Oral Presentations

Monday 23rd July 2007

Session 1

The effect of olfactory enrichment on predator and prey species; fossa (*Cryptoprocta ferox)* and ring-tailed lemur (*Lemur catta*) at Newquay Zoo.

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The introduction of appropriate environmental enrichment to zoo enclosures has been shown to have positive effects on both the physiological and psychological welfare of zoo animals. Olfactory stimulation has had relatively limited use as a form of enrichment but has been shown to be effective in a number of species; specifically it has encouraged foraging behaviour in predator species when they are exposed to prey scents.

This study, undertaken at Newquay Zoo, explored olfactory enrichment in predator / prey species; fossa (*Cryptoprocta ferox*) and ring-tailed lemur (*Lemur catta*). Monkey fist rope knots were used to provide three treatments: 1. unscented rope ball, 2. rope ball with vanilla scent and 3. rope ball with predator/prey scent. A control condition (no rope ball) was also used. The scent of sympatric predator/prey species were introduced into the corresponding species enclosure i.e. fossa scent introduced into the ring-tailed lemur enclosure and vice versa.

Preliminary results indicate that the activity of both species increased from control across the treatments to treatment 3 and the time spent interacting with the rope ball was greater for both species when it was scented. All treatments also appeared to increase affiliative behaviour of both species and vocalisation of the lemurs, with the predator/prey scented rope ball tending to have the greatest effects. Further analysis is required but preliminary indications are that predator/prey scent is effective enrichment for these species.

Prioritising mammal species for olfactory enrichment using anatomical criteria for olfactory specialisation

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Olfactory enrichment is being increasingly used in zoo management programs as it is known to provide a number of physiological and behavioural benefits to a variety of mammals. This contrasts with a relatively poor understanding of how mammalian olfactory specialization may be linked to a species physiological and behavioural response to introduced scents. We used a published data-set of ethmoid bone size (the bone through which the primary olfactory axons reach the olfactory bulb) and skull size, to estimate ethmoid/skull ratios for a number of commonly housed zoo mammal species (a selection of primates, felids and canids). Ethmoid/skull ratios can be seen as anatomical criteria for olfactory specialisation, and we use this ratio to highlight significant differences in the degree of olfactory specialisation for common zoo mammal species. Given these differences, we explore, retrospectively, to what degree the sensory ecology of a species is reflected in olfaction studies to date. We find that

published studies fail to reflect mammal olfactory specialisation, and instead indicate a strong bias toward large felid species. Given the ever-increasing time constraints on zoo husbandry and management regimes, we identify a selection of mammals from our data-set, (canid, lemur and loris species) considered as 'high priority' for olfactory enrichment based upon species sensory ecology. Whilst we advocate that anatomical criteria of sensory organs be used increasingly by researchers wishing to investigate the benefit of various stimuli upon zoo animal welfare, important consideration must first be given to the choice stimuli and its relevance.

Is there a quick way to assess the efficacy of enrichment?

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Environmental enrichment (EE) has been shown to improve the psychological and physiological well-being of captive animals. Unfortunately, not all objects and devices provided to stimulate zoo animals are effective EE; EE is deemed to be effective when it achieves a designated goal. Traditional methods of assessing EE efficacy are usually time-consuming and entail comparing the daily activity budgets of animals with and without EE. If evaluation of potential EE could be completed more rapidly, keeper time and effort could be directed at only providing EE which has been proven to be effective. This study compares the traditional, detailed, long-term observation method of evaluating EE, with a rapid one, which uses quick and easy measures.

Abyssinian black and white colobus monkeys (*Colobus guereza kikiuyuensis*, N=4.0) and Sulawesi crested black macaques (*Macaca nigra*, N=4.6) housed at Paignton Zoo Environmental Park were provided with, respectively, 4 and 5 different potential EEs one at a time on separate days (6 and 7 days each, respectively). The goals of the EE were to increase 'positive' behaviours, such as exploration, locomotion, foraging and affiliative social interactions. Daily activity budgets with and without each EE were constructed and potential rapid assessment measures were also recorded: lag time to first use of EE, length of first use of EE and number of revisits to EE in first 10 or 30 minutes.

The results of the rapid measures were compared with EE efficacy, as determined by changes in daily activity budgets, to evaluate their suitability for rapid assessment of EE. Although some rapid measures are potentially useful variations between EE types and species reduce their reliability.

Session 2

Captive 'feeding' programmes; improving cricket production at Chester Zoo

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Can changes in temperature, humidity and tub size account for the increased production of crickets at Chester Zoo?

Chester Zoo supplements its supply of purchased invertebrates by breeding their own migratory locusts (Locusta migratoria) and black crickets (Gryllus brimaculatus). The locust colony has been operational for 30 years and is self sustaining. The cricket colony has been operational for three years but is not successful because it has proved impossible to rear crickets beyond the third developmental (instar) stage. Thus it is necessary to buy in breeding adults. Crickets may be a better food source for insectivorous animals, because they provide a broader range of prey sizes, for frogs in particular.

Currently the locusts and crickets are bred in one large rearing room with considerable temperature and humidity fluctuations. Temperature fluctuates as a result of staff moving into and out of the room. Humidity is affected by staff cleaning equipment and hosing down the room. Locust colony production appears unaffected, however, it is feasible that crickets were more sensitive to the environmental fluctuations of temperature and humidity.

To test whether temperature and humidity fluctuations are a factor, a separate 'hot' room was established for rearing crickets; more constant environmental conditions were created using both wall-and ceiling-mounted heaters. The existing invertebrate room served as a control room and was termed the 'warm room'.

Four tubs were placed in each room housing a different developmental stage: pinheads (hatchlings), 1st instar, 2nd instar and 3rd instar. In total eight experimentat tubs were used, housing 600 crickets. The same food was used in each tub and water dishes were also included. Fifty crickets from each tub were randomly sampled weekly and length measurements were recorded. The test was run for a period of 25 days to ensure that the oldest crickets reached adulthood. Measurements were taken on day 0, day 4 and then at weekly intervals. Adults were humanely destroyed and submitted for chemical analysis to assess the nutritional quality of the crickets in each rearing system. To measure room conditions, for the duration of the study data loggers recorded temperature and humidity values at 15 minute intervals. To monitor the microclimate within the tubs temperature values were recorded at four intervals throughout the day: 8am, 11am, 2pm and 5pm using hygrometers. Crickets reared in the 'hot room' grew faster and survived to reproduce.

Changes in tub colour, size and furniture were also evaluated to determine if cricket rearing could become more efficient. We will present the results of these studies, the chemical analyses and discuss the implications of these changes in invertebrate rearing for Chester Zoo.

Public perceptions of carnivore feeding methods

Vicky Melfi and Kathy Knight, Whitley Wildlife Conservation Trust, Paignton Zoo

The provisioning of carnivores in captivity is a highly controversial subject due to the nature of their wild diet; most species actively hunt live invertebrate or vertebrate prey or will scavenge other kills. Many zoos cannot provide a 'real' hunting experience due to the need to consider the welfare of the prey animal and legal obligations. One way in which zoos can provide a more 'natural' foraging/feeding experience is to provide captive carnivores with whole animal carcasses.

