in research staff to nearly 200 staff in 75% of zoos in 2010.

However we are not yet able to assess the success of conservation projects as to date there has been no assessment of conservation indicators. Whilst measuring conservation success is extremely difficult, it is necessary both to ensure that funds are used appropriately and to better convince the public, governments and NGOs that the work of zoos is worth supporting. We are also concerned about variation in interpretation and reporting among members, and propose that both financial investment and staff involvement in field conservation needs more simple guidelines to assist completion of the annual questionnaire.

Overall, BIAZA zoos contribute significantly and increasingly to field conservation, through financing, staff time and expertise. However there is always room for improvement in both the level of investment, and the accuracy and precision of contribution estimates. The BIAZA FPC will therefore continue to develop its role in providing advice and technical support for field conservation by member zoos, and in improving the annual review of conservation activities.

An investigation into the knowledge of visitors at Colchester Zoo: do regular visitors have a deeper, broader knowledge about natural history than non-regular visitors?

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A study was conducted at Colchester Zoo, Essex, UK into the knowledge obtained by its visitors. Colchester Zoo is one of many zoos which enable its visitors to gain regular access to the grounds with the use of a membership card – these are categorised as regular visitors.

There are many opportunities for visitors to develop and broaden their knowledge about the natural world and how zoos work whilst visiting Colchester Zoo. There are over 50 daily presentations, free of charge for visitors to watch and take part in. Due to the size of the zoo grounds (over 60 acres) and the number of presentations, we do inform visitors that they will not see every presentation on just one visit. We therefore encourage repeat visits with the use of a membership card. This membership scheme is a one off payment to entitle visitors to enter the zoo for up to one year (gold card) or two years (platinum card) at no additional cost. By offering this scheme, visitors can take advantage of the varied information on offer and so gain more of an insight into the natural word.

The knowledge and understanding of regular visitors was compared to that of non-regular visitors with the use of a questionnaire. This questionnaire was designed with short, closed questions which visitors could find the answers to within the zoo grounds and also during public presentations; additional questions were added to investigate deeper knowledge not gained from the zoo. The survey was carried out over a period of 11 days which coincided with a school half term holiday. Surveys were conducted towards the end of the day when many visitors had walked around the zoo and attended various presentations. Visitors had not been shown or able to obtain the questions prior to the questionnaire being conducted.

This presentation will present the results of this study. It is hoped that the results will highlight the importance of the educational facilities at Colchester Zoo and also how successful the education is. We also hope that the study will show the commercial success of the gold card scheme in terms of enticing visitors for repeat visits. The study will ideally be conducted over a longer period of time to determine if there are further differences between the knowledge of visitors across different times of year.

Development of keeper research at Colchester Zoo: understanding animal keepers' knowledge of research within the zoo.

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Research is one of the main roles of a modern day zoo and is one of the main objectives for Colchester Zoo. The majority of research that is carried out in the zoo is by undergraduate students looking for topics to study as part of their final year dissertation. Masters students along with PhD students, do carry out data collection within the park but these are far fewer. The number of projects completed at the zoo has increased over recent years and more students are visiting the park for data collection from further afield. Animal keepers tend to assist students by suggesting ideas and also taking the time to assist students with their study.

The main aim of this study was to investigate how much understanding the animal keepers at Colchester Zoo have in regards to the amount and type of research that takes place within the park. The study was also used to encourage keepers to create their own research projects. This study will form part of long term study in order to develop further keeper-based research at Colchester Zoo. A short questionnaire was produced and handed out to each animal section within the zoo for all keepers to answer anonymously. Questions included how many research students visit a year; popular topics researched; understanding of application protocols; how results should be presented and finally questions related to the opportunity for keeper research.

Results so far have demonstrated that, despite many animal sections having close communication with research students, keepers tended to have little knowledge into the research carried out across the zoo. It was also evident that keepers had little understanding of how students apply for research projects in the first place. Furthermore, many keepers would like the opportunity to take part in their own research projects and have more of a say in what students are carrying out.

The study has permitted a good insight into the understanding of keepers with regards to research at Colchester Zoo. Future developments in how information is put across to staff will be looked at further. Suggestions for new methods for feedback of project results and considerations into how all keepers can be informed of on-going research within the park are made. The benefits of the study will hopefully enable keepers to get further involved with research, increasing communication amongst keepers, education staff and the students themselves hopefully developing new, exciting and successful projects.

