



2015 SCIENCE REVIEW

Reporting period January to December 2015

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Wildlife Conservation is at the heart of everything Chester Zoo does. We use scientific evidence to help identify and address many of the challenges our natural world faces. We aim for our conservation research to help in decision making that improves the management of the animals and plants in our care, influence the sustainability of wild populations, and inspire others to be motivated to join us in our challenge to Act for Wildlife to conserve the living world.

Scientific activity occurs right across the zoo and beyond and involves our highly skilled and experienced staff on many different teams. This review highlights some of Chester Zoo's key projects from 2015 which fall under six broad specialisms:

- **Biodiversity Surveys and Ecological Monitoring**
- **Conservation Breeding and Management**
- **Human-Wildlife Conflict**
- **Livelihoods and Sustainable Development**
- **Visitor and Community Engagement**
- **Wildlife Health and Welfare**

More information on our current and previous projects can be found on our website www.chesterzoo.org/conservation-and-research. To keep up to date with our scientific activities you can now follow us on twitter on [@ScienceatCZ](https://twitter.com/ScienceatCZ) where we publicise our work.



Chester Zoo's endocrinology lab

Collaborative Research

At Chester Zoo many of our staff are actively involved in scientific projects by either leading, supervising, or advising on the research. Research projects involving the animal and plant collection are primarily identified and prioritised by our curators and animal and plant teams and research linked to our six field programmes are prioritised by our field conservation experts. Currently, in collaboration with our academic partners across nine Universities, we are supervising a record number of twelve *Chester Zoo Conservation Scholars*. Our scholars are working to provide evidence on a range of topics from conservation breeding of plants and amphibians, monitoring wild populations of endangered species, human-wildlife conflict in Africa and South Asia and the welfare of captive populations.

Supporting Scientific Research

In addition to actively undertaking research projects within the zoo and in the field, we support a wide range of scientific activities. We provide biological samples from our animal and plant collection for research, we provide training opportunities for undergraduate students and provide funding and assistance to global conservation projects. We primarily support global projects which have conservation impact across six different regions of the globe; Africa, Latin America, Mascarenes and Madagascar, South Asia, South East Asia and UK and Europe. In 2015 we supported 10 students through our studentship scheme and over 40 field projects involving science through our conservation grant scheme.



Collecting behavioural data on Salvador monitor lizards at Chester Zoo

Scientific output

In 2015 we supported over 200 scientific projects in total, with Chester Zoo staff directly involved by leading, supervising, or advising on 50 of these projects. Chester Zoo supported a further 150 projects, either through our undergraduate training scheme, providing biological samples or funding and assistance through our studentship and conservation grant schemes. We worked with over 100 organisations to conduct, support or collaborate on these scientific activities. Staff published over 60 peer reviewed articles, abstracts and scientific reports as well as peer reviewing over 80 manuscripts and conference abstracts. Three staff members hold editorial or associate editorial roles in journals (*Journal of Zoo and Aquarium Research* and *Journal of Zoo and Wildlife Medicine*). Forty talks were delivered to Chester Zoo Staff, interns and members and 39 lectures were delivered to University students. Over 20 technical and specialist training sessions were delivered and 35 presentations were given at scientific conferences. Chester Zoo's endocrinology lab processed approximately 10,000 samples from a variety of wildlife from institutions across the UK and Europe.

Our Facilities

We have a range of fantastic facilities for scientific research here at Chester Zoo. Scientific activities predominantly take place in the *Applied Conservation Science Centre* where there is office space for staff and visiting researchers and a meeting room for academic supervision meetings and training sessions. The *Applied Conservation Science Centre* also houses Chester Zoo's *Endocrinology Laboratory* providing diagnostic services for both Chester Zoo's living collection and other collections across Europe. Chester Zoo's *Animal Health Centre* provides office space for staff, a laboratory and fully equipped surgery and post mortem room. The majority of staff are based at *Cedar House*, Chester Zoo's administration building. Chester Zoo also has a *Lecture Theatre* with conference and lecturing facilities for up to 170 people in addition to *Oakfield House* which also hosts conferences and meetings.

Working with us

We prioritise research that will have a positive impact on the living world, either directly through improved animal management or indirectly through the promotion of conservation action. We welcome collaborations with PhD students and professional researchers and have conducted many successful projects with postgraduate training programmes. We also provide training opportunities for students studying for undergraduate or masters degrees who can conduct observational research on our range of animals and plants. We have a number of potential projects already identified, for more information about current opportunities and to find relevant application forms please visit our website www.chesterzoo.org/conservation-and-research/conducting-research.

Collecting behavioural data on Sumatran orangutans at Chester Zoo



BIODIVERSITY SURVEYS AND ECOLOGICAL MONITORING



Scanning a dormouse for a microchip

Monitoring the Common dormouse

Although categorised as of 'Least concern', dormouse populations in Britain have decreased by half over the last 100 years. It is thought that habitat reduction and fragmentation through human disturbance is the main cause of this decline. In the UK, a biodiversity action plan is in place to stabilise population numbers by improving habitat quality and reintroducing individuals to areas where the species has gone extinct. This study is part of ongoing research aiming to estimate Common dormouse population trends, as fluctuations in numbers can signal negative environmental changes or successful conservation efforts.