At the 7th International Conference on Environmental Enrichment (ICEE), New York, a number of authors contributed to the symposium 'to carcass or not?' Research suggested that carcass provision for carnivores was beneficial; promoting natural behaviours, reducing abnormal behaviours and it was not detrimental to health. However, carcass feeding is not implemented worldwide. During open discussion after the symposium, it was suggested that public perception of carcass feeding influenced its implementation. Furthermore, zoo managers were concerned that zoo visitors would perceive carcass feeding carnivores negatively and was the principal reason given to explain why it was not implemented more widely; despite it being extremely beneficial.

This presentation provides an overview of the empirical results from an international survey of zoo visitor perceptions of carcass feeding carnivores. These data have been collated, from surveys undertaken using a standardised methodology and encompassing zoos in more than 4 continents and 7 countries. The results will provide a much needed insight into; the knowledge zoo visitors have about carnivores, how they feel about husbandry practices, and elude to which educational media may be best to teach visitors about carcass provision.

Marmoset Meals

Nick Rowley, Twycross Zoo.

The tropical house at Twycross Zoo is a large, mixed species exhibit based around a South American theme. The exhibit contains twelve species which cohabit within it including two toed sloth, sebas fruit bats, green iguanas and a variety of South American birds. Recently a group of four common marmosets was also introduced into this area.
All of the species are constantly kept within the exhibit except for the marmosets which have access to an off show area where they also spend the night. The marmosets are fed three times a day within this area. However since the other species are fed in the exhibit it was felt that the marmosets would take the opportunity to feed out of the other animals' food bowls and that their diet would be compromised. This study was therefore designed to monitor the food which the marmosets are eating.
When the marmoset group was first moved into the tropical house they were kept in the off show area to get them used to the house. During this period all the food they were given was weighed and the amount of each food item was noted down. Food that was uneaten was collected, the amounts noted and the weight taken. After a week the marmosets were let out into the exhibit where they would have access to other species' food bowls. Their own food was still given to them in the off show area where it was monitored as before for a further week. The assumption was that the intake of marmoset's own food will be reduced when other animals' food is available.
After the marmosets had been in the tropical house for a month the study was repeated to see if there was any change in the amount eaten once the animals had become fully acclimatised to the exhibit. The plan is then to repeat the study after two months have passed so as to give further data for comparison.
At the time of writing the study is not yet completed but already we have discovered some interesting results. The marmosets are eating less of their own food when they are in the exhibit and it is generally the same food stuffs that are being left suggesting that they are replacing a less liked food item with a more favoured one which they are finding within the exhibit. Also some food items are left regardless of whether the marmosets are in the exhibit or not. Once the study completed, is a full review of the marmosets feeding regime will be discussed, with some food items being reduced and others possibly eliminated altogether. A full set of results will be available by the date of the symposium.

The leaf preference of a
captive leaf cutter ants (*Atta cephalotes)* colony.

Liam Shepheard and Alexander Kent, Drusillas Park.

Captive leaf-cutter ant colonies (*Atta cephalotes*) can be seen within many collections throughout the UK, despite this there has been very little ex-situ research focusing on their behaviour. This study therefore aimed to expand our knowledge of the leaf preference of a captive colony of this species, with a view to enhancing their husbandry and management. This study focused on the provision of five plant species which were frequently utilised as leaf material for the colony, with a view to discover which species is preferred.The results indicated a significant preference towards spotted laurel (*Aucuba japonica*). Of the total leaf mass harvested 49.32% was from this species, double the quantity of the next most heavily harvested species, *Euonymus japonicus* (25.05%). An unexpected result showed that there was a gradual increase in preference towards *Elaeagnus ebbingei* throughout the study.This corresponds with the natural seasonal growth pattern of this species. A second aim of this study was to discover whether there was any temporal variation in the ants harvesting behaviour. The results did not show much difference in activity between the day and night time period, except for when harvesting *Aucuba japonica* where the colony were significantly (X^2,1, 0.03 $P<0.05$) more active during the day. This study suggests that there is a leaf preference for captive leaf cutter ants and that harvesting activity is more substantial during the day. This therefore has implications for the management of this species in an ex-situ environment, and the plant species offered.

Session 3

Human-Animal Relationships in the Zoo

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Much recent research has focused on the possibility that the behaviour of animals in zoos is affected by the presence and behaviour of members of the public visiting the zoo. Most of this research concerns nonhuman primates, and because these often show increased aggression and activity in the presence of people, it is widely thought that visitor-presence is stressful to zoo animals in general, and therefore presents a potential welfare issue. However, examination of the literature shows that not all taxa respond in the same way to human visitors, and even within the same taxon there may be differences in the way individuals respond. In attempting to understand this variability we must also account for the responses zoo animals give to their keepers and other familiar people they encounter regularly. Here a model is presented to give a framework for understanding how the quality of interactions that animals experience with both familiar and unfamiliar people in the zoo can lead to the establishment of human-animal relationships (HARs) of different quality, and what the behavioural consequences of those HARs are likely to be.

An inter observer reliability test: Keeping a check on the keepers!

Ross Snipp, Drusillas Park.

In July 2006 a 12-month infant development study began, charting the behavioural and social changes in a newly born lar gibbon (*Hylobates lar*). This study, now nearing completion, has been undertaken solely by members of the zoo keeping staff at Drusillas Park. Data are collected using instantaneous focal animal sampling. Multiple observers have been used to collect data throughout the study. Using multiple observers has the potential to create undesirable variation in how behaviours are identified and recorded. Too much variation will reduce the consistency of the dataset. To determine the consistency between observers repeated inter-observer reliability tests were undertaken. The first test was undertaken at weeks 9-11 and repeated again at weeks 42-45. During each of the tests two of the observers were paired together and collected data during the same 15-minute sample period. Percentage agreement levels were high during the first test, but fell during the second test. Reasons for the reduction in consistency are discussed and include an increase in the range and complexity of behaviours observed during the second test, and an increase in the number of observers. Factors that can influence inter-observer reliability include observer training (and experience), complexity of behavioural categories and activity levels of the focal animal. It is suggested that future multiple observer studies focus on fewer, more discrete behaviours and that extensive training be given to all observers. Inter-observer reliability testing should be carried out at frequent intervals to assess consistency of the data in the longitudinal studies.

Improving literacy, numeracy and communication skills in students with learning difficulties using action research at Blackpool Zoo.

Sarah Thomas, Blackpool Zoo.

Since 2005, a local agricultural college have been in partnership with Blackpool Zoo providing weekly group work experience for a number of animal care students with learning difficulties. Due to their varying abilities, many organisations can not provide placements as too much individual support is needed. The demographics for the group were 11 students (6 females and 5 males - ages 16-29) with varying physical and learning special needs.

As well as practical experience working in the collection; it was decided that an intervention could be performed that required students to improve their literacy, numeracy and communication skills whilst on placement. The scheme was based on an action research methodology using the zoo and its wide selection of species as a tool for learning.

At the end of each term the students were asked to produce an A2 poster and give a 5-10min presentation about a selected animal in the zoo. There were given 2-3 sessions of preparation time. The first presentation was in a group of 3 individuals, then in pairs and the last one at the end of the academic year was given individually. Before each presentation students were asked about their thoughts and feeling regarding the talk. This was documented and the words coded into positive and negative responses. After the sessions they were also asked specific questions regarding their performance. Feedback and questions from the other members of the groups was also initiated and the comments and scores used as product evidence of assessment.