What's new? Novel object testing in Psittacine birds

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Members of the order Psittaciformes are known for their relatively large forebrain, and observations of innovative tool use, usage of novel foraging techniques and cooperative problem solving suggest they may be considered as one of the most innovative taxa. However, little is known about variation between species in innovativeness. Innovation can occur through a number of processes, such as exploration, social and individual learning and neophilia Attraction to novelty (neophilia) is likely to speed innovation, whereas avoidance of novelty (neophobia) is likely to slow down innovation. The neophobia level in birds can influence their response towards new feeding situations and so influence their ability to assess and learn about new environmental innovation.

A well-established test to assess neophobia is the response to novel objects. In the current study we investigate the level of neophobia in two novel object tests in five pairs of Psittacine birds of five species at Antwerp Zoo (salmon-crested cockatoo; kea; yellow-headed Amazon; blue-headed macaw; hyacinth macaw). After studying the birds' baseline response to a food dish placed in their enclosure, we presented to each pair two separate experimental novelty tests. A week after baseline observation we placed an orange cone next to the feeding tray, which was removed after 60 minutes. One week later we placed a blue plastic box next to the food dish and again removed it after 60 minutes. We measured 1) the latency to approach a familiar food dish next to a novel object, 2) the frequency of approaches, 3) the duration of the time spent close to the object and 4) the duration of novel object manipulation. During each test, subjects were video-recorded for later analysis.

Preliminary results indicate that the presence of novel objects increased latency to approach food. The orange cone treatment elicited more neophobic response in all species, compared to the blue box. The species differed in their latency and frequency of approaches. While kea and hyacinth macaw showed the least neophobic response, salmon-crested cockatoos never approached the novel objects. More research and an increase of the sample size are needed, but these preliminary results have implications for further cognitive research, applied behavioural purposes (use of enrichment) and conservation issues.

New girl on the block: social integration of a female Gorilla (*gorilla gorilla*) into a captive group at Antwerp Zoo

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In August 2011, a new adult female gorilla (*Gorilla gorilla gorilla*) was introduced into a resident captive, non-breeding group of gorillas at Antwerp Zoo, which consisted of three adult gorillas: two unrelated *Gorilla beringei graueri* females and one infertile *Gorilla gorilla gorilla* silverback. The group was monitored during the entire introduction process (10 days) for a total of 74 observation hours, focusing on the behaviour of the migrant female, all agonistic and affiliative interactions among the residents were also recorded. The integration of the migrant female was a step-by-step, gradual process. After the last stage, the behaviour of the newly formed group was monitored for one additional week. Six months after the introduction we monitored the behaviour of the group again for 25 hours.

Our results show that initially, the introduction of the new female did not work out as expected, with a high frequency of agonistic behaviour from the new female towards the silverback male. Yet, after interaction with the older resident female, the migrant female started to behave submissively towards the male. The following days, the male and the new female mated several times and he supported her against resident female aggression. The initial high rate of agonistic display by the females towards the migrant female decreased rather quickly. After six months the new female was fully accepted by the resident gorillas. This acceptance was translated in lower agonistic interactions and a high frequency of social interactions, such as play between the immigrant female and the youngest resident female.

To conclude we can state that, despite the initial assertive behaviour of the migrant female, the integration process proceeded at a fast rate and resulted in a stable mixed species captive group of gorillas.

Is Skippy shy? A study on visitor effects on kangaroo visibility and enclosure use