To achieve the most accurate results, different monitoring methods were compared. Previously captured individuals were



Dormouse monitoring

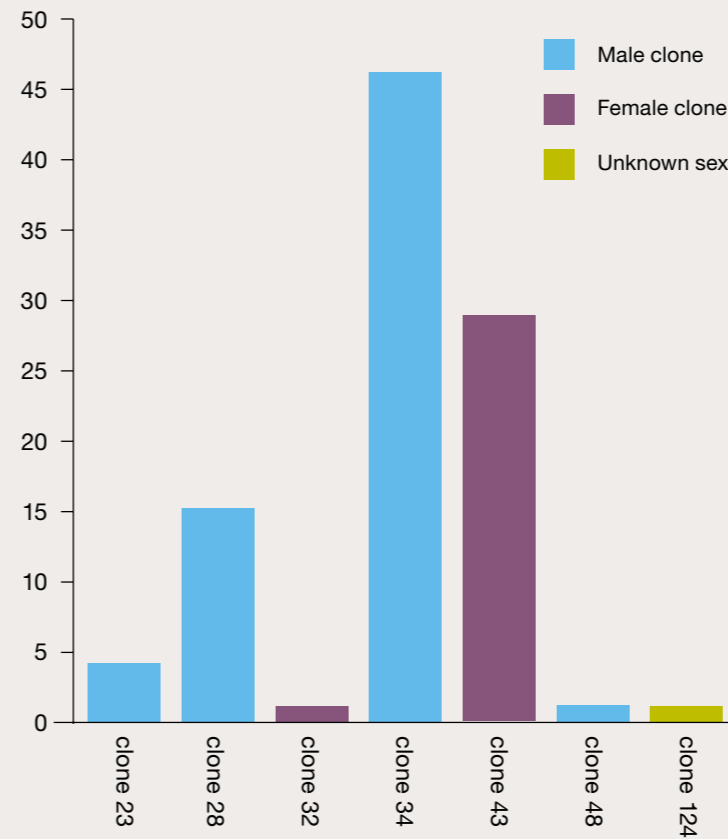
marked using Passive Integrated Transponder (PIT) tags for use in mark-recapture analysis. In addition to this, integrated population modelling (IPM) was also tested. This technique for population modelling uses dormouse nest counts and offspring counts, taken as part of the routine nest monitoring. This was the first study to apply this method to small mammal monitoring and it was found that compared to the mark-recapture technique, IPM is significantly more accurate at estimating populations and demographics. As a result, this method was recommended for the ecological monitoring and surveying of the Common dormouse. In 2015 we concentrated our efforts on our North Wales study site, Bontuchel Wood.

Alongside the on-going study, staff from Chester Zoo and the North Wales Wildlife Trust began training to microchip dormice without anaesthesia. Previously, vets would chip using anaesthesia but it is likely that a Home Office license will be required for the use of anaesthetic in future. Furthermore, it appears that the 'new' procedure, when conducted according to approved methods, is less stressful for the dormice. The experience and expertise of Chester zoo provided invaluable advice to guide future licencing of this procedure in the UK, through Natural England and Natural Resources Wales, and the new technique will ensure the best results are achieved to protect the Common dormouse from further population declines.

The Cheshire Black Poplar Project

In the UK the native Black Poplar was recognised as under threat in the 1980s, with remaining trees ageing and almost no natural regeneration occurring. Surveys identified Cheshire as an important area, with more female trees than other counties. An action group was established with partners including Cheshire County Council, Cheshire Wildlife Trust, RECORD, Forestry Commission, and Mersey Forest; Chester Zoo became involved in 2002. Over 300 mature trees have been identified in Cheshire, but the majority are old and fragile. Most are single individuals planted in boundaries by landowners over 150 years ago - these were most likely planted as cuttings, not grown from seed.

There are very few places where males and females occur together, so it is almost certain that no true seed is being set. Survey work by partners and volunteers over the last 30 years has contributed to a Black poplar database that is managed by RECORD. A review of the data in 2014 showed that many trees had not been checked in over 10 years, and a significant number had been lost, so a re-survey was initiated in 2015. Approximately 30% of the county has been covered so far. Since 2010 it has been possible to genetically fingerprint the trees from leaf samples, through Forest Research, samples from 105 trees have been tested. The tree survey data is currently being processed, but it seems that a significant number of old



Frequency of Black poplar clones found in Cheshire

trees have been lost, and a smaller number of new trees have been found. Genetic fingerprinting has shown that in the 105 trees tested, only seven different clones are present. Only two of these clones are unique to Cheshire, and each of these is represented by a single tree. Also, despite having a lot of female trees, only two female clones have been found so far. This makes the conservation status of the native Black poplar even more precarious.



Distribution of Black poplar clones in Cheshire

Chester Zoo Conservation Scholars

Project: Population status and conservation of the critically endangered Bermuda skink *Plestiodon longirostris*, Heléna Turner, University of Kent.

'I am researching the population and conservation of a critically endangered lizard, the Bermuda skink. As they have many threats, I want to know how many currently remain in the wild and determine whether there have been any significant changes in the health of the population to help with their future recovery.'



Additional Biodiversity Surveys and Ecological Monitoring Projects

Reproductive Endocrinology of the European Badger (*Meles meles*): Effects on Reproduction, Behaviour and Survival Strategies, *University of Oxford, MSc*

Defining in situ characteristics to determine best practice for ex situ husbandry for Harlequin mantella (*Mantella cowanii*), *University of Manchester, PhD*

UK Pine marten recovery programme: Impact of translocation strategies, *University of Exeter and Vincent Wildlife Trust, PhD*

CONSERVATION BREEDING AND MANAGEMENT



An Eastern black rhino at Chester Zoo



An Eastern black rhino in Kenya

Are ex-situ populations of Eastern black rhinos sustainable?

Our recent research suggests that ex-situ Eastern black rhino (*Diceros bicornis michaeli*) populations are sustainable. However, by making comparisons to their wild counterparts, our research has also highlighted there is room for improvement and has identified where we should focus our conservation breeding efforts to maximize success. Captive populations are becoming increasingly important to the sustainability of endangered species, especially when their wild counterparts face substantial threats. It is important that ex-situ populations are both genetically and demographically sustainable to ensure they retain the characteristic features needed for them to respond appropriately to challenges in the wild. Due to poaching in the wild, Eastern black rhino captive collections have never been more important to protect the survival of this species; currently 10% of the global population of Eastern black rhinos are kept in Europe. Data on the European collection from January 1985 to December 2010 were extracted from the European Association

of Zoos and Aquariums' (EZA) studbook. Population viability analysis (PVA) and population management software were used to assess the demographic and genetic sustainability of the European population. Comparisons were then made with their wild counterparts from eight managed populations, supplied by the Kenya Wildlife Service (KWS).