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

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

This action research project is deemed to be qualitative in nature. The data is not subject to formulaic analysis and often makes use of more opened ended questions that allow expression of opinions and attitudes. Qualitative data collected comprised of opened ended questions and the nature of the data is words, images and categories that are then analysed to discover themes, patterns and holistic features. With these kind of studies there has to be a clear focus to the project but there is usually minimum pre-structuring and a high degree of flexibility. Researchers do not claim to find the final answer to a question, but do claim to improve and change practice through development an educator.

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

The development of a key to the mammals of the Udzungwa Mountains, Tanzania, based on their hair morphology and its use in identifying samples collected in the area from hair traps.

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The Udzungwa Mountains are part of the Eastern Arc range in Tanzania; these mountains are a global biodiversity hotspot and have a high level of endemic and endangered fauna. This includes a rich but poorly studied forest antelope community, including the endangered Abbott's duiker (Cephalophus spadix).

During 2005 a researcher from Paignton Zoo spent six months in the Mwanihana Forest in the Udzungwa Mountain range trying to establish an effective monitoring method for forest antelope. One of these methods trailed was to set up hair traps: transparent sticky tape suspended across forest paths in order to trap hairs of terrestrial mammals passing under or through.

This project aimed to identify the hairs caught by these traps. A key to the hairs of mammalian species of the Udzungwa Mountains is being developed for use with hair trap analysis – a total of 37 species have so far been identified. The key is based on cuticular scale patterns of hairs but other features of hair morphology will be discussed. The main limitation of the key is that small differences in cuticular scale patterns are sometimes used as diagnostic criteria to enable identification to species level. The most frequently identified species were antelopes particularly Harvey's duiker and mongooses particularly Mellers mongoose.

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

Session 4

ENVIRONMENTAL INFLUENCES IN CAPTIVE POPULATION DECLINES OF TWO ENDANGERED POLYNESIAN TREE SNAILS (*PARTULA* SPECIES)

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Invertebrates contribute the majority of the planets animal biomass, but relatively little attention has been paid to the health and welfare of invertebrates of conservation importance in captivity. *Partula* species Polynesian tree snails are small Molluscs, belonging to the class Gastropoda, order Stylommatophora, family Partulidae. They are a unique genus endemic to the Pacific region, and more specifically to the Society Islands. There are over one hundred species of *Partula* snails described, with 79 species on the International Union for the Conservation of Nature (IUCN) Red List. 50 species are currently classified as extinct, 14 as extinct in the wild, and 15 as critically endangered. Wild populations have declined since the introduction of a predatory snail, *Euglandina rosea,* introduced to control the also introduced Giant African land snail (*Achatina fulica*) which had become an agricultural pest. The London Zoo coordinates a worldwide captive breeding programme for *Partula* snails and occasional periods of high mortality have occurred in a variety of species. While the extinction of *Partula turgida* in captivity has been postulated to have been due to a microsporidian infection, investigations of the majority of other captive *Partula* species population declines have failed to identify causative diseases. A study of the population dynamics of a habitat generalist (*Partula clara*), and a habitat specialist (*Partula tohiveana*) confined to small areas on the island of Moorea, and the daily minimum and maximum temperature and humidity was performed over a three year period. At the same time post-mortem examinations, including histopathology of dead snails was performed to investigate the role of any infectious diseases in the population declines. No obvious infectious aetiological causes were evident. There appeared to be a clear association between some of the declines and changes in environmental parameters. Linear regression demonstrated a significant association between *Partula clara* mortality with maximum and minimum humidity **(**F = 39.43 with 1 and 50 degrees of freedom (df), P = 0.000 and F = 68.57 with 1 and 50 *df*, P = 0.000 respectively); *Partula clara* fecundity with maximum and minimum humidity (F = 68.57 with 1 and 50 *df*, P =

0.000 and F = 14.62 with 1 and 50 *df*, P = 0.000 respectively); and *Partula tohiveana* fecundity with maximum and minimum humidity (F = 11.39 with 1 and 50 *df*, P = 0.01 and F = 6.31 with 1 and 50 df, P = 0.015 respectively).

Comparative behavioural study of two Waldrapp ibis (*Geronticus eremita*) colonies, a captive group at Dublin zoo and a free ranging group in Austria.

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Captive populations often exhibit behavioural patterns that are significantly different from those in wild populations (Hakansson & Jenson, 2007). Wild type behaviour has long been used as a welfare indicator by zoo researchers (Shepherdson 1989, McDoughall et al, 2005). Furthermore, loss of behavioural diversity in captive populations is often cited as a contributing factor to the poor success rates of reintroduction programmes involving captive bred animals (Beck *e. al*, 1994, Brightsmith et al 2005). The present study investigates the differences in behavioural patterns between a free ranging and a captive group of Waldrapp ibis (*Geronticus eremita*). Activity budgets were constructed for each group, and for a sample of males and females from each group. There was a significant difference in the behavioural pattern observed in each group with the captive group foraging and walking significantly less than the wild group. Some behaviours were almost completely absent in the captive group. The average behavioural patterns of the males and females were significantly different within each group with the females foraging significantly less than the males in the Dublin group.

Behavioural interactions between three species of auks at Living Coasts

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Auks are unusual amongst sea birds in that several species are often found breeding in close proximity to one another. At Living Coasts in Torquay, the Auk Cliff exhibit houses representatives of three auk species: tufted puffins (*Fratercula cirrhata*), common guillemots (*Uria aalge*) and pigeon guillemots (*Cepphus columba*). Auks are rarely found in captivity so this exhibit provides a valuable opportunity to study their behaviour at close quarters. This study investigated intra and inter-specific interactions of the birds throughout the breeding and non-breeding season. Eight individuals of each species, covering both sexes and a range of ages, were observed between November 2006 and June 2007 using focal follows.

In common guillemots, it appears that pair-bonding behaviours are performed between established pairs throughout the year, becoming more common and more exclusive to the pair as the breeding season approaches. In contrast in tufted puffins and pigeon guillemots such behaviours are rare during winter, but occur more often shortly before and during the breeding season. Preliminary results indicate that most aggressive acts or displacements are initiated by common guillemots and the most frequent recipients are tufted puffins. A single individual, a common guillemot hatched at Living Coasts in 2005 and hand-reared, initiated more than half the displacements, but no particular individuals were regular victims. The auks appear to initiate and receive displacements less often in the areas in which they spend most of their time. Against expectations, tufted puffins and pigeon guillemots, which compete for nesting burrows, did not appear to engage in aggression with each other as often as with common guillemots, which breed on cliff ledges and therefore are not in competition with the other birds for nest locations.

An understanding of how these three species interact within the exhibit will provide a basis for future husbandry decisions.

What Affects the Behaviour of Squirrel Monkeys (Saimiri boliviensis) in a Captive Environment? A Look at Two London Zoos.

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Numerous behavioural studies have been conducted on captive primates but relatively few have looked at New World monkeys. This study investigates the behaviour of four groups of captive squirrel monkeys at Battersea Children's Zoo and London Zoo. These zoos were chosen as both have several individuals and they provide variation in exhibit type. During the pilot study for this research, it became obvious that many different factors affected squirrel monkey behaviour and the study was therefore designed to investigate visitor effects, noise levels and environmental conditions (weather). The animals were observed at both zoos from March through early June 2007. Alternating between times, enclosures (three at Battersea Zoo and one in London Zoo), and zoos each enclosure was observed for a total of ten days; including weekdays, weekends and holiday periods. Using instantaneous scans (one minute point sampling) and focal animal sampling, notes were taken on the monkey's behaviours, sky conditions, visitor numbers and ages, the number of pushchairs, and noise levels. Notes were also taken on the feeding times and enclosure accessibility. Additionally, adlib notes were taken when deemed necessary. Weather information (mean temperature and air pressure) was obtained for each study day from the meteorological office records. Initial observations show that weather and enclosure accessibility have the greatest effect on the monkeys' behaviour. There also appears to be behavioural differences between the groups at the two zoos. The relationships between the different factors and the observed behaviours will be discussed and compared with results from previous studies of primates.