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A number of studies in zoos have investigated the effect of visitors on animal behaviour in zoos. These studies are mostly biased towards primates and large carnivores, but little is known about the effect visitors have on other taxa. In this study, we investigated the effect of visitors on the behaviour of a captive group of red kangaroos (*Macropus rufus*) at Planckendael Wild Animal Park in March and April 2012. To improve the welfare and reduce the influence of visitors, vision screens can be used. Therefore we studied the use of vision screens by the kangaroos. The study included five different stages according to a ABCDB method: 1) Screens in original position 2) No screens 3) Screens positioned parallel with the visitors 4) Screens positioned transverse with the visitors 5) No screens. Every stage had a four day duration. We used instantaneous scan sampling with a five minute interval to score the number of animals in each area (quadrant) of the outside enclosure. The visibility of the animals and the Spread of Participation Index (SPI) were calculated. Overall, the SPI value in each stage was very high, indicating that the kangaroos do not make full use of their enclosure. The SPI values varied between the stages, but effects were not significant. The visitor numbers, nor the temperature could predict the SPI values. Animals were more visible in the parallel and transverse stages, but again, differences were not significant. The correlation between the visibility and the visitor numbers was not significant, but our results point out that the temperature could be a predictor of the visibility. Overall, the use of the screen areas varied, with one screen area used more than the others, especially in the transverse stage. Nevertheless, the animals used the other areas (with no screens) more often. To conclude we can state preliminary that visitor numbers did not had an effect on the visibility of the animals and use of the enclosure. The vision screens were not used by the animals to hide themselves during crowded days. Therefore we conclude that the enclosure use of the red kangaroos at Planckendael is not influenced by visitor numbers, and probably visitors have no negative effect on kangaroo welfare.

Seasonal effect on the behaviour of a captive troop of common squirrel monkeys (*Saimiri sciureus*)

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Animals from tropical regions have not evolved to live in a temperate climate and therefore are not physiologically adapted to the marked seasonality present in temperate areas. For this reason, keeping tropical animals within a temperate climate may be potentially problematic from both a behavioural and welfare prospective.

The aim of this study was to identify any changes on the behaviour of a captive group of common squirrel monkeys (*Saimiri sciureus*) housed at Colchester Zoo, in Essex. Nine individuals were observed in total over spring, summer and autumn using scan sampling every five minutes with behaviours being recorded and then further categorised into Non-active, Locomotive, Social and Feeding behaviours.

The difference in behaviour over three seasons was found to be significant (c^2=13.63, d.f.=6, p<0.05), but under further statistical analysis, only the Non-active behaviours proved to be significantly different among the seasons (c^2=7.85, d.f.=4, p<0.05). The frequency of active behaviour was higher in spring and decreased consecutively over the next two months, suggesting that warmer and more favourable weather conditions promoted inactivity and increased resting. Trends were identifiable in the non-significant behaviours, with an unexpected low proportion of social behaviour being observed in all three seasons. Seasonal differences are therefore apparent in the behaviour of captive *S. sciureus.* This information can be used to improve the husbandry of this tropical species of primate and potentially other tropical species housed in British zoos, with the potential to considerably improve captive welfare.

Are nocturnal houses effective zoo exhibits? A comparative study of the activity levels of nocturnally and diurnally housed sloths (*Choloepus didactylus*) in five UK collections.

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Nocturnal houses (and reverse lighting) are popular exhibit methods for zoos across the world, however there is little research into the effects that this lighting system has on the activity levels of species which are exhibited in this way.

This study attempted to investigate the effectiveness of the reverse lighting system, implemented by zoos in nocturnal houses, by comparing the activity levels of Linne's two-toed sloth (*Choloepus didactylus*) housed under nocturnal and diurnal conditions. In order to better understand sloth activity, differences between activity levels in gender and age were investigated. 10 sloths (5♂ & 5♀), ranging between 4 and 28 years old, were studied across five different collections over a five week period. The sloths were observed for four hours a day and behaviours they exhibited were categorised as either "active" or "inactive".

Once the data had been collected and analysed, it was found that the nocturnally housed sloths were significantly more active than those found in exhibits which use natural light, this means that the assumption can be made that reverse lighting does have an effect on the activity of sloths kept in nocturnal houses. No significance was found for the effect of gender or age on a sloth's activity. Additional studies on other species (which are commonly kept in nocturnal houses) need to be conducted in order to definitively state whether reverse lighting has an effect on all animals kept in this type of exhibit, or whether it only affects sloths. The results of this study will hopefully lead towards a better understanding of the husbandry requirements and exhibit methods of Linne's two-toed sloth (and other nocturnal species).

Comparison of reconciliation in bonobos and chimpanzees.