Comparisons between the European Eastern black rhino population and those found in Kenya revealed that the captive population has a 1-2% population growth rate per annum, whereas a 6-8% growth rate is found in their managed wild counterparts. Although the population is sustainable, the current growth rate is under 5%, which is the annual target. This may be due to longer inter-calf time periods, females not reproducing until a later age or failing to reproduce at all. 40% of individuals at breeding age were found to not be breeding. In addition to this, pedigree analysis showed that more than a third of individuals were related to only five founders from over 100. These factors all contribute to a reproductive skew in the population and make it harder to maintain genetic and demographic viability in the captive population. Therefore, understanding the potential of reproductive output of in-situ Eastern black rhinos has highlighted that there is room to improve the reproductive potential and reproductive skew of the European ex-situ Eastern black rhino population.

Are captive Golden mantellas fit for release to the wild?

As the management and conservation of endangered amphibians often involves reintroductions, captive populations are playing an increasingly important role in conservation. For reintroductions to be successful animals have to be able to adapt to wild conditions. Captivity is significantly different from wild environments so animals may have undergone genetic and behavioural changes that can affect their ability to survive disease, predators and competitors. By evaluating the species fitness of captive amphibians, such as Golden mantellas (a critically endangered frog from Madagascar), we can improve the success of reintroduction attempts. Data were collected from five distinct populations of Golden mantella; Chester Zoo, two groups from Mitsinjo captive breeding association, founders collected from the wild and their offspring and wild frogs from the Mangabe region of Madagascar. Samples were collected relating to indicators of Golden mantella fitness including presence of skin microbiota, vocal calls, skin colouration, body conditioning and a tonic immobility test. Body condition can be a good indication of the relative health of an individual so any difference between groups could indicate how fit they are to survive. We found that the offspring of wild caught founders had a significantly lower body condition in comparison with the other groups. In addition, wild individuals during the breeding



Example of difference of colouration of captive frogs (top picture) and wild frogs (bottom picture)

season had a poorer body condition than those sampled after. The results from the skin colouration and tonic immobility test showed a higher percentage of captive individuals were significantly different in skin colouration and did not perform tonic immobility when compared to wild populations (50% compared to 20% and 18% in the wild populations) which may make them more susceptible to predation in the wild. Analysis has yet to be performed on the skin microbiota and vocal calling data. By investigating all these factors in our captive populations, we can better understand how differences from their wild counterparts may negatively impact them in the wild. We can then make more informed decisions regarding reintroductions and improve the success of conservation efforts in the future.

Chester Zoo Conservation Scholars



Luiza Passos

Project: Impact of ex situ husbandry: comparisons between in-situ and ex-situ species, Luiza Passos, University of Salford

'My project is trying to evaluate the effects of the captive environment on the behaviour of reptiles and amphibians in order to understand if, in the case of a reintroduction, captive animals would have the right skills to survive back in the wild.'

Project: Orchid-Mycorrhizal fungi interactions; improving propagation methods for chlorophyllous and mycoheterotrophic orchids, Oliver Hughes, University of Manchester



Jersey orchid *Anacamptis laxiflora* germination

© Oliver Hughes

'My research looks at interactions between orchids and fungi. For the majority of their lives most orchids are reliant on interactions with fungi, to share nutrients and gain protection from diseases. Orchid seeds rely on being infected by fungi to germinate and grow. I am studying this relationship to better understand the biology of these plants and help their conservation.'

Additional Conservation Breeding and Management Projects

Do mixed species aviaries work? Evaluating breeding success of bird species housed within mixed species enclosures within British and European zoological collections *Liverpool John Moores University, MPhil*

Early influences on the development of cooperation in wild mammals *University of Exeter, Post-doctoral Researcher*

Environmental impact upon faecal corticosterone metabolite levels in a range of equine species *Nottingham Trent University, External Professional Researchers*

Mitigating the potential extinction crisis of Malagasy frog communities from chytridiomycosis: Selection of antifungal probiotics that persist on Malagasy amphibians *Technische Universitat Braunschweig, PhD*

Proteomic and genomic comparison of montserrat tarantulas with near relatives *Canterbury Christchurch University, External Professional Researcher*



Jaguar caught in a camera trap

A review of Human-Jaguar conflict research

The largest threat to Jaguars in the Americas is conflict with livestock farmers, 65% of the remaining Jaguar range is unprotected and the edges of these areas carry the most risk. Human-Jaguar conflict occurs across the entire range and addressing the persecution of the species is an urgent issue. By compiling the most relevant and expert knowledge, we can draw attention to the areas of high risk and identify ways of diffusing the conflict to support Jaguar conservation efforts. Short, web based questionnaires were sent to experts in the field of Human-Jaguar conflict to examine perceptions and knowledge. Peer reviewed publications on Human-Jaguar conflict were identified to combine with the expert-based data. To identify areas of known or rising conflict, a range-wide scale model was created using data on Jaguar, Human and livestock densities. Poor livestock husbandry and the depletion of wild prey resources appear to be the main causes of livestock predation by Jaguars. Despite this, we found that incidences of retaliation killings by farmers were not necessarily down to livestock loss. Perceptions of Jaguars and social norms appear to contribute to a low tolerance attitude.

Therefore, to minimise Human-Jaguar conflict, the ideal scenario would be to improve prey availability, provide better livestock husbandry and encourage a higher tolerance. To achieve this, guides have been produced for farmers to improve husbandry with Jaguar deterrents, barriers and guarding. By understanding the perceptions of people, we can better educate them on ways to reduce the levels of depredation and subsequent retaliation killings. Further to this, we found that conflict occurs in approximately 15% of the Jaguar range, with levels of high, medium and low risk varying across countries. This can potentially be used to identify priority areas for landscape-level

conservation planning. With human-wildlife conflict causing major threats to species such as the Jaguar, reviews like this one are vital in assessing the causes and potential solutions to this problem to maximise conservation efforts.