Tuesday 24th July

Session 6

Reconciliation and conflict prevention in captive bonobos (*Pan paniscus*) during potentially stressful situations

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A social association inevitably leads to conflicts. Since aggression carries a risk of injury, increases the risk of further aggression, and damages social relationships, mechanisms of conflict prevention and resolution are a critical component of the social life of any group-living species. Bonobos (Pan paniscus) reputedly are a peaceful species, for which sexual behaviours have been convincingly described as a mechanism to reduce tension; in tense situations, such as at feeding time, rates of sexual behaviour are higher compared to control situations. Moreover, conflicts are often reconciled by sexual behaviour, and high rates of sexual behaviour have been linked to the establishment of new relationships. Our main goal in this study was to examine the effect of potentially tense situations, i.e., spatial crowding (seasonally changing housing conditions) and social disruption (the introduction of a new

female to an established social group), on baseline cortisol levels in urine to establish whether these are stressful situations for captive bonobos. Subsequently, we examined whether sexual behaviours are indeed, as suggested, a general mechanism of bonobos to prevent and resolve conflicts during such situations. Spatial crowding caused higher cortisol levels and this effect was even more pronounced after the introduction of a new group member. Sexual behaviours seemed to function as conflict prevention mechanism during social disruption but not spatial crowding, during which only the rate of non-sexual social behaviours was increased. Conflicts were reconciled more often when individuals had to cope with both spatial crowding and social disruption. In conclusion, sexual behaviour certainly is an important aspect of the bonobo's social life, though it seems not to be the only mechanism to reduce tension.

Conflict management mechanisms under times of a reduced resource in captive hamadryas baboons (*Papio hamadryas)*

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An exploratory study into aggression and conflict management mechanisms was performed on a captive group of hamadryas baboons (*Papio hamadryas*) at Paignton Zoo Environmental Park. Conflict arises in situations where two (or more) individuals have incompatible goals; conflict management acts to reduce aggressive escalation of conflict and mitigate or repair damage caused by escalation. In a captive situation a controlled resource induces a duality of behaviours under times of aggression – those concerned with conflict management, and those concentrated on obtaining the benefits of the resource. This study investigated whether access to a resource takes priority over conflict management and reconciliatory behaviour and whether this has any effect on troop dynamics and levels of anxiety as a result.

The troop was observed during feeding times to determine rates of aggression, conflict management and avoidance behaviours during times of access to a desirable resource. The six most dominant males were observed for 15 minute focal-follows in three situations: post-conflict (immediately following an aggressive encounter), matched controls (at the same time as the post-conflict session on the next day) and baseline (non-feeding times). These were carried out in two sections of their enclosure differing in size and complexity. Preliminary investigations show that crowding (in the smaller enclosure section) does not appear to have an effect but that in both sections the occurrence of conflict management and avoidance mechanisms are lower at times of feeding. This in turn affects frequency and levels of aggression and anxiety rates. Further statistical analyses are being performed.

The formation of coalitions and alliances through grooming and play by juvenile Hamadryas baboons

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This study investigated the onset of coalition and alliance formation in a troop of Hamadryas baboons (*Papio hamadryas*) at Paignton Zoo Environmental Park. Grooming and play relationships among baboons at the juvenile stage were studied to assess their influence on the development of alliance formations later in life. In addition to enhancing physical development and maternal behaviour learning play is also thought to be important for 'testing out' potential opponents in adulthood. Grooming is known to be important for building and maintaining relationships and possibly for trading for other beneficial commodities.

Previous studies at Paignton Zoo have indicated that play and grooming behaviour in the late-juvenile age group, but not in younger age classes, will influence social relationships in adulthood. It was suggested that there were higher rates of aggression between preferred grooming partners, but lower rates between preferred play partners, compared with other dyads. The play, grooming and conflict behaviour of the same 11 juvenile individuals used in the previous study (now a year older) have been recorded to further investigate these relationships and how they have changed over time. During this study the subjects ranged between 3 to 7 years of age. Twelve 20 minute focal follows were carried out on each individual to obtain baseline behaviour patterns, and *ad libitum* focal sampling was carried out for grooming, play and conflict interactions. Preliminary results support the previous study and further statistical analyses are being performed to determine the influence of juvenile behaviour on adult relationships.

Session 7

A Conditioning Programme for a Group of Chimpanzees at ZSL Whipsnade Zoo.

Emma Whitlock and Jo Dodds, Zoological Society of London.

The veterinary management of captive chimpanzees (*Pan troglodytes*) can be challenging. Historically the chimpanzees at ZSL Whipsnade Zoo (ZSL WZ) have been very difficult to anaesthetise, using a blowpipe or dart gun to deliver the anaesthetic agent has previously been the only option. Any darting produced enormous stress in the group and presented a risk to both the animals and the veterinary and keeping staff involved.

A conditioning programme was started with the ZSL WZ Veterinary Department nurses to resolve the problems associated with general anaesthesia in the chimpanzees. The presentation discusses the equipment used and the processes involved in the establishment of the conditioning programme. The successful use of the trained behaviours is illustrated by a case study. Since initiating the training programme in 2003, 8 chimpanzees have successfully been anaesthetised using hand injected drugs administered by the Veterinary Nurses at ZSL WZ.

Clinically related research by the Veterinary Department at ZSL Whipsnade Zoo.

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Having a veterinary department on site is advantageous in many ways for a zoological collection. Above and beyond the daily care of the animals and the “fire brigade” work, members of the veterinary team at ZSL Whipsnade Zoo (ZSL WZ) are involved in preventative medicine, nutrition and research.

Because of the diversity of species held in zoos, everyday routine work can come up with interesting findings that have not been previously recorded. A good diagnostic work up and response to treatment can be written up as a case report or presented to scientific meetings.

Furthermore, zoological medicine is constantly evolving with new anaesthetic protocols being set up and new drugs being used. Currently we are focusing on improving wild equid anaesthesia (zebra, onagers and Przewalski horses) and rhino anaesthesia. All physiological parameters are recorded and anaesthetic protocols are compared. This leads to more established protocols with strong scientific background that can be published as a full paper.

Finally, the Veterinary Department at ZSL WZ is involved in collaborative research with both internal and external researchers. Working under the guidance of both ZSL’s Ethical Review Committee and the Animals Scientific Procedures Act (ASPA), on specific occasions, additional sample material above that needed for the clinical diagnosis may be taken when

carrying out routine veterinary procedures. If routine samples show hidden problems (e.g. low blood vitamin E levels), contact is made with the appropriate person(s) (e.g. nutritionist) and possible trials, again in accordance to the ZSL Ethical Committee and ASPA requirements, to correct these problems are discussed and set up.

This talk discusses some of the research-related work the Veterinary Department at ZSL WZ is involved with and may highlight possible areas where the vets at other collections may be incorporated into the relevant research programmes.