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Reconciliation occurs when two former opponents in a conflict show affiliative behaviour after the conflict has ended, and has been shown in many primate species. Several studies have investigated reconciliation in chimpanzees, but only two published studies have looked at this behaviour in the closely related bonobos. Initially it was believed that bonobos show more reconciliation than chimpanzees, and also use sexual behaviour to reconcile. However the second study on bonobos, using the same standardised analyses as recent chimpanzee studies, found that reconciliation rates in bonobos fall within the chimpanzee range. Since it has been shown that bonobos in captive situations can show variation in social behaviour, more data from different groups are needed to compare the two species. In the present study we looked at reconciliation in a captive group of 6 adult bonobos in Planckendael Wild Animal Park, and compared this with a group of 9 adult chimpanzees. The bonobos were studied for 200 hours on 26 days in the summer of 2010. The chimpanzees were housed in a series of enclosures ranging from 68 to 850 m^3 and were studied for 271 hours on 36 days. We collected data on 229 conflicts in chimpanzees and 222 in bonobos. For chimpanzees we could analyse 86 Post conflict/Match control pairs, in bonobos we analysed 80 pairs. In both study groups, affiliation between former opponents was more pronounced after a conflict, compared to matched control observations. In both species pairs were significantly more attracted to each other than they were dispersed. Chimpanzees reconciled most often by sitting in close contact with opponents (75%) and by grooming (13%) or playing (9%). In bonobos, contact sit was also the most frequent form of reconciliation (48%), followed by grooming (15%) and affiliative touch, play and sexual behaviour (each representing 11%). We found a mean corrected conciliatory tendency (CCT) of 18.57 for the bonobos, and 32.86 for the chimpanzees. Comparison with literature suggests that there is considerable overlap in CCT between the two species, and bonobos do not show higher reconciliation rates than chimpanzees.

Using a scatterfeeder to reduce stereotypic pacing in two spotted hyenas

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In the wild, spotted hyenas (*Crocuta crocuta*) occupy large territories, show elaborate hunting behaviour and live in very large social groups. This makes them prone to locomotor stereotypies when kept in zoos, and appropriate enrichment schemes can be necessary to reduce the occurrence of such stereotypies. In the present study we investigated the impact of enrichment on pacing behaviour in two male spotted hyenas housed in Planckendael Wild Animal Park. We collected data on activity budgets of the two hyenas by instantaneous scan sampling during 4 1-hour sessions on five days in the following conditions: 1) no enrichment provided; 2) dead chicks, blood trails and bamboo sticks placed in the enclosure; 3) a pre-programmed scatter feeder spread dog biscuits in the enclosure once a day at a fixed time in the afternoon. We compare activity budgets of the two hyenas in the three conditions. Preliminary results indicate that pacing was reduced in the scatter feed condition compared to both other conditions. However, aggression also increased after scatter feeding, probably because of restricted surface in which the dog biscuits were spread out. Hyenas were more prone to pace when daily temperatures were low, but on average temperatures in the scatter condition were not lower than in the other conditions. This seems to indicate that, even though food was only scattered out over a small surface, during a very brief period in the afternoon, it succeeded in reducing stereotypic pacing to a significant degree. Research into the influence of this scatter feeder at Planckendael will be continued, to further assess the impact on the hyenas' welfare.

Inter-specific interactions between silver-leaf langur (*Trachypithecus cristatus*), Asian short-clawed otter (*Amblonyx cinereus*) and binturong (*Arctictis binturong*) at Colchester Zoo, Essex.

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Mixed-species enclosures are a relatively recent addition to most zoos. They are becoming more and more common, not only as a way of furthering education about animals in the wild, but also as an enrichment scheme for the animals being kept. Although little research has been conducted over the impacts of species sharing an enclosure, mixed-species enclosures are becoming more popular in zoos.

This study aims to observe the interactions within a mixed-species enclosure at Colchester Zoo, Essex. The enclosure houses three Asian species that occur sympatrically in the wild; three female silver-leaf langurs (*Trachypithecus cristatus*), one male and one female Asian short-clawed otters (*Amblonyx cinereus*), and two female binturong (*Arctictis binturong*). The enclosure was observed for 120 hours over two months between June and August. The observation period was every ten minutes over three hours; inter-specific behaviour and enclosure use of both the species as a whole and the individuals were recorded.

Analyses of the behaviours show that inter-specific behaviour, especially aggression, rarely occurs. In fact most encounters were observed as being amicable; and general frequency of encounters being relatively low. Enclosure use analysis demonstrates that each individual had a preferred zone in which they spent the majority of their time; and enclosure use overall by each individual was generally not influenced by the presence of another species.