Non-invasive monitoring of 'stress' in wild Asian Elephants in Peninsular Malaysia

Human-Elephant conflicts, usually involving elephants raiding crops, are causing economical loss to plantation owners and smallholders in Peninsular Malaysia. One of the few mitigation efforts taken is to translocate these elephants to large contiguous forest areas, however not much is known about the effect of translocation on the health of the animals and if they are able to adapt to their new surroundings. Application of non-invasive wildlife endocrinology techniques (which doesn't require the capture of the animal) using faeces from elephants is an attractive method to monitor the elephants in their new habitat. Glucocorticoids are one of many hormones involved in the body's physiological responses towards challenges. Metabolites, when extracted from the dung matter and measured, give an indication of the amount of glucocorticoids circulating in the body. First, an experiment was carried out on 80 dung piles with 685 subsamples to verify the stability of faecal glucocorticoid metabolites in a tropical environment. The metabolites were found to be stable up to eight hours. Five translocated males and four local (non-translocated) elephants, collared with GPS satellite collars, were successfully monitored for a year and we successfully collected and analysed 253 dung samples. The results from the wild elephant monitoring is currently in final stages of analysis, the results of which will be presented to the management authorities in Peninsular Malaysia.



Chester Zoo staff conducting fieldwork in Malaysia



Asian elephants in Malaysia



Asian elephants

Chester Zoo Conservation Scholars

Jacqui Morrison



Project: Fencing African elephants in Kenya: landscape and welfare impacts, Jacqui Morrison, Manchester Metropolitan University

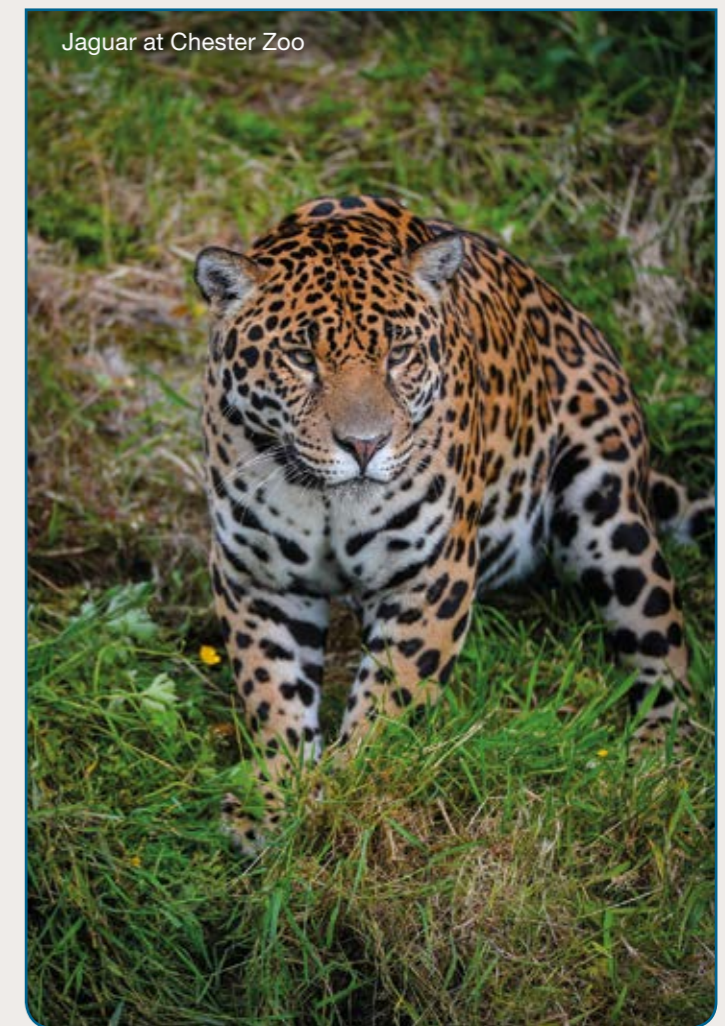
'My research is looking at what the effects are of building a fence around a national park in Kenya. I will be measuring levels of stress in elephants and looking at their group structures whilst also assessing the impact on the habitat including the types of vegetation present and any possible damage.'

Project: Factors influencing management and conservation of wild Asian elephants in Peninsular Malaysia, Ee Phin Wong, University of Nottingham Malaysia Campus,



Ee Phin Wong

'Human-elephant conflict usually involves elephants raiding crops, which causes economical loss to plantation owners and smallholders in Peninsular Malaysia. One mitigation measure is translocating these elephants to larger forest areas. My PhD is investigating the effect of translocation on the health of the animals and how they adapt to their new environment using non-invasive wildlife endocrinology techniques.'



Jaguar at Chester Zoo

Additional Human-Wildlife Conflict Projects

Assam Haathi Project, Chester Zoo Staff

LIVELIHOODS AND SUSTAINABLE DEVELOPMENTS

Living with tigers

Chitwan and Bardia National parks in Nepal are two of the largest strongholds of tiger populations, with an estimated population of 120 and 50 individuals respectively. However, the livelihoods of those that must live alongside these animals are heavily dependent on the forests they share and risk attack when venturing for resources. As a result of human and livestock casualties, tigers are often hunted out of resentment, undermining the conservation efforts already put in place. Despite the high profile of tigers, the awareness and solutions to conflict are not well communicated. In 2010, the Nepali government committed to doubling tigers numbers by 2022 by reducing threats such as conflict. This project will contribute to that aim by drawing attention to the plight of those who must live with the existence of tigers and their associated problems and seek practical, long term solutions to improve the lifestyles of both humans and wildlife. Through this initiative we hope to save lives and promote the safety of the communities that live alongside tigers.

By training locally respected community members, we hope to challenge the actions of individuals to encourage changes that will benefit both the tigers and the communities around Bardia and Chitwan. Ultimately, we hope to build a replicable framework for local communities to inspire others to pursue new poverty-alleviating livelihoods. By working directly with the communities and influencing relevant government authorities, we hope to find practical outcomes that are both culturally appropriate and situation-specific, to reduce the dependency on forest resources. This in turn, will help to minimise the number of human-tiger encounters. Alongside this, the project will conduct social and ecological surveys to establish tiger home ranges, sites of high conflict risk and the overall effectiveness of the project to ensure the best possible impact is made. By combatting this issue the 'Living with Tigers' project is helping to protect this rare species and local communities.