Acknowledgements

Since research is a team effort, credits are in place to Animal Management Department, (Keepers and Curators), my colleagues in the Veterinary Department (both at London and Whipsnade) and the Scientific Officer, Andy Hartley.

Poster Abstracts

South-American Camelidae (alpacas, guanacos and vicunas): basic activity budgets.

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Three groups of South American Camelidae were observed in Wild Animal Park Planckkendael, Belgium to quantify their activity budget. The alpaca group (*Vicugna pacos*) consisted of two females and one male, the guanaco group (*Lama guanicoe*) of two adult females and one male, and the vicuna group (*Vicugna vicugna*) consisted of four females and one male. Focal animal sampling (15') was used to score activities of all individuals. Social interactions were scored *ad libitum*. 38 focals were carried out on the alpacas, 40 on the guanacos and 36 on the vicunas. All data were life scored with The Observer 5.0 software (Noldus, Wageningen). Observations ran from November 2006 till April 2007. The animals spent 65% (alpacas), 43% and 53% of their time eating. Rumination took 11% (alpaca), 18% (guanaco) and 14% (vicuna) of their time. Of the three species, the vicunas were most active: they ran and walked around most (44%), followed by the guanacos (30%) and alpacas 22%. The guanacos seemed most susceptible to itching, showing considerably more comfort behaviour than the other species, such scratching, twitching etc... Stereotypic behaviour in the guanacos consisted of repeated walking with slightly elevated tail, ears somewhat forewards. Further, two of the vicunas showed stereotypic pacing behaviour. The alpaca group had an extremely high rate of agonism (defined as displacements, standoff displays, spitting and chasing) (n=179), in comparison to the guanaco (n=23) and vicuna group (n=52). This was apparently due to the social incompatibility and aggressive behaviour of the male. The alpacas were further never heard "humming" which is a typical content contact call in this species. It was concluded that the welfare of these individuals was reduced.

Behavioural observation of a captive cheetah group (*Acinonyx jubatus*): food and visitor effect.

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A social group of four adult female and one adult male cheetahs was observed in a privately owned zoo to quantify the social relationships and behavioural changes related to a) feeding context and b) presence of visitors. The group had been stable for several years and was kept in an enclosure of 120m^2 with hiding facilities. They were fed at irregular times. Focal animal observations (10 minutes) were carried out by means of The Observer software (total 1050 minutes). We scored positive social interactions (eg. grooming, sniffing, face licking, cheek rubbing), aggressive behaviour and general data on activity budgets (eg. resting, pacing and out of sight). Feeding context was scored per focal as "previous to feeding time", "during feeding time", "after feeding time" and "day of fasting". Visitor presence was scored as "none", few (1-4 visitors), many (more than 5 visitors). Aggression was relatively infrequent (n=20) and the animals showed more positive social interactions (n=64). Within dyads, aggression and positive interactions tended to correlate. Preferred partners received friendly as well as aggressive interactions. After feeding or on fasting days, hardly any social interactions occurred. Aggression and positive social interactions occurred predominantly during the presence of food and prior to feeding, and numbers did not differ significantly among individuals. Pacing occurred mostly in anticipation of feeding and was absent after feeding. When more than five visitors were present, frequency of pacing tended to increase and incidence of being out of sight increased significantly. Our data confirm that, while cheetahs are generally a solitary species, they also have a "social potential", although its' effect on reproductive suppression should be kept in mind. Pacing in anticipation to feeding was found in other studies too and it has been suggested that irregular feeding times increase this problem. The animals react to visitors presence even with relatively few people, confirming the shy nature of this species.

Behavioural observation of a captive chimpanzee group (*Pan troglodytes*): number of cages and visitor effect.

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A mixed social group chimpanzees (*Pan troglodytes*) (four adult females and five adult males) was observed in Antwerp Zoo, Belgium, to quantify aggression, grooming and play behaviour related to a) number of available cages and b) number and category of visitors. During focal animal sampling, grooming, aggression, submission and displays were scored. Observations (focal animal sampling and *ad libitum* scoring of agonisms) ran during 20 days from February till April 2007 for 110 hours. The animals could use either three or five inner cages (about 70m^3 each), and a larger covered outdoor enclosure (825m^3). The visiting people were classified as "anonymous visitors, recurrent known visitors, keepers, observers and technical workers". During agonistic displays that were not directed towards other chimpanzees, it was scored which category of people was present or whom the displays were directed at. When the animals had only three cages in stead of five, grooming frequency tended to increase and there was no difference in performed aggressions. Overall, males performed significantly more aggression than females. On days when more cages were available, incidence of play behavior increased significantly. Daily total visitor number did not correlate with aggressions or grooming frequency, but daily play frequency increased significantly with increasing daily visitor number. Displays were directed more towards categories of people that paid recurrent visits (regular visitors, keepers, observers, technical workers) - although these persons were relatively few in number - rather than towards the large crowd of anonymous visitors. The visitor-directed displays were mostly performed by two hand-raised males. It was concluded that it is beneficial for this group to allow them the use of five cages. There was a clear visitor effect. Hand-raised males displayed particularly towards regular visitors or known people. On crowded days, the chimpanzees played more.

The effect of two environmental enrichment devices on the behaviour of yellow-chested capuchin monkeys (*Cebus xanthosternos*)

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Captive primates rarely have to spend as much time searching for, obtaining and processing food, as do their wild counterparts. Consequently behavioural needs are thwarted and abnormal behaviours may develop. This is not only a sign of poor welfare but is undesirable to zoological institutions that strive to educate the public and conserve the genetics and natural behaviour patterns of endangered species. Without the conservation of natural animal behaviour patterns, the hope of future reintroductions into the wild may be diminished. Feeding enrichment techniques designed to encourage captive primates to spend more time engaged in species appropriate behaviour and foraging time budgets that mirror wild counterparts, have been successful. A reduction of abnormal behaviours in such studies has also been documented. However, there has been no scientific investigation into how the effect of feeding enrichment may affect the behaviour of the critically endangered yellow chested capuchin monkey (*Cebus xanthosternos*). A study investigated the effect of a simple ladder device and a more complex puzzle device on foraging and abnormal behaviour in a group of four captive *C.xanthosternos*. Allogrooming dyads were also analysed in an attempt to determine whether the dominant male was actually over grooming himself or whether another group member was responsible. A combination of scan and focal sampling observations were adopted to measure the frequency of behaviours.

The preferred substrate types within the captive coati (*Nasua nasua)* enclosure at Retford Wetlands Waterfowl Reserve, England.

Mary Jane Bridges Selk, Nottingham Trent University.

Coatis genus (*Nasua*) behaviour is little studied in captivity. Kept mainly as flagship species coatis are seldom bred with the intention of reintroduction to the wild. It is therefore imperative that the natural behaviour repertoire of captive coatis be taken into consideration to maintain a high level of welfare throughout the animals' existence. An enriched environment is often considered beneficial to captive animals and a means of coping with its' captive environment, thus a study was conducted observing three captive bred coatis at Retford Wetlands Waterfowl reserve in Nottinghamshire, England. The hypothesis was set; captive coatis show no exploratory preference between presented substrates in which to forage in, and a five hour observation was conducted with half hour instantaneous scam samplings. At five minute intervals observations were recorded in which to be used for analysis.