From this study and future research, it should become apparent just how beneficial mixed-species enclosures can be, not only finance-wise for the zoo, but also enrichment-wise for the species involved. By determining both the positive and negative behaviours that species can have on each other, it may be recommended that all zoos adopt a mixed-species enclosure policy where possible.

The effect of visitor number on the behaviour of the pileated gibbon (*Hylobates pileatus*)

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Animal-human interactions in zoo animals have not been as intensively studied when compared with farm animals. Moreover, previous research has found that for some animal species visitors can provide a form of stimulation. Nevertheless, and specifically on primates, animals can fail to cope with the demands of being in a captive environment and often show signs of compromised welfare and stereotypical behaviours. One of the main aims of a zoo is to attract large numbers of the general public with the primary aim of improving conservation, education, welfare and research of endangered and exotic animals.

This study aimed to investigate how visitor numbers during high and low seasons affect the behaviour of two pileated gibbons at Colchester Zoo. Pileated gibbons (*Hylobates pileatus)* primarily live in forests around Thailand and Cambodia. They are classified as endangered by the IUCN due to deforestation, agriculture, over hunting and the pet trade. Behavioural observations were done using scan sampling for five minute slots during an hour period. Within a day, the pileated gibbons were observed for a total of three hours with an hour break between each period to gain a varied amount of behaviours throughout the day using a paired *t*-test to compare the behaviour displayed between high and low visitor numbers.

The results showed that there was no significant difference between the behaviours displayed in the high and low season of both the male (t= 0.72, d.f.=4) and female (t= -1.04, d.f.=4). This result contrasts with the available literature where it has been found that primates are usually affected by visitor number. We recommend further research in other zoological institutions or on other primate species to have a better insight on human-animal interactions in the pileated gibbon and in other zoo animals.

Experimental personality research in okapis (*Okapia johnstoni*): An assessment of the possibilities and challenges.

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For a wide range of animal species different behavioural types or personalities have been identified between individuals of the same species. Personality is the notion that differences in behavioural responses between individuals are consistent over time and between contexts. Interestingly, personality traits not only have implications for ecology and evolution, but in particular in captive populations, personality profiling can have practical applications, for example for population management decisions.

For personality assessments to be useful in the management of captive populations it is necessary to develop a simple assay to allow personality profiling of the animals of a particular species. To this end, a series of standard behavioural tests were performed to determine whether it is possible to use an experimental approach to study personality in okapi in a zoo setting. Three male and three female okapi at Antwerp Zoo, Belgium were used to assess whether 1) individual animals respond differently to standardised experimental treatments, 2) whether these differences were consistent over time and contexts, and 3) if an underlying structure of personality traits could be found. The tests included a control test; a novel object test; a mirror image stimulus test; a resistance to handler test; and interaction test with a keeper or an unfamiliar person.

With a number of these tests and for several behavioural parameters significant differences between the okapi were identified and these parameters were mostly consistent over time. Further investigation of the correlation structure of parameters between and within tests revealed that reactivity in the tests was probably mostly determined by three underlying components that we identified as Fear, Sociality and Sociality to person. We conclude that it is possible and relatively easy to do experimental personality research for the okapi in a zoo setting. Extension of these experiments to a larger part of the captive okapi population could provide clear insight into okapi personality and an important tool for improving zoo population management.

Zoo BAPs: developing Biodiversity Action Plans for conserving native wildlife in and around zoological gardens

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There are an estimated 8.7million species on earth, with around 87% of land species and 91% of marine species still to be discovered. Despite new species being discovered and defined each year, the rate of extinction is thought to be more than 1,000 times the natural background rate. Many of these extinctions are caused by, or related to, human disturbance, and the earth is now considered to be in a sixth mass extinction. In the wake of the CBD's (Convention on Biological Diversity) failure to halt biodiversity declines by 2010 there was a call for further work, including increasing the role of zoological gardens particularly for those species threatened by habitat loss.

Considering the temperate location of most of the world's zoos it is often hard for zoo visitors to relate biodiversity loss back to their home countries. However biodiversity loss is occurring on a world wide scale, e.g. the UK alone has seen 100 extinctions in just 100 years. This has led to the development of both regional and national Biodiversity Action Plans (BAPs) in the UK. These documents set out targets for biodiversity, based on priority species and habitats, in accordance with the CBD.