Bengal tiger



© James Warwick



Action planning in Chitwan National Park

© Alex Zimmerman

Palm oil research with restaurants

Palm oil is an edible vegetable oil that comes from the fruit of oil palm trees. As the highest yielding, most efficient and versatile vegetable oil crop, palm oil is the world's most widely used edible oil and global consumption is rising. It is found in 50% of supermarket products, from foods to cosmetics, cleaning products and animal feed. Our concern is with the deforestation, loss of biodiversity and greenhouse gas emissions which have resulted from the rapid and unregulated expansion of unsustainable plantations. Transforming the palm oil market to a sustainable and traceable supply is the most responsible path and the first step to ensuring that the palm oil industry impacts as little as possible on the biodiversity of the regions it is grown in. The Roundtable for Sustainable Palm Oil (RSPO) is the most recognised certification scheme globally, however currently only 20% of palm oil produced is certified, with a focus on manufacturers of products sold in supermarkets. Knowledge of sustainable palm oil in the UK catering industry is unknown and perceived to be more limited. Our research aims to identify existing knowledge and current procurement procedures in



Informing members of the public about palm oil



Sumatran orangutans at Chester Zoo

restaurants around Chester. We will be looking specifically at knowledge of and attitudes towards sustainable palm oil and the 2015 deadline which many production companies are working towards. Part of this research will aim to identify the perceived benefits and barriers to adopting sustainable palm oil procurement in restaurants in Chester and will test acceptance levels for a range of interventions and determine the approach that the restaurants would be most likely to respond to and find useful. As part of the project, we have developed a restaurant toolkit full of practical tips to help businesses make and deliver their sustainable choices; our first sustainable palm oil restaurant partner is The Lowry, Salford. So far we have involved over 80 restaurants in our survey; the data we have gathered is being analysed and we aim to measure the interest levels of engagement in the project amongst local restaurants.



Palm oil plantation

Chester Zoo Conservation Scholars

Project: Assessing practical interventions for reducing human-large felid conflict in Nepal, Susana Rostro, WildCRU & University of Oxford

'I'm identifying the factors that influence human-felid conflict in Nepal, and determining the effectiveness of interventions carried by Chester Zoo to reduce conflict. This will help to: 1) evaluate if interventions are culturally-relevant, situation-specific, and successful; 2) determine if tigers and leopards are affected; 3) understand the relationship between ecology and conflict.'



Susana Rostro, centre



Settlements next to Chitwan National Park

Are interactive activities for zoo visitors effective education tools?

Education is one of the four main roles of a modern zoo alongside research, conservation and recreation. Therefore, it is important that we provide opportunities for our visitors to learn about the biology and conservation of the species that we keep. However, due to the vast amount of variability among visitors, investigating the effectiveness of these initiatives can be difficult. This study evaluated the impact of informal learning practises and interactive activities in a zoo environment and identified variables that impact positively on the experience. Two interactive activities were used, focussing on two species of endangered frogs; the Mountain chicken and Golden mantella. Visitors were interviewed using a series of open and closed questions designed to explore factors that may impact on informal learning in a zoo environment including; motivation for visit, prior knowledge, what the visitors found out during their visit and knowledge of amphibians and their conservation (in particular the amphibians focussed on in the activity) and awareness of Chester Zoo's conservation work. Individuals were interviewed on days the activities weren't

available to act as a control. We found that visitors that engaged with interactive learning activities achieved stronger learning outcomes regarding their knowledge of endangered animals, but little impact was observed regarding knowledge of Chester Zoo's conservation efforts. It is possible that this was due to the high awareness already established in most of the visitors. Moreover, those that had visited the zoo with motivations to 'see the animals' appeared to gain more from the interactive activities than visitors with alternative motives. Following the results of this study, recommendations were made to continue using learning and interactive elements to informal learning delivery at the zoo but as there appears to be a particular group of visitors that benefit from interactive learning, activities designed to target specific audiences would be ideal.



Photo: Mountain chicken frogs at Chester Zoo

Evaluating the educational impacts of visiting zoos: a global study

The 20 Aichi Biodiversity Targets form the basis of the United Nations Strategic Plan for Biodiversity 2011–2020. Target 1 of this plan states that 'by 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably'. With around 700 million annual visits the world's zoos and aquariums are ideally placed to contribute to achieving this target. Chester Zoo scientists teamed up with the World Association of Zoos and Aquariums (WAZA) and the University of Warwick to uncover whether zoos can positively contribute to achieving Aichi Biodiversity Target 1. As a first step, we conducted the first global evaluation of the educational impacts of visits to zoos and aquariums. Data collection took place between November 2012 and July 2013, with more than 6,000 visitors to 30 institutions participating. The study's main findings were positive; namely, that biodiversity understanding and knowledge of actions to help protect biodiversity both significantly increased over the course of zoo visits. Following on from this first survey, in May 2014 a global awareness-raising campaign – 'Biodiversity is Us' – was rolled-out in a large



Educational activities at Chester Zoo

number of participating zoos and aquariums. A second global survey was subsequently conducted (5,000 visitors to 20 zoos and aquariums from 14 countries), with the aim of evaluating whether the 'Biodiversity is Us' campaign was successful in further raising levels of biodiversity literacy amongst zoo and aquarium visitors. Mirroring the findings from the 2012/2013 survey, we again found that respondents had a significantly better understanding of biodiversity and improved knowledge of actions to help protect biodiversity after compared to before their visit. Those respondents who were exposed to the campaign's interpretive graphic panels and films showed a significant increase in biodiversity understanding over the course of a zoo visit. The 'Biodiversity is Us' campaign was amongst the largest of its kind globally, which reaffirms the important role of zoos and aquariums as providers of biodiversity-related education.

Does Islands work for animals and visitors?