The coatis displayed little natural foraging behaviour as food was set out in bowls and scattered on the floor of the enclosure during regular intervals. To stimulate natural foraging similar to that displayed *in situ*, a range of substrates were presented to the coatis; soil (S), Leaf litter (L.L), Wood shavings (W.S) which were placed into separate wooden boxes concealing mealworms. The results concluded that the coatis displayed preference to soil as the coati was observed exploring soil on 44 occasions of the five hour study and 34 occasions within leaf litter.
Therefore it may be considered that enriching the coatis' enclosure with varied substrates such as soil and leaf litter would induce natural foraging behaviour thus reducing the risk of stereotypical behaviours generated through a lack of stimuli.

'Foraging Devices Increase Species-typical Behaviours in Zoo-housed Primates'.

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

Feeding enrichment is increasingly used to encourage species-typical behaviours. For this study two custom-made foraging devices were presented to two zoo-housed primate species, Woolly Monkeys (*Lagothrix lagotricha*) and Chimpanzees (*Pan troglodytes*). The woolly monkey troupe demonstrated a significant increase in foraging behaviours. The chimpanzees showed a marked preference for the more complex device. The foraging devices increased species-typical behaviours and were used by most of the primates.

Changes in social interactions in Western Lowland gorillas (*Gorilla gorilla gorilla*)

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The aim of this study was to compare the social interactions and enclosure use by a group of captive Western lowland gorillas (*Gorilla gorilla gorilla*) before and at different times after the birth of infants.

The adult gorilla group had been mixed together in the Gorilla Island complex at Bristol Zoo Gardens and was made up of an adult female who had been at the zoo since 1998, a second adult female who arrived in November 2001 along with an adult male who arrived in July 2003. The second female had cataracts in both eyes that were removed successfully in 2002. The male had a history of aggressive behaviour resulting in injury to females and veterinary intervention was required to modify the behaviour of the male to aid integration of the group.

Behavioural observations of the gorillas were made at different times as a follow-up to the introduction of the male and at various times after. Continuous sampling of a focal animal was used to record behaviour while location and social interaction were recorded concurrently using a point sampling method. More general observations were also recorded on an ad hoc basis.

After his initial aggressiveness the male has modified his behaviour towards the females and includes mating, socializing and playing with the females and an infant. He chastises the females where appropriate but is very tolerant with both females and infants. He initially formed strong affliative bonds with the younger female and was more likely to be near her while the older female spent more time away from the other two.

This was reversed in the first part of the study reported here where the younger female was more likely to be on her own which corresponded to her pregnancy. Following the birth of the first infant the adults were less likely to be away from each other. Observations recorded in the early months of 2007, after the birth of a second infant to the older female, showed that she is most likely to away form the others, is more likely to terminate interactions than the others and that the two females spend little time together. The male associates with all the animals in the group and spends little time away from them.

The changes in the group dynamics reflect maturing relationships within the group as well as the sexual receptiveness or pregnancy of the females and the presence of infants.

The Effect of Zoo Visitors on the Behaviour of Captive Ring-tailed Lemurs *(Lemur catta)*.

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Previous studies have produced conflicting evidence regarding the impact of visitors on the behaviour of zoo animals. The majority of research agrees that visitors are a source of potential stress to captive-housed species, especially primates. This research was designed to gain greater understanding of the visitor effect on a common species of prosimian, the ring-tailed lemur (*Lemur catta*). A major variable that may mitigate the visitor effect is enclosure design; hence this study aimed at assessing (via the response to it by lemurs) how the visitor effect is impacted upon by enclosure design. It is believed that the ring-tailed lemur has not been the sole focus of any previous visitor effect studies and this project is therefore a new concept for assessing the implications of visitor impact on this species. The ring-tailed lemur is the most intensively studied and most common captive lemur species, thus making this investigation a relevant addition to existing knowledge of its captive requirements.

The study examined the behaviours of seven captive ring-tailed lemurs housed at two animal collections in contrasting enclosures. Daily activity budgets were constructed for each group using instantaneous scan sampling of each subject animal at one-minute intervals during three half-hour time slots per day (1: prior to the park opening, 2: during public visiting hours and 3: after closing time). The results suggest that visitors do effect the activity of ring-tailed lemurs due to the increased prevalence of particular behaviour patterns when higher visitor numbers were recorded; including significant increases in locomotory ($P = 0.000$) and aggressive behaviours ($P = 0.001$) and decreases in social behaviours ($P = 0.003$). The results also suggest a significant difference between visitor effects observed at the two enclosure designs ($P = 0.000$). This study supports previous behavioural research stating that visitors have a meaningful impact on primates in zoos (due to altered activity budgets) and increases the knowledge of how enclosure design can impact on the visitor effect experienced by captive species.

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“After all, he is not a tame lion”

Natalie Cook, Bishop Burton College.

Captive lions perform the most abnormal behaviours compared to other carnivores, due to the size of their neocortex, 2nd highest in the carnivore species. Captive animals are motivated to perform natural behaviours even in the absence of any need. Primates, elephants, carnivores have large brain taxa and benefit from enrichment. Feeding enrichment provides animals with opportunities to use natural foraging strategies in order to obtain food. Promoting hunting behaviour in captive carnivores through enrichment is good for animal welfare. The enrichment is to encourage species-specific feeding behaviour, pawing, pulling and biting. The lions used are two African lions, a male and female, at Colchester Zoo, Essex. The lions interacted with the enrichment; the male spent more time with the enrichment, and retrieved the food from the sack. The female spent more time with the enrichment compared to pre-enrichment but she did not retrieve the food from the sack. Despite the statistical results being insignificant the visual trends seen in indicates an increase in predatory behaviour. Both lions used their teeth, claws and paws to manipulate the sack. Subu put all of his weight into pulling, tugging and ripping the sack. Enrichment for captive felids improves welfare by giving them a healthy environment and improves the experience of visitors as they see natural behaviours. The increased time spent with the enrichment device could have been due to the novelty. To maximise the enrichment integrate it with the other enrichments for complexity and novelty. It is argued that wild wide-ranging animals such as lions would benefit from having a larger enclosure in which to roam than just enrichment.

Molecular inference of paternity using hairs reveals inbreeding and inbreeding depression in the captive population of bonobos (Pan paniscus).

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Inbreeding and the loss of genetic diversity may lower fitness and reduce the potential for a population to adapt to changing environments. We investigated the effects of inbreeding on infant mortality in the captive population of bonobos (*Pan paniscus*). Using Great Ape Kit and PowerPlex® 16 System (Promega), nuclear DNA was amplified from hair samples. 54 bonobos were genotyped at 8 tetranucleotide repeat microsatellite loci. In combination with high-quality pedigree data from genotyped individuals, up to 140 captive born individuals were comprised in this study. Inbreeding coefficients were calculated for each individual for which paternity was confirmed. Individuals with an inbreeding coefficient of zero were classified as 'non-inbred', while individuals with an inbreeding coefficient greater than zero were classified as 'inbred'. Infant mortality was defined as all deaths prior to the age of 12 months. We found that infant mortality of inbred young was higher, though not significantly, than that of non-inbred young (31,25% vs. 12,1%; Fisher Exact Test; p = 0,0548). However, the total cost of inbreeding for bonobos is probably underestimated. First of all, inbred individuals that survive to adulthood may still suffer reduced fitness via reduced adult survival, poor performance in mating competition, reduced fecundity and less proficiency in parental care. Also, the breeding program of captive bonobos is aimed at avoiding inbreeding as much as possible. This has led to a great improvement in the captive breeding program, but also resulted in the lower statistical power to detect inbreeding depression. We can conclude that inbreeding reduces infant survival, but that the total magnitude of inbreeding depression is probably fairly underestimated.