A growing number of zoos are also now looking toward conserving native wildlife within their grounds, both as a tool for education and as a way of contributing to biodiversity loss. "Zoo BAPs" therefore have real potential for zoos to achieve formal development of biodiversity targets and actions. Here we introduce the method for development of a Zoo BAP created and developed through the biodiversity programme at Flamingo Land Resort. This method is now being adopted by the BIAZA Native Species Working Group to help stimulate future development of Zoo BAPs elsewhere in the UK and beyond.

In the pink; behaviour, exhibit use and breeding success of lesser flamingos *(Phoeniconaias minor)* at WWT Slimbridge Wetland Centre

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It is said that flamingos are the world's most popular zoo-housed bird, yet little current research exists on how the captive environment affects time budgets and daily activity patterns. All six species of the order Phoenicopteridae are currently maintained in captivity, with some species affording more success than others in terms of captive breeding and population sustainability. As evidenced-based zoo animal management progresses and research-lead husbandry changes become more applied, species that were considered near-impossible to reproduce in captivity are beginning to show signs of successful breeding events. The lesser flamingo *(Phoeniconaias minor)* is one such "problematic" species, with only two recorded successful breeding attempts noted at WWT Slimbridge Wetland Centre.

In the summer of 2011, data were collected on the behaviour and enclosure usage of the flock of 44 lesser flamingos housed at Slimbridge to determine an outline of what the birds "do" with their time. As with so many captive species, enclosure usage is not equal (as determined by the Modified Spread of Participation formula), with birds favouring specific areas for particular behaviours. Aggressive interaction also correlated with individual areas of the exhibit. There was no relationship between time of day and activity pattern, nor did the presence of visitors have an adverse effect on the flock's time budget. Nesting sites were self-built by the flamingos in a small, confined section of the exhibit, rather than using those created ready for the birds to adapt. Close proximity between nests was noted as a key factor in instigating reproduction. Disruption to breeding birds seemed to occur mostly from the previous youngster, hatched in 2006, attempting to interact on the nest sites.

Overall, lesser flamingo behaviour at WWT Slimbridge would appear to mimic a wild time budget and birds are clearly capable of reproducing in captivity, providing their enclosure enables them to feel secure. The success of a newly-raised chick provides an added boost to the conservation programme for lesser flamingos; with wild populations threatened by the potential of soda ash extraction in Lake Natron captive flocks may become increasingly important. It is hoped that, with the on-going development of a new exhibit and close monitoring of breeding displays and their timings, this success can be repeated in the future. These data are feeding in to a bigger project on captive flamingo social behaviour, flock dynamics and enclosure usage that will provide a more in-depth overview of the importance of social structure to the group, as well as to the individual bird that will hopefully shed light onto how captivity influences and shapes the behaviours of highly social species.

GnRH agonist Deslorelin (Suprelorin®): using a contraceptive database to identify key research areas in primates

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Contraception is widely used in animal collections as a tool for the management of reproduction and, more recently, as a means of controlling aggressive behaviour. Historically, contraception has been permanent, which is not considered suitable when future breeding may be recommended to ensure population viability. This has resulted in a call for chemical contraceptive products available for both males and females which would allow reversibility of reproductive suppression. A relatively novel and now widely recommended chemical contraception product being increasingly used in both males and females for reproductive and behavioural control is the GnRH agonist Deslorelin (Suprelorin ®). However, as Deslorelin was originally developed for domestic dogs, there is a need to evaluate its success in a range of exotic animals.

The European Group on Zoo Animal Contraception (EGZAC) has been working in collaboration with the AZA Wildlife Contraception Centre (AZA WCC) since 2009 and both collect and collate data on wildlife contraception within animal collections. With currently as many as 30,000 entries, evidence based information can be extracted using Microsoft Access. Drawing on reported animal husbandry issues related to Deslorelin (Suprelorin ®), this data was utilised in order to identify key research areas for development.
The use of Deslorelin (Suprelorin ®) has been identified as data deficient for reversibility in primates. Additional concerns have been raised regarding changes in social behaviours and social structure. This could be due to modification of the individual's reproductive endocrinology through the use of contraceptive products. Due to reversibility being questionable, the AZA WCC is reluctant to recommend it and EGZAC suggest caution with genetically valuable animals.