Not only is Islands the largest development in UK zoo history, it got the zoo's scientists excited for an additional reason - namely, because it also presented them with a unique research

opportunity. As the majority of the animal species now housed in Islands actually came from exhibits in the core zoo, it meant that we could assess animal behaviour and welfare both pre- and post-Islands, within the same individuals. Similarly, by assessing key visitor-related variables such as visitor viewing behaviour, perceptions, attitudes and social conversations we would also be able to assess the impact Islands has on visitors. This large-scale, cross-disciplinary work has, to date, involved over a dozen students collecting pre-Islands data since May 2014. Focal species have included Rhinoceros hornbills, Southern cassowaries, Sulawesi macaques, Sumatran orangutans and Sumatran tigers. Smaller studies have also been conducted on other species such as the Banteng. From the pre-Islands animal behaviour and welfare research, examples of some of findings include visibility data for all individual Sumatran orangutans, enclosure use of the Southern cassowary and a detailed social network analysis of our troop of Sulawesi macaques. With the pre-Islands visitor research, we found that people viewed the Sulawesi macaques and Sumatran orangutans for the longest amount of time (an average of 1 minute 28 seconds and 1 minute 26 seconds respectively), and that while 20% of visitor conversations focussed on the location of the animal in front of them, only 0.4% of conversations were related to the topic of conservation. Post-Islands data will continue to be collected into 2017 to enable a full assessment of how the animals have settled into their new homes and how our visitors react to them.



Islands at Chester Zoo



Word cloud visualisations comparing the responses given to the question 'What three words would you use to describe a Mountain chicken?' by the control (top) and test (bottom) group.

Additional Visitor and Community Engagement Projects

- Encouraging feedback-seeking in the workplace through contemplation *University of Sheffield, Post-doctoral researcher*
- Evaluating the education and wider impacts of a pilot Safari Ranger programme: Quantifying the educational impact *Zoo staff*
- Evaluating the education and wider impacts of a pilot Safari Ranger programme: Capturing the student and teacher voice *Zoo staff*
- Identifying factors influencing zoo visitor behaviour and knowledge: A mixed methods approach *University of Leeds, MSc*
- Investigating the impact of interactive educational initiatives on visitors in a UK zoo *Zoo staff*
- Persons as animals *University of Leeds, Post-doctoral Researcher*
- Spillover versus compensation behaviours related to conservation of biodiversity in Chester Zoo members *Zoo staff*
- What impact does exhibit design have on conservation, education and the visitor experience? *Queens University Belfast, BSc*



Emerald tree monitor



Aquatic turtle

Can environmental enrichment increase activity levels in reptiles?

Environmental enrichment plays a vital role in improving captive animal welfare. By offering more mental and physical stimulation, the animal is encouraged to display a more diverse range of natural behaviours and increased activity levels. This project aimed to evaluate the impact of a variety of environmental enrichments on activity levels in three species of lizard (Komodo dragon, Emerald tree monitor and Salvador monitor) and two species of aquatic turtles (Golden coin turtles and Vietnamese pond turtles). Behavioural observations were conducted on the five reptile species. Each of the species was introduced to a variety of food and scent based enrichments, including scent trails, hanging and terrestrial feeders and animal furnishings for the lizards and fruit kebab skewers, floating rafts and scatter feeds for the turtles. Behaviour was recorded before, during and after the enrichment was provided. Results showed that in the two species of turtle and two species of lizard (Komodo dragon and Emerald tree monitor), there was an increase in activity levels during enrichment. During the post-enrichment periods,

activity levels decreased, returning to baseline as time went on. However, the activity levels of the Salvador monitor lizard started to increase 30 minutes after enrichment was placed inside the enclosure and sometimes continued for a further two hours. Additionally, activity levels varied according to the type of enrichment provided. For example, kebab skewers and forage feeds were more effective at increasing activity levels than floating rafts in the aquatic turtles. Overall our enrichment assessment showed that activity levels were increased in all species within a two hour period and that continual assessment is key to evaluating the impact on behaviour over time, as responses may change as the novelty wears off. Further study could also help to determine any species and enrichment differences and evaluate the potential to apply these enrichment methods to other species.

Chester Zoo's Badger Vaccination Programme

Bovine tuberculosis (bTB) is an infectious disease caused by the bacterium *Mycobacterium bovis*. It has re-emerged as a major threat to the British cattle industry but can infect a range of species; therefore posing a threat to the animals within Chester Zoo's animal collection. Localised spread and the gradual increase of the disease has been attributed to badgers. A number of mechanisms are being trialled in order to control the spread of the disease, including culling. Badger vaccination is a more humane control mechanism which has proven to reduce the severity and progression of bTB and reduce excretion of *M. bovis* by badgers. Cheshire is considered an 'Edge' county, meaning it is on the border between high risk and low risk areas for bTB in cattle. Our vaccination programme is an extra precaution to protect both the zoo animals and wild badgers from bovine tuberculosis. Annual site surveys are carried out to monitor how badgers are utilising the zoo estate and camera trap surveys allow us to monitor changes in population size. In 2015, two members of staff completed training to become certified lay vaccinators, annual vaccination is carried out adhering to the Animal and Plant Health Agency (APHA) protocol. We are collaborating with other partners in Cheshire to try and increase our impact on the county. Continual monitoring of the setts using camera traps allowed us to estimate changes in population size and structure. This year camera trap footage revealed we had eight cubs, with a total resident population of 11. Site surveys revealed the most active areas on the zoo estate. This information along with data on trap success from last year helped us to determine the best places to position traps. In 2015, 10 badgers were vaccinated, two of which had been caught and vaccinated last year. Therefore, eight new individuals were captured and microchipped; seven cubs and one adult. The data we are collecting allows us to build up a picture of the badger population's demographics.

Chester Zoo Conservation Scholars



Rhiannon Bolton

Project: Influences of competitive behaviour in cooperatively breeding mammals, Rhiannon Bolton, University of Liverpool

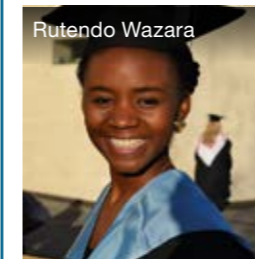
'My project aims to investigate the underlying mechanisms that balance contented and aggressive behaviours in mammals which rear their young together in shared nests. Such animals, for example African Painted Dogs, are endangered in the wild, therefore gaining greater understanding of how their bodies function should help to improve the conservation of these species.'