Keywords: Bonobo, inbreeding depression, infant mortality, microsatellite DNA

Energy and nutrient intake and digestibility in captive Mongoose lemurs (*Eulemur mongoz*)

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Key Words: Mongoose lemurs, Body weights, Obesity, Activity budgets, Seasonal variation

Lemurs in the wild live in harsh and unpredictable environments where food resources may be scarce during certain times of year. To cope with these conditions they have evolved different energy-saving mechanisms, including low energy requirements [Wright, 1999]. In zoos, lemurs tend to be fed diets rich in sugars and low in fibre, and the amounts remain constant year-round. This is thought to result in the high rate of obese lemurs that is observed in captive populations [Pereira and Pond, 1995; Terranova and Coffman, 1997; Schwitzer and Kaumanns, 2001]. For many lemur species it is not known to what extent they utilise the energy and nutrients in their diets, which makes it difficult to predict how much food they need to consume to meet their requirements. Mongoose lemurs in zoos are reported to be particularly susceptible to obesity [Schaaf and Stuart, 1983; Terranova and Coffman, 1997]. In this study we examined the energy and nutrient intake and digestibility in

three Mongoose lemurs at Bristol Zoo Gardens. To establish activity budgets, behavioural observations were made for each individual over a 24-hr period using focal sampling and continuous recording. During a five-day digestibility trial, food and leftovers were weighed daily and faeces collected. As total collection of faeces could not be ensured, we used TiO_2 as an external marker. Food and faeces samples were freeze-dried and analysed for dry matter (DM), crude protein (CP), crude ash (CA), crude fibre (CF) and ether extract (EE) as well as for neutral detergent fibre (NDF) and acid detergent fibre (ADF). Nitrogen-free extracts (NFE) were calculated as 100-CP-CA-CF-EE. Body weights of the three individuals were taken prior to the trial period.
Comparing body weights of the captive lemurs with those of wild conspecifics, the adult male was more than two standard deviations heavier than the mean wild weight of the species and was thus considered obese, whereas the adult female and sub-adult male could not be considered overweight. The results of our study showed that the diet consumed by the lemurs was high in easily available carbohydrates and relatively low in fibre. The animals preferred fruits and vegetables over the rest of their diet. Dry matter and nutrient digestibility was high. There was little difference in nutritional composition of wild and captive diets. However, the captive lemurs consumed more energy than their wild conspecifics per animal and day, which, together with a stable year-round supply, is likely to have led to obesity in the male.

Niche Separation of four captive lemur species in a mixed species enclosure

Kara Moses, University of Birmingham.

Co-existence of ecologically related species is made possible by differential exploitation of the environment, which reduces resource competition. Previous studies of niche separation in lemurs have focussed on wild populations, however unnatural species combinations are often created in captivity. Niche separation between four species of lemur not naturally occurring in sympatry was evaluated by comparison of activity budget, activity pattern and habitat use, in a captive mixed-species environment. Species' responses to the unnatural environment were then compared to those of wild populations and their sympatric species. Differential use of space and time allowed co-existence of the four species. *L. catta* displayed varied use of substrate, height and area within the enclosure. *V. variegata* showed less variation, spending the majority of their time on the ground, mostly in one area. Habitat use of *E. f. collaris* and *E. m. macaco* was restricted in area, substrate use, and height as they rarely left their houses, possibly due to aggression of *V. variegata* directed towards them. This aggression may be due to territoriality. The activity budgets of the four species differed; *L. catta* was most active in the mornings and late afternoons, resting over the midday period. *V. variegata* was the most active, most social species. *E. f. collaris* was least active, resting for most of the day, possibly making use of its flexible temporal niche to reduce interspecific competition for space that appeared to occur with *V. variegata*. *L. catta* and *V. variegata* displayed behaviour characteristic of their species when in captivity, but lack of behavioural studies of *E. f. collaris* and *E. m. macaco* prevents conclusions being made for them in this study.

Red Panda (*Ailurus fulgens fulgens*) at Parco Natura Viva (Italy): Animal behaviour and effect on visitor interest.

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Recently, red panda (*Ailurus fulgens fulgens*) has become a familiar species in European zoos most of them involved in International breeding programs for wide range of species. Red Pandas have been listed Appendix I, CITES, in 1995 and IUCN Red List, in 1996 and are involved in SSP and EEP breeding programs. Successfully adaptation of this animal to captivity is necessary for animal welfare, thus it is an important aspect to study for conservation purposes. The aims of this study are to analyse the behaviours of the four red pandas hosted at Parco Natura Viva – Garda Zoological Park, Italy; to analyse the general

visitors knowledge regarding this species by collecting spontaneous comments of Parco Natura Viva visitors in order to sensitize them to the red panda conservation. The results of this study highlight that the subjects of Parco Natura Viva show behaviours and level of activity similar to those of wild animals and that they do not seem to be influenced by the visitors presence. Moreover our red pandas show to prefer staying in a particular zone of the enclosure characterized by the presence of firs where the main behaviour observed was to sleep. Furthermore, the visitors show a positive approach to this species although children and teens have shown very little knowledge about this species and boys express delusion. As few studies were carried out on red panda's behaviour in captivity our results may provide information of red pandas to improve their management in captivity. Furthermore our findings can suggest how to increase the knowledge of the zoo visitors.

Reproduction and Welfare Research Unit; Endocrinology Laboratory at Chester Zoo

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Hormones control reproductive success and an animal's ability to cope with stress. When animals fail to thrive or breed, clues can generally be found through hormonal assessments.

In the past 20 years, hormone monitoring has allowed the scientific community to establish reproductive and seasonal profiles in a large variety of species, including mammals, birds, and more recently, amphibians. This information can be used to increase breeding potential and promote genetic diversity in our captive populations. In addition, we can compare and contrast hormone profiles from populations or individuals that are flourishing and reproducing, with those that are not. Hormone profiling helps us to explain and understand what may be going wrong. If a species is not thriving, be it in captivity or in the natural world, what harmful environment stressors or conflicts do they have to cope with? Hormone monitoring in combination with other factors used to assess well-being (i.e. general fitness and/or behaviour), help increase our understanding of the biological impact of these potential stressors. Equipped with this information, we can implement changes and increase the health and well-being of an individual or of an entire population.

Chester Zoo has recently established a Reproduction and Welfare Research Unit which features an endocrine laboratory. A function of the endocrine laboratory is to combine complementary disciplines, such as hormone analysis with behavioural observations. The laboratory has the capacity to measure non-invasively a number of different hormones, with particular emphasis on (but not limited to), progesterone, oestradiol, testosterone and glucocorticoid metabolites.

The poster presentation accompanying this abstract will illustrate examples of published research which has utilized hormone assessment to improve our understanding and enhance the reproductive health and well-being of wildlife living in zoos and in the natural world.

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A training program for a colony of captive Cotton-top Tamarins: A tool to carry out problem solving studies.