The effective management of Old World monkeys (particularly macaques, *Macaca spp.*) requires the need for intervention both in controlling the breeding of genetic lines within the studbook and carrying out group introductions with minimal aggression, and Deslorelin is often prescribed to deal with these situations. Behavioural and endocrinological research is necessary to provide more insight into the reversibility of Deslorelin and effects on both hormonally influenced and learnt behaviour, which could be implemented into the husbandry of collections.

The impact of zoo visitors on ring-tailed lemurs (*Lemur catta*) in a walkthrough exhibit

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Visitors are known to affect zoo animals and their behaviour. Such effects may be stressful, enriching, or have no detectable influence on their emotional state. The majority of research in this field has focused on the effect visitors have on animals in traditional exhibits. Few have examined the impact of visitors in free-ranging and walkthrough enclosures where there is increased proximity to animals and decreased access to visual blocks. The goal of this study was to observe the influence of visitor numbers upon the behaviours of a group of captive ring-tailed lemurs in a free-ranging walkthrough exhibit at West Midlands Safari and Leisure Park.

The behaviours of six animals were observed and visitor numbers were counted simultaneously. A total of 180 hours of data was collected over thirty days between 29th August and 25th October 2011.

The relationship between behaviours and visitor numbers was then explored using Spearman's rank correlation tests. Results revealed a significant, positive correlation between visitor numbers and bouts of inactivity and self-directed behaviours, such as autogrooming and scratching. Further analyses (Wilcoxon matched pairs tests) were done to ascertain whether there were differences in the frequency of behaviours in the morning compared to the afternoon. It was found that time of day did have an impact on inactivity and feeding, as well as on other indicator behaviours.

Since visitor numbers also correlate with time of day, further work is required to differentiate between the effect of visitors on activity levels and the influence of time on day on behaviour. However, behaviours such as aggression and self-directed behaviours appeared to occur at higher frequency during times of higher visitor numbers. These are not necessarily time oriented behaviours, which increases the likelihood that their increase in frequency was occasioned by the presence of larger numbers of visitors.

This study suggests that visitors may significantly affect the behaviour of ring-tailed lemurs in a walkthrough exhibit and highlights factors which may cause stress in this situation. It is the first part of a project which will be completed of over the summer of 2012. Data will be collected to allow the findings of our 2011 study to be further investigated. We will look for the effects of visitor numbers independent of time of day and make recommendations on how walkthrough exhibits could be designed in order to reduce the negative impact of the presence of visitors.

They might be giants…but just how visible are they?

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Visibility of animals is an important issue to zoos, as it contributes to providing an enjoyable, value-for-money day out for visitors, but also to provide better opportunities for conservation education. At Chester Zoo, we carry out a series of studies investigating animal behaviour and enclosure use, as well as visibility from the public's point of view. These studies focus on several key species, including giant otters (*Pteronura brasiliensis*), for which we consider there to be a visibility issue. We use the data to help us make decisions about animal management, such as to develop targeted enrichment programmes to encourage activity in under-used (and more visible) areas of the enclosures, or to make changes to enclosures to try to improve a species' profile. Annually since 2010, we have repeated several short-term summer studies on the giant otters, and some of the data were presented at the 2011 BIAZA Research Symposium (Hill and Birt, 2011). We confirmed visibility issues in this species, partly because a large proportion of their time was being spent out-of-sight underwater, or in their off-show house. In January 2012, Chester Zoo opened a new extension to the existing enclosure, to provide an on-show indoor house for the giant otters, and to provide visitors with an underwater viewing area, where they can watch the giant otters swimming and interacting through glass viewing windows. Using our standardised methods, additional data were collected in January, so that we could monitor animal visibility and report it on a daily basis to animal managers. In this presentation, I describe how we are using our visibility studies to contribute to evidence-based management, and provide an update on improving visibility in giant otters at Chester Zoo.

An investigation into the behaviour and interactions of a male red panda (*Ailurus fulgens*) with a mature female at Colchester Zoo.

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Red pandas (*Ailurus fulgens*) are native to the cool, temperate bamboo forests in Sichuan and Yunnan Provinces in China, in the Himalayas, and Myanmar. They are classed as a vulnerable species on the IUCN Red List of Threatened Species as a result of two main factors; deforestation and hunting. As a result of this, it is important to sustain a diverse captive population to ensure such a unique animal isn't lost. It is important for zoos to observe the behaviour and interaction of their potential breeding pairs to obtain an indication of whether or not the animals are likely to form a successful breeding pair, or whether different partners will need to be found. Colchester Zoo houses a pair of red pandas, a mature female (Lushan, ten years) and a male (Anan, two years). Anan was just reaching sexual maturity during this investigation, making it a vital time for observing the behaviour and interaction of the pandas to obtain early indications as to whether or not the pairing is likely to result in a successful breeding pair.