Project: Environmental sound impact on zoo mammals, Marina Bonde de Queiroz Salford University



Marina Bonde de Queiroz

'My research is about the impact of sound pollution on zoo mammal behaviour and welfare. I will focus specifically on the noise produced by the zoo visitors, how it can affect the animals, and how it can influence the public's experience at the zoo.'



Rutendo Wazara

Project: Social welfare of captive Asian Elephants, Rutendo Wazara, University of Liverpool

'My PhD will be about measuring the strength of social bonds of captive elephants. My aim is to find a way for zoo keepers to monitor the social development of elephants simply and effectively and to test if social relationships are linked to other measures of zoo elephant welfare.'

Additional Wildlife Health and Welfare Projects

An investigation into social relationships and social structure in European zoo elephant herds, *Nottingham Trent University, PhD*

Banded mongoose cardiac (*Mungos mungo*) review, *Zoo staff*

Behavioural and endocrine responses of captive Sulawesi macaques (*Macaca nigra*) to a novel enclosure, *University of Manchester, MPhil*

Behavioural observations, enclosure use and visibility of Javan rhinoceros hornbill (*Buceros rhinoceros silvestris*) and Southern cassowary (*Casuarius casuarius*): a pre-occupancy of 'Islands' evaluation, *University of Manchester, BSc*

Behaviour and enclosure use of Bornean orangutans prior to enclosure modifications, *Nuffield foundation Placement*

Behaviour and activity levels of sloths at Chester Zoo, *Nuffield Foundation Placement*

Black rhino (*Diceros bicornis*) mortality review, *Zoo staff*

Case study of body condition scores of elephant at Chester Zoo, *Royal Veterinary College, BSc*

Evaluating the effectiveness of current enrichment practices used with three monitor lizard species at Chester Zoo, *University of Manchester, BSc*

Evaluation of current enrichment for aquatic turtle species at Chester Zoo, *University of Manchester, BSc*

How does sound produced by the zoo-going public affect zoo mammals? *University of Salford, PhD*

Interaction between Slender-tailed Meerkats (*Suricata suricatta*) and Cape Porcupines (*Hystrix africaeaustralis*), *Harper Adams University College, BSc*

Islands' exhibit evaluation of Banteng, *Harper Adams University College, BSc*

Mortality review of the Mountain chicken (*Leptodactylus fallax*), *Zoo staff*

Observing behaviour visibility and enclosure use of Sumatran orangutans at Chester Zoo, *Manchester Metropolitan University, MSc*

Pre-occupancy 'Islands' evaluation of Sumatran tigers, *Student Work Experience*

Pre-occupancy 'Islands' evaluation of Rhinoceros hornbills and Southern cassowaries, *Student Work Experience*

Prevalence of mycobacterial infections in a zoo aquarium, *University of Liverpool, MSc*

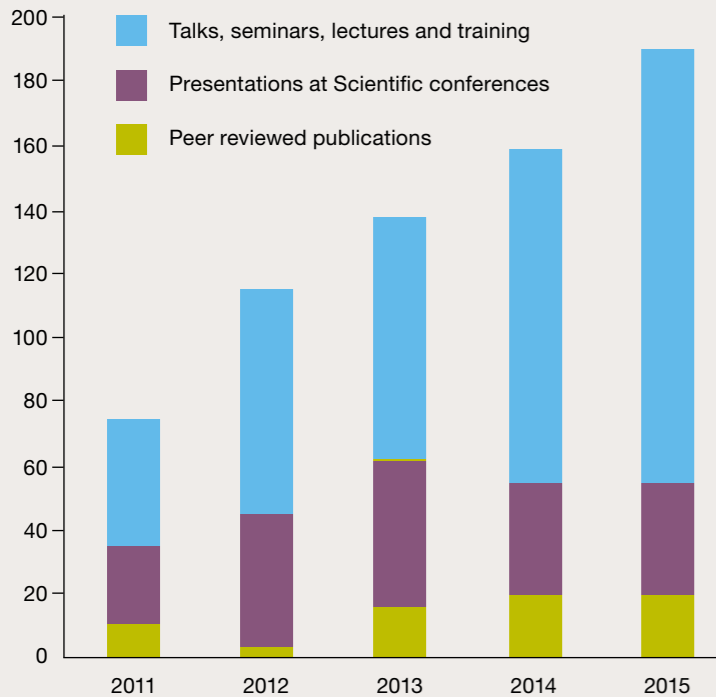
Space utilisation by captive Sumatran tigers, *University of Liverpool, BSc*

The behaviour effects of a move to a new exhibit upon two Sumatran tigers, *Manchester Metropolitan University, MSc*

To investigate the behavioural impact of moving enclosure on a family group of Sumatran orangutans at Chester Zoo, *University of Manchester, BSc*

SCIENCE COMMUNICATION

Communicating scientific activities is integral to our work. It serves to provide an external audit of the quality of science undertaken, increases our profile within the scientific community and general public, and informs decision making both within the zoo and externally. We disseminate our science to peers through publishing peer reviewed journal articles, presenting our work at scientific conferences and providing talks, seminars, lectures and technical training. We have been increasing these activities over the past five years.



Total number of publications, presentations and training from Chester Zoo staff over the past five years

Media

Chester zoo received much media interest from numerous news broadcasters in 2015, including BBC news, ITV news and local newspapers, websites and magazines. This news coverage was wide-spread across several departments including scientific research. Topics of interest ranged from veterinary procedures to the role of endocrinology in the birth of endangered animals. This widespread coverage reaches people that may not have previously visited and generates further interest in the work that we do to help conserve biodiversity.

Here are some examples of the scientific achievements that were reported on during 2015:



In September 2015, the BBC aired an episode of Blue Peter which followed the birth of Usala, our male okapi calf, born in April. As part of the episode, Rebecca Purcell, Chester Zoo's Endocrinology Technician, was interviewed in relation to the work completed within the lab to diagnose and monitor pregnancies in endangered animals such as the Okapi.