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Positive reinforcement training has achieved wide recognition as a valuable tool for contributing to the management and the psychological well-being of captive non-human primates. Furthermore, the role of training in the management of captive populations has changed significantly over time. It has evolved into a procedure that allows behavioural by achieving voluntary cooperation and safeguarding the welfare of non-human primates to promote scientific validity. The aim of this study is to verify the use of training technique as tool for involving cotton-top tamarins (*Saguinus oedipus*) in a problem solving study. Six cotton-top tamarins (3 male and 3 females) hosted at Parco Natura Viva – Garda Zoological Park, Verona, Italy were engaged in a training program in order to habituate them to be isolated in a familiar area through positive reinforcement (pellet) for husbandry and medical procedure. During the training each tamarins was involved in a problem solving task in order to evaluate their cognitive problem solving abilities. Our results show significant differences across subjects in acquiring how to solve the task. However cotton-top tamarins were able to solve the problem in order to obtain the reward. This study alights how training provides the tools to allow behavioural and cognitive researches to increase our knowledge of this species.

Play behaviour in wild and captive warthogs.

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Africa's warthogs *(Phacochoerus sp)* are still locally abundant and listed as "lower risk" on the IUCN Red List, however, throughout the last centuries the species have been through a noticeable decline throughout the continent. In the United Kingdom the species is kept in zoos for public attraction and for the purpose of captive breeding projects. With this on the zoos agenda it is vital to maintain their natural behavioural repertoire and to keep the welfare of the animal high. Play is often used as an indicator of welfare. In this dissertation play behaviour in *ex situ* and *in situ* warthogs are compared to see how natural behaviour, focusing on play, can be maintained and how to keep the welfare high. The study sites are Lake Mburo national park in Uganda and Colchester and Edinburgh zoo in the UK. The hypothesis set for the study is that there will be no difference in the play behaviour between the three locations. Behavioural observations were conducted over five hour periods at all three study sites. 10-minute instantaneous scan sampling with recording intervals of 30 seconds was used to analyse the gathered data. The difference in observed play bouts between Edinburgh zoo and Lake Mburo national park was significant with 80.75 and 6.5, respectively. Between Colchester zoo and Edinburgh zoo there was also a significant difference with 6.5 play bouts observed at Colchester zoo. However, there was not a significant difference between play observed in Lake Mburo national park and Colchester zoo. The higher number of play bouts observed at Edinburgh zoo may be due to the group composition of mainly piglets but also the substrate and effective enrichment that invited to more play. The lack of play *in situ* is believed to be due to need for foraging and predator vigilance. The most important finding of this study was that *ex situ* enrichment are encouraging play behaviour as well as preventing stereotypical behaviours and therefore keeping the welfare high for the warthogs kept in captivity. It was also found that play was observed in excess in the warthogs *ex situ* if compared to their natural behaviour repertoire *in situ* but this is not necessarily negative as play might be the captive animals only mean of exercise and energy outlet.

Behavioural observation of a captive wolf group (*Canis lupus*): effect of safari train and observer on activity and use of space.

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A group of European wolves (*Canis lupus*) consisting of a breeding male and female, three cubs, and four other adult females, was observed in Le Parc Animalier de Han-sur-Lesse, Belgium, to quantify their activity budget and use of space in relation to a safari train. The train with visitors stopped up to four times per hour during a brief period at the front of the wolf enclosure. The observed was located at the opposite side. The mesh-wired enclosure was 2900m² large and located in a relatively remote forest area. Focal animal sampling (15') and

scan sampling (every 15 minutes) was used to score activities and locations of all individuals. Social interactions were scored ad libitum. Data were entered in The Observer software (Noldus, Wageningen). Observations ran during 20 days from september till october 2006 for 60 hours. The wolves remained significantly more out of sight when the train was present. They showed significantly more an alert posture with the train present. On days that they were fed, the presence of the train did not affect the time they spent eating. Without the train they rested and slept more. Strikingly, the wolves used the part of the enclosure at the front most, which was closest to the train. They did so probably in order to maximize their distance to the observer. The wolves indeed kept a significantly greater distance with the observer than they did with the visiting train. The data underline the shy nature of the wolves and the sublety of the visitors effect: some behaviours were more affected by the presence of the train, others were apparently mostly affected by the observer. Remote data recording may be a justified recommendation in this context.

A report of severe diarrhoea when feeding a homogenous diet containing a chemical marker (Chromium oxide, CR_2O_3) as part of a digestibility study of two Callitrichid species

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This paper reports an onset of severe diarrhoea during a routine digestibility study of two Callitrichid species, *Saguinus oedipus* (Cotton-top tamarin) and *Callimico goeldii* (Goeldis monkey), possibly as a result of feeding a homogenous, gluten-free diet containing an inert digestibility marker (chromium oxide, CR_2O_3). To overcome the problem of diet selection and food preferences of each individual, a homogenous feed was produced to ensure even marker distribution in the diet.

A base ration of homogenous feed was produced as one batch to remove variability in nutrient content of feed items. Ingredients were blended together using a food blender to make a fluid mixture to which the digestibility marker was added (chromium oxide at 1% of feed dry matter). This mixture was then frozen at -19ºC. Daily portions were defrosted one and a half days in advance in a fridge at 10°C. Following defrosting, additional components of a gluten-free mix, marmoset jelly, gum Arabic and gelatine were added to the base ration with half a tablespoon of honey and two drops of vanilla essence to enhance palatability. At 8am the solid feed portion was removed from the fridge and divided into three feed portions for each group (breakfast, lunch and afternoon feeds).

The lunch and afternoon feeds were then placed back in the fridge. Each feed were left at room temperature for at least 30mins before feeding to prevent diarrhoea from ingesting chilled food. The Callitrichids were adapted onto the homogenous feed over three days, given 100% of their normal diet with 25% of the full homogenous ration on day one with the normal ration dropping to 50%, then 25% on days two and three with 100% of the homogenous ration presented.

Both Callitrichid groups ate a proportion of the homogenous feed on day one of presenting it to them. Initially, the Cotton-top group ate the feed more readily than the Goeldis monkeys; however, both groups showed a daily increase in their intake of the feed over the period that it was given. On day 3 of feeding the homogenous feed, a proportion of faecal matter was loose but on day 5 and 6 faeces appeared to return to normal consistency. However, on day 7 and 8 both groups had developed severe diarrhoea and at 11am on day 8 the feed trial was terminated by zoo management. No faecal matter had been collected as the trial was stopped on day one of faecal collections.

There is no clear answer as to why the homogenous feed with the chemical marker caused such a reaction in the two Callitrichid species. Previous studies have fed a homogenous feed with a chromium oxide marker and have not reported any digestive problems (e.g. Power and Oftedal, 1996). Explanations for the digestive disorder might include microbial spoilage of the diet, a high moisture content (23% dry matter), a reaction to the high protein gelatine or the novel honey and vanilla essence, or the transition from a varied daily diet to a homogenous one. The Callitrichids housed at Colchester Zoo are used to a varied diet of chopped fruits and vegetables. In comparison, the Callitrichids used in the Power and Oftedal, (1996) study were fed a canned marmoset feed which may have been similar in consistency to a homogenous feed resulting in a better adaptation to the feed trial diet. It is possible that a longer adaptation period was required for feeding the homogenous diet.

There is a lack of accurate information concerning the nutrition of primate species housed in zoos; however, if this type of feed trial is to be carried out with Callitrichids in the future, careful consideration is required as to how it is undertaken.

References

Power, M.L. and Oftedal, O.T. (1996) 'Differences among captive Callitrichids in the digestive responses to dietary gum', *American Journal of Primatology*, **40**, 131-144