Ethograms were used to assess the behaviours of the pair. Enclosure usage was noted, along with when the pandas were together/separate, number of visitors, and weather. The latter two were recorded as these were considered to be important factors to take into account when seeking to determine whether any changes in behaviour were a result of the animal maturing, or a result of these factors. Enclosure usage was included in the study to determine whether there were any trends in the environment chosen for each activity. This may assist the optimisation of enclosure design to best suit the animals' natural behaviours.

Data is still being collected, and so final conclusions have yet to be reached. This presentation will demonstrate some of the findings so far. The red pandas were observed mating several times on nine different days during March, 2012. This is an important observation, as red pandas are only usually in oestrus for one to three days per year, therefore suggesting that it is very likely that they will form a successful breeding pair. It was observed that, almost without fail, the male would 'call' to the female before mating. Further observations noted that their activity generally increased on drier days, but does not necessarily with temperature. The number of visitors doesn't appear to have any impact on their behaviour. Finally, differences were noted in enclosure usage of the red pandas, particularly relating to certain activities.

Data will continue to be collected over the next four months, and further analysis will be conducted. It is hoped that this study will reveal that the red pandas will form a successful breeding pair, and this information will be of valuable use to the keepers at Colchester Zoo, providing an insight into their behaviour.

Don't count your flamingos before they've hatched – a comparison of breeding success in two flamingo species, *Pheonicopterus chilensis* and *P. ruber*, at Chester Zoo from 2003-2011

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Flamingos are a popular bird species found in many zoos. Flamingos are colonial birds yet irregular breeders. Reproduction is stimulated by rainfall, day length and appropriate environmental conditions (e.g. suitable substrate to build nests) and sufficient population sizes to trigger mating displays. However, many zoos have insufficient space to accommodate large numbers of individuals.

Two species have been kept at Chester Zoo for many decades, the Chilean flamingo (*Pheonicopterus chilensis*) and the Caribbean flamingo (*P. ruber*) and both have bred during this time. Key to their success are close observations of pair bonding and nest building during the breeding season, nest location records and artificial incubation of all eggs laid. The eggs are returned to the nest prior to hatching. A cluster of flamingo chick deaths in 2010 prompted a more detailed investigation of reproductive success and chick mortality in both species.

Records exist since the populations were established, listing births, deaths and transactions in and out of Chester's collection. Information relating to all flamingo eggs laid includes nest location, date laid, dimensions, and whether it hatched, died during incubation, or was presumed infertile; these data have been collated electronically since 2003. Using incubation data and adding information from ARKS and keeper observations recorded in diaries, a database was compiled of the reproductive effort of both species for the period 2003-2011.

Populations in 2011 totalled 101 individuals for *P. chilensis* and 103 for *P. ruber*. This represents an increase in flock size of 49% and 36% respectively since 2003. In wild populations, juveniles may reach sexual maturity at a young age (as early as two years) and while they may take part in mating display, they appear to delay the onset of reproduction for several years. Records at Chester Zoo reveal our flamingos pair bond and breed from the age of four. Taking this into account, for 2011 the effective breeding population was 80 and 77 individuals for *P. chilensis* and *P. ruber* respectively. Although the effective breeding groups are similar in number for both species, many of the birds are unsexed. Furthermore, differences in breeding patterns and success between the two species are evident. The egg-laying period for *P. chilensis* can start in May and lasts until August, with eggs hatching as late as October. In contrast, the laying period for *P. ruber* occurs primarily in June, with most eggs hatching throughout June and July. On average, annually *P. chilensis* lay more eggs than *P. ruber*, but hatch rate is lower. Chick survival is also lower in *P. chilensis,* with mortality occurring primarily in birds aged less than seven days; a greater proportion of *P. ruber* chicks survive to the age of six months.

This review provides a better understanding of the breeding patterns and success for two species of flamingo maintained at Chester Zoo, which may be relevant to husbandry and management of flamingo species more widely.