In June 2015, Chester Zoo hosted the Rhino Keeper workshop, which brought together rhino keepers and researchers from around the world, including the USA, Europe and Australia. This biennial event provides a platform for sharing information on best practices and future plans for rhino conservation and husbandry.



In October 2015, two rare aquatic snakes from South East Asia were confirmed to be pregnant after receiving an ultrasound scan from Chester Zoo's Vet team. Tentacled snakes give birth to live young and are not kept at any other UK zoo.



In October 2015, Chester Zoo launched the Green Gold Conspiracy event as part of the Palm Oil Challenge campaign and Manchester science festival. The event was delivered over a three course meal and was designed to engage audiences with the conservation of endangered species affected by food production. Diners took part in an interactive game whereby they had to manage their own South East Asian business, facing the decisions and consequences of balancing economic demand

and the survival of the orangutan. By delivering information on the science behind sustainable food choices and positive changes that can help stop deforestation in an entertaining way, we can inspire people to take action and raise awareness of the consequences behind our food choices.

Conservation Symposium

In October 2015, Chester Zoo hosted the Annual Conservation Symposium focussing on labelling sustainability. The event was attended by a large number of representatives from universities and conservation groups to high street giants. A range of speakers from a variety of organisations including Marks & Spencers, the Marine Stewardship Council and Natural Resources Wales, discussed the impact of sustainable labelling on wildlife and what we can do to help the planet.



Science Festivals

As part of the Cheshire wide 'Amazed by Science' festival, Chester zoo hosted numerous hour long 'Meet the Scientist' sessions between the 23rd and 31st May. These sessions aimed to give visitors an insight into what happens behind the scenes at the UK's number one zoo. Members of the Science team and Field programmes gave talks in collaboration with our Discovery and Learning division. Each of the hands-on workshops consisted of interactive activities designed to engage visitors in the importance of different scientific disciplines, including social sciences, nutrition, endocrinology, animal behaviour and field surveys. The event was a success with each of the sessions highlighting how the important work conducted by zoo staff can help to make informed management decisions.



Chester Zoo staff at the Science Uncovered event in Manchester

In September, Chester Zoo staff took part in Science Uncovered, part of the European Researchers' Night. The event was hosted at Manchester Museum and provided the opportunity for our science and conservation teams to showcase the work that we do to inspire an audience of next generation scientists. Visitors had the chance to engage in activities involving videos, zoo food, microchip detectors and fake poo to demonstrate how Chester Zoo uses a range of techniques to protect wildlife all over the world.



Dr Andrea Fidgett at the Girl Geek Dinner at Manchester Science Festival

Dr Andrea Fidgett attended the Girl Geek Dinner as part of the Manchester Science Festival which brought together specialists from science, technology and engineering to discuss what science has done for them and being a female working in the industry.

Conference Participation

By distributing our scientific activity, we hope to raise the profile of Chester Zoo as a centre of excellence for animal and plant care and scientific value. In doing this, we create opportunities for future collaborations and research. Chester Zoo staff deliver a number of lecture programmes and participate in international conferences in order to share ideas and scientific achievements with the zoo community and academic institutions. Over 170 presentations were made during 2015, including the BIAZA research symposium in Dublin, Ireland, where we presented four intern research projects, one of which was awarded with the highly commended prize. Chester Zoo won the BIAZA Gold award for Research in 2015 for Rachel Antwis' PhD 'Frogs and friendly bacteria, it's not just skin deep'. This research investigated the relationship between frogs and symbiotic bacteria which may have practical applications for treatment against chytridiomycosis. By examining the effects of different husbandry and marking techniques on these bacterial communities the research identified host-microbe-environment interactions which may affect the frogs' suitability for release. Within the zoo, staff led programmes such as the Junior Members Summer School and Zoo Intern Workshops provide the opportunity for future conservation scientists to learn about the work of Chester Zoo. We also host a number of successful internal symposia and invite leading experts and academics to give lunchtime talks at the zoo.

Manuscripts reviewed

Invitations to review papers by other scientists are indicative of the scientific credibility of our staff. In 2015, Chester Zoo staff reviewed 12 manuscripts across disciplines such as animal

health and welfare, social sciences, physiology, and zoology. In addition, over 70 abstracts were reviewed and three staff members held editorial positions.



Andy Moss, Conservation Social Scientist, presenting at the EAZA Education Conference



Presenting to Chester Zoo staff



Chester Zoo Conservation Scholar Induction Day



MEMBERSHIP LIST

Alongside the services our staff provide for the zoo, many are active members or chairs of external boards and institutions. The list below gives an idea of the work that our staff have been involved with over the past year.

UK	Europe	International
Association for the Study of Animal Behaviour (ASAB)	EAZA	Amphibian Survival Alliance
BIAZA	EAZA Alatoran gentle lemur EEP	AZA Nutrition Advisory Group
BIAZA Bird Working Group	EAZA Amphibian Taxon Advisory Group	Comparative Nutrition Society
BIAZA Carnivore Focus Group	EAZA Animal Welfare Working Group	International Committee of American Association of Zoo Veterinarians
BIAZA Environmental Sustainability and Climate Change Committee	EAZA Ape Taxon Advisory Group	IUCN Asian Elephant Specialist Group
BIAZA Field Programmes Committee	EAZA Aye aye EEP	IUCN Cat Specialist Group
BIAZA Native Species Working Group	EAZA Bird Taxon Advisory Group	IUCN Conservation Breeding Specialist Group
BIAZA Palm Oil Sub Group	EAZA Eastern Bongo EEP	IUCN Wildlife Health Specialist Group
BIAZA Reptile and Amphibian Working Group	EAZA Education Committee	Mauritian Wildlife Foundation
BIAZA Research Committee	EAZA Elephant Taxon Advisory Group	Orangutan Veterinary Advisory Group
British Veterinary Association	EAZA Group on Animal Contraception	Pan African Sanctuary Alliance
British Veterinary Zoological Society	EAZA <i>Leptodactylus fallax</i> European Studbook	World Conservation Union (IUCN)
Flora and Fauna International (North West Group)	EAZA Nutrition Group	
Primate Society of