



Zoo Research News

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News and Views from the Zoo Research Group

Federation of Zoos 6th Annual Symposium on Zoo Research

The 6th symposium was held at Edinburgh Zoo on the 8th and 9th July 2004 and included many excellent talks and posters from zoo and academic researchers, covering a wider range of species and topics than ever before. This year's workshop, led by Dr Sheila Pankhurst (Anglia Polytechnic University), was on behavioural profiling, how to do it and its possible uses in zoos. Behavioural profiling has been the source of some controversy lately and the discussion groups gave plenty of opportunity for lively debate! The workshop outcomes will be published as an issue in the Zoo Research Guidelines series and should provide interesting reading for researchers and animal managers alike. Symposium prizes for student/keeper presentations went to Stephanie Armstrong (Trinity College Dublin) for "A Taste for Grass" (best talk) and Rhian Hughes (Paignton Zoo Environmental Park/Cardiff University) for "Play in Juvenile Baboons – Lessons for Life" (best poster). Congratulations to them and to all the oral and poster presenters. The standard of presentations at the annual symposium has been increasing rapidly each year and this year certainly did not disappoint. Congratulations and thanks also to Rob Thomas and Charlotte Macdonald of Edinburgh Zoo for their excellent organisation of the symposium.

Workshop on Statistics for Typical Zoo Datasets

This workshop was held at Edinburgh Zoo on 7th July and attended by a mixture of zoo based researchers, academics with interests in zoo research and statistics advisors. The aim was to agree the most appropriate statistical tests for typical zoo research situations and provide solutions to commonly encountered statistical problems. The workshop went extremely well and we believe we have come up with good answers for most of the difficulties and criticisms we meet in this field of research. The results will be written up as an issue of the Zoo Research Guidelines series, hopefully by the end of this year. Once produced we hope these guidelines will help to standardise the methods used and lead to greater consistency and higher quality analyses and interpretation, and ultimately more publications. Many thanks to all those who attended the day, especially the statistics advisors Graeme Ruxton, Nick Colegrave and Juergen Engel.

The Reporting Group

The Reporting Group consists of academics, zoo staff and others with an interest in zoo-based research. Its main aim is to forge links between researchers and zoos, in particular with the Taxon Advisory Groups, to better direct research towards the needs of zoos. Most Reporting Group members regularly attend the annual symposium and many have led workshops and written parts of the Zoo Research Guidelines series. The group communicates via an email list, if you would like to join please contact Olivia Walter (conservation.fedzoo@zsl.org) or Anna Feistner (atc.feistner@virgin.net)

Zoo Research Group Resources

The following resources can be downloaded without charge from the Federation website (www.zoofederation.org.uk):

- Zoo Research Guidelines: Project Planning and Behavioural Observations. Wehnelt, S., Hosie, C., Plowman, A. and Feistner, A. 2003.
- Zoo Research Guidelines: Monitoring Stress in Zoo Animals. Smith, T.E. 2004.
- Research Sampling Guidelines for Zoos. 2002

Available soon: *Zoo Research Guidelines: nutrition*
Zoo Research Guidelines: visitor effects

Planned: *Zoo Research Guidelines: statistics*
Zoo Research Guidelines: behavioural profiling

The following resources are available from the Federation Office (there may be a small charge, please email fedzoo@zsl.org):

- Abstracts of the 1st Annual Symposium on Zoo Research. Plowman, AB (ed.) 1999
- Proceedings of the 2nd Annual Symposium on Zoo Research. Plowman, AB (ed.) 2000
- Proceedings of the 3rd Annual Symposium on Zoo Research. Wehnelt, S and Hudson, C (eds.) 2001
- Proceedings of the 4th Annual Symposium on Zoo Research. Dow, S (ed.) 2003
- Proceedings of the 5th Annual Symposium on Zoo Research. Gilbert, T (ed.) 2003
- A database of browse use in British and Irish Zoos and poisonous plants information (CD, 2001). Plowman, A.B. and Turner, I.
- A Bibliography of References to Husbandry and Veterinary Guidelines for Animals in Zoological Collections. Macdonald, A.A. and Charlton, N. (eds.) 2000

Crocodile environmental enrichment: as necessary as monkey puzzles!

Vicky Melfi, Paignton Zoo Environmental Park and Charlene Uwakaneme and Merry Rees, Drusillas Park.

Introduction

Reptiles are often overlooked in zoo research, especially when it comes to the study of animal welfare and the effect of housing and husbandry on behaviour. The captive care of crocodilians and the promotion of their welfare is commonly limited to the provision of an enclosure with the appropriate climate and feeding regime (Britton, 1995-2003). In part, this is probably due to a lack of research on wild reptiles and as such no 'yard stick' by which to judge what our captive crocodilians should or could be up to. The mental abilities of crocodilians is under-explored, despite them being used in training programmes in zoos and 'entertainment shows' in farms (personal communication VA Melfi). So why should we consider enriching crocodilians? We recognise that crocodilians spend long periods of their time basking, or lying in wait to attack their prey. Research has also demonstrated that crocodilians show quite complex social behaviours, both in terms of nesting and raising young (Bustard, 1986) but it has also been suggested that they take part in cooperative hunting (Gans, 1989; King *et al.*, 1998); a complex behaviour also noted in lions and chimpanzees (Estes, 1991). Captive crocodilians, kept for farming, are also known to display distinct food preferences, preferring live fish over live chicks or mince (Morpurgo *et al.*, 1991).

It seems likely, from this research and our knowledge of other animals, that crocodilians take in a large amount of information from their environment. So what information is being provided for most zoo housed crocodilians and could we improve this through enrichment? The aim of this study was to address this question, by studying two African dwarf crocodiles at Drusillas Park. Given the natural history of crocodiles, we expected that if our enrichment was successful we would observe subtle behavioural changes, mainly through increased behavioural diversity. As crocodiles do not spend a great deal of their time in 'active' behaviours, we did not expect or intend our enrichments to increase activity *per se*, but to provide the crocodiles with the opportunity to express a greater range of their 'naturally occurring' behaviours.

Methods

Subjects, husbandry and housing

The behaviour of two (2.0) African dwarf crocodiles, *Osteolaemus tetraspis*, housed inside (24°C, at 70% humidity) were studied. The enclosure consisted of a heated (28°C) pool and beach area (comprising of stones and sand), both areas had some overhanging vegetation and there was uninterrupted public viewing along one side of the enclosure.

Data collection and analyses

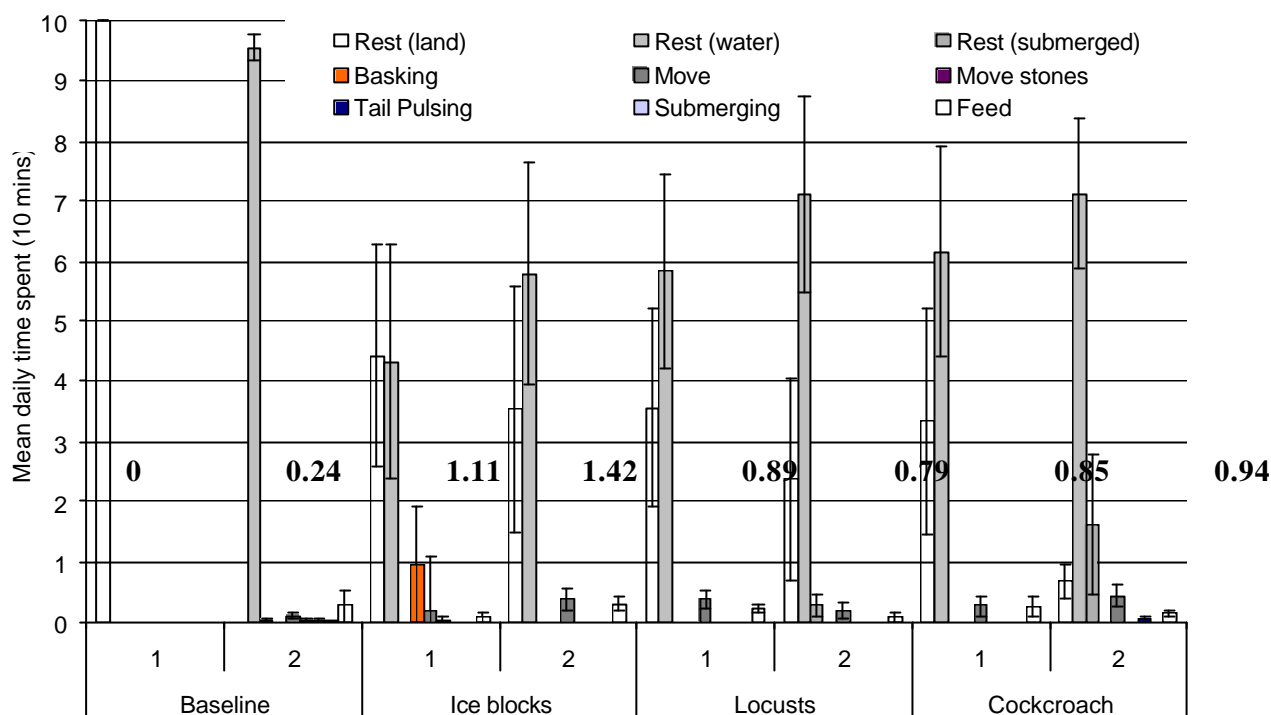
Behaviour of both crocodiles was noted using instantaneous scan sampling every 1min, for 10 mins, seven times a day. The time of each session was evenly balanced between 0800 and 1700 daily. The experimental design included four conditions; control (no enrichment), enrichment 1 (ice blocks), enrichment 2 (locusts) and enrichment 3 (cockroaches). The presentation of the enrichment occurred early in the morning (about 0900) and was randomised so each of the four conditions occurred randomly throughout the study period. Each condition was repeated six times (total of 24 days).

The crocodiles' behavioural diversity and activity budgets were calculated. Daily Shannon-Weiner diversity indices (H) were calculated for each crocodile [$H = S(p_i \times \ln p_i)$, where p_i is the mean frequency of observations for each behaviour]. Activity budgets were generated by calculating the mean daily time spent performing behaviour. One-way repeated measures randomisation trials were used to compare resting behaviour and the behavioural diversity indices across all four conditions (Todman & Dugard, 2001); two-tailed hypotheses were tested using a 4 condition x 2 subject design.

Results

The crocodiles spent most of their day in one activity prior to enrichment (fig.1); one rested in water, while the other rested on land. With the provision of the enrichments the crocodiles spent significantly less time in these two behaviours ($p < 0.001$) and their behavioural diversity also increased significantly ($p < 0.001$, noted on figure 1). The crocodiles' behavioural diversity more than doubled, when enrichment was present. The greatest increase in behavioural diversity expressed by the crocodiles' was observed when ice blocks were provided; behavioural diversity indices rose from 0 and 0.24, for each crocodile during baseline, to 1.11 and 1.42 for each crocodile with ice blocks.

Figure 1. Mean (+/- SE) time spent performing behaviour by two crocodiles at Drusillas Park. Mean behavioural diversity indices for each condition are noted.



Discussion and conclusions

All the enrichments used were cheap, easy and successful in increasing the crocodiles' behavioural diversity. This increase was not just a result of resting elsewhere in the enclosure but the expression of additional behaviours, including basking, moving and feeding. The provision of ice blocks had a larger impact on the crocodiles' behaviour than the food enrichment and also resulted in a higher level of basking behaviour. This is not surprising, as Seebacher (1999) found that crocodiles change their body posture and behaviour to thermoregulate and by adding ice to the enclosure we had provided a homeostatic challenge for the captive crocodiles. As the crocodiles had access to a heat source, enabling them to bask, the promotion of this behaviour was considered stimulating.

The enrichments provided in this study increased the information available in the captive crocodiles' environment and stimulated the expression of a wider array of natural behaviours. This study illustrates how 'non-food' enrichment can be a very effective way of introducing more complexity to the lives of captive animals and enable them to respond naturally to challenges in their environment. The food enrichments were also successful and highlight the need to vary the food (and potentially its presentation) provided for crocodylians; indeed at Paignton Zoo the Cuban crocodiles, *Crocodylus rhombifer*, and dwarf caimans, *Paleosuchus palpebrosus*, receive more than ten different types of food, including fish, chicks, meat and insects (personal communication Rod Keen, Senior Reptile Keeper). This study demonstrated that the behaviour of crocodiles' can be successfully influenced by environmental enrichment.

This project was undertaken as part of the Zoo Research Services scheme operated by Paignton Zoo Environmental Park, Devon, UK.

References

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Self-injurious behaviour in zoo primates

Geoff Hosey, Bolton Institute and Lindsay Skyner, University College Chester

It has long been known that social isolation, particularly in infancy, can lead to the development of abnormal behaviours in some primates, and that this can include self-injurious behaviour (SIB), where the animal repeatedly injures parts of its own body. SIB can, however, also occur in non-isolate-reared primates and can be triggered by frustration or environmental events. SIB has mostly been reported from laboratory primates, and is usually associated with macaques. Whether it occurs in zoo primates, and if so to what extent, has not previously been systematically studied. A questionnaire-based survey of 42 British and Irish zoos was carried out (with support from the Zoo Federation) to find out the extent of SIB in zoo primates, and whether it was associated with any environmental or developmental events. Responses to the questionnaire indicated that although SIB occurred across a range of primate species, its incidence was very low. Only two forms of SIB were reported, hair pulling and self-biting, the latter being the most common. A variety of environmental events were identified by the respondents as implicated in initiating SIB, and although the data set was too small to confirm these statistically, several trends were discernable. It was concluded that SIB is not a major problem in zoo primates.

A paper on the results of this study is in preparation for publication at present. Further info: Dr Geoff Hosey, Psychology and Life Sciences, Bolton Institute, Deane Road, Bolton, BL3 5AB. Tel. 01204 903647. Email: gh2@mail.bolton.ac.uk

A novel computer program to calculate spatial proximity in captive primates

Lindsay Skyner, Jason Roberts and Tessa Smith, University College Chester

Measures of social proximity are an important tool for monitoring the type and intensity of social relationships in primates. Scientists can use a variety of methods when assessing spatial distances but the results of these methods may not concur. The current study was part of a larger research project assessing social dynamics in the lion-tailed macaque (*Macaca silenus*). The aims of our research were 1) to assess the utility of a novel program designed to compute social proximity and 2) to assess the effectiveness of the new program in comparison to a standard proximity assessment method. The novel computer program required data to be entered on the position of an individual in a 3-dimensional grid system. Pythagoras' theory was then used to calculate distances between individuals. The standard proximity method quantified the number of instantaneous sample points that animals were or were not within arms reach during focal animal observations. We found that the computer program successfully calculated proximity data, was cheap, flexible, easy to use and the data collection method allowed other questions to be answered, for example on enclosure use by the study animals. The two methods of proximity measurement provided a different picture on the spatial relations of individuals in the group. The results have implications for how proximity data is scored since the methods used seem to bias the results.

A paper on the results of this study has been submitted for publication. Further info: Lindsay Skyner, University College Chester, Department of Biological Sciences, Parkgate Road, Chester, CH1 4BJ. Tel: 01244 375444 (EXT 3007). Email: l.skyner@chester.ac.uk

An enriching method to investigate colour discrimination in foraging behaviour of small primates

Jessica Bradford, Alaina Thomas and Phil Gee, University of Plymouth and Christine Caldwell, Paignton Zoo

There is a large amount of scientific literature regarding the discrimination abilities of typical lab species, such as rhesus macaques, capuchin monkeys, pigeons, and rats. However, very little such research has been carried out on zoo species. In this study, a method of testing for discrimination learning in the zoo environment was investigated. A group of seven Goeldi's monkeys (*Callimico goeldii*) housed at Paignton Zoo Environmental Park were used as test subjects. The apparatus used took the form of a foraging task, made up of 36 different boxes in which food could be hidden. The apparatus was designed in such a way that the front sections of each box could be removed and replaced with alternative sections of different colours. In this study, black and white discrimination was tested, using multiple presentations of the apparatus with the black and white boxes appearing at random locations on each occasion. White boxes were always rewarded (contained food) and black boxes unrewarded. The apparatus was used effectively by all the subjects, and over the course of the study it was clear that the black/white discrimination was being learned. It was concluded that the apparatus was an effective method of testing for discrimination learning in the zoo setting, and that further research could readily capitalise on the wide range of manipulations that the apparatus allowed.

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The importance of 24-hr observations for behaviour studies on zoo animals: the orang-utans at Chester Zoo as an example

Stephanie Wehnelt, Chester Zoo and David Williams, Liverpool University.

Most studies that investigate the behaviour of zoo animals focus on daytime activities. This is due to restricted access to the premises outside zoo opening hours and problems with visibility of the animals caused by light levels and off-show night enclosures. Studies that focus on environmental manipulations or the short term effect of certain events that occur at daytime are not affected by this constraint. However, a narrow observation window can cause problems for some zoo research. It is often impossible to compare time budgets of zoo animals with those observed for the species in their natural habitat, since daylight hours of the two conditions vary greatly and the full daytime activities are usually not recorded in a zoo. Also, daytime events, such as novel enrichment, can have long-term effects, which usually stay undetected. Further, zoo animals are known to behave differently (e.g. greater enclosure use, increased socio-positive behaviours) in the absence of the public and keeping staff, which also remains undetected in the common zoo study.

As part of the ongoing welfare assessment of the orang-utans at Chester Zoo, infra-red CCTV equipment with time-lapse function is being used. A preliminary 5-day investigation of the five adult females revealed that all animals built nests and rested between 8.30pm and 06.45am, i.e. for the majority of the time when no keepers were present. The rest of this time is mainly taken up by feeding and social interactions (grooming and play). No stereotypical or other undesired behaviours occurred. Ongoing 24hr-studies will allow for a comprehensive assessment of the animals' activities and a valid comparison once the new orang-utan facilities are in use in 2006.

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The effect of visitors on captive non-human primates

Laurie Simpson, University of Stirling

It has been suggested that visitors can be enriching, stressful or of no consequence to captive primates. Previous research has shown that high visitor density can have a detrimental affect on psychological well-being, and that small primates tend to be most affected by visitors. Camouflage nets can reduce negative visitor effects by increasing the frequency of species-typical behaviours and decreasing the frequency of abnormal behaviour. The aims of this study were three fold: 1. to investigate whether visitor density had any effect on the well-being of three primate species, stump-tailed macaques (*Macaca arctoides*), Goeldi's monkeys (*Callimico goeldii*), and western lowland gorillas (*Gorilla gorilla gorilla*); 2. to investigate the effect of camouflage netting on observed behaviours of these three species; 3. to investigate the effect of visitors in a walk-through enclosure on red-ruffed lemurs (*Varecia variegata rubra*). In each case data were collected at Edinburgh Zoo using scan and all occurrence sampling over two conditions: baseline and camouflage net manipulation (for the three former species) and "visitors" and "no visitors" for the red-ruffed lemurs in the walk-through enclosure.

High visitor density was significantly positively correlated with increased aggression in the macaques ($r = 0.31$, $p < 0.05$) and foraging in the macaques ($r = 0.31$, $p < 0.05$) and Goeldi's monkeys ($r = 0.36$, $p < 0.05$), and significantly negatively correlated with grooming in Goeldi's monkeys ($r = -0.30$, $p < 0.05$). The behaviour of the gorillas was not significantly affected by high visitor density but all three species spent less time at the front of their enclosures (i.e. near to visitors) when visitor density was high. Camouflage netting resulted in a significant decrease in aggression in macaques ($Z = -0.89$, $N = 7$, $p < 0.05$) and an increase in play ($Z = -0.91$, $N = 7$, $p < 0.05$). The Goeldi's monkeys were less active when the nets were in place ($Z = -0.94$, $N = 5$, $p < 0.05$). The gorillas were unaffected by the nets. The lemurs were more active and utilised their walk-through enclosure more, spending more time nearer to the visitors' path when visitors could walk through their enclosure than when it was closed to visitors, suggesting that they may find visitors enriching.

It is concluded that high visitor density had a negative impact on the stump-tailed macaques and the Goeldi's monkeys and that the camouflage nets were effective in reducing this impact in the stump-tailed macaques, whose enclosure has many viewing windows. Contrary to previous research in this area, the gorillas were unaffected by high visitor density. The study illustrates that the effects of visitors on zoo primates are likely to be influenced by many factors such as species, exhibit design and ability of the animals to choose to approach or avoid visitors.

Further info: Laurie Simpson, Department of Psychology, University of Stirling, Stirling, Scotland. E-mail: lauriesimpson@onetel.com

A peanut-shuttle feeder as enrichment for the elephants at Blackpool Zoo

Rebecca Whitefield, Myerscough College

This study of the four female Asian elephants at Blackpool Zoo was designed to test the effectiveness of a feeding enrichment device designed for their indoor enclosure, an area that is often overlooked with regards to enrichment. Previous feeding enrichment for the elephants had focused on substituting usual feeding rations with other types of food, changing the feeding regime, or hiding food items within the enclosure. This enrichment, the 'peanut shuttle' was a novel feeding device designed to encourage feeding behaviours similar to those seen in wild elephants. The shuttle was threaded onto a high-tension cable across the width of the enclosure, above elephant height, thereby avoiding problems of destruction associated with ground or wall mounted enrichment for elephants. The shuttle was filled with peanuts, which were dispensed when it was manipulated by the elephants using their trunks. The aims of the enrichment were to: increase feeding and foraging behaviour, reduce inactivity and stereotypic behaviour and increase social interactions between the four elephants. Three of the four elephants were known to occasionally exhibit stereotypic behaviours.

Scan sampling at 5 minute intervals for one hour on each observational day was used to record general behaviour, position within the enclosure and proximity to other elephants. The observation period (December 2002-April 2003) was split into pre-, during and post-enrichment phases and 10 hours of observation for each elephant was recorded in each phase. Behaviour was compared across phases using ANOVAs. Only one elephant, considered to be the matriarch, actually manipulated the shuttle, although all four elephants consumed the food items that were dispensed. Overall during the enrichment phase time spent feeding and foraging significantly increased, time spent inactive and performing stereotypic behaviours significantly decreased but there was no significant difference in social interaction between the three phases. The peanut shuttle can be considered a successful enrichment for these elephants and could be tested for captive elephants elsewhere.

The learning abilities of a Californian sea lion *Zalophus californianus*

Louise Wagstaff, Bishop Burton College

Training is an important part of animal husbandry in zoos to facilitate routine and veterinary procedures and possibly as a form of enrichment. Operant conditioning, a form of training involving positive reinforcement, can be used on a wide range of species and a well planned training routine can make procedures such as taking blood sampling or foot care quicker, easier and safer for staff. It can also reduce stress to the animal during these procedures. Although the learning abilities of many animals have been studied for many years little is still known about many marine mammals such as the Californian sea lion, particularly their vision and discriminative learning. This information could aid in the training of animals as vision plays an important part in learning and cognition.

In this study the ability of a male Californian sea lion at Blackpool Zoo to discriminate between colours was assessed. The sea lion was conditioned, using positive reinforcement training, to touch a yellow target. He was then tested using yellow, blue, red and black targets, introducing one at a time until all four were presented at once, always only being rewarded for touching the yellow target. The sea lion rapidly learned the command to touch the yellow target being successfully conditioned after the fifth attempt during the first week. During the testing week he was asked to select a target 15 times per day. By the end of the week he was scoring 93% correct responses (i.e. touching the yellow target). Assuming that this male is not atypical, these results demonstrate the rapid learning ability of sea lions, that they respond well to positive reinforcement training and can discriminate between colours. This implies that different individuals could be trained to respond to specific coloured targets providing a simple means by which keepers could differentially manage individuals within a group.

Further info on both the above: Suzanne Hayes, Research Coordinator, Blackpool Zoo. Email: education@blackpoolzoo.org.uk

Announcements

The 5th International Symposium on Physiology, Behaviour and Conservation of Wildlife, Berlin, 26-29th September 2004

This symposium is always an interesting mix of free-living and captive wildlife research. This year's themes include Management of Captive and Small Populations, Stress and Disturbance, Animal Welfare and Conservation, Olfactory Communication, Chronoethology, Behavioural and Hormone-mediated Maternal Effects, Non-invasive Monitoring of Hormones. For further information see www.izw-berlin.de/izw-symposium.html

Your contributions are needed

Please send contributions, announcements, comments or other feedback for the next issue by the end of Sept., to:

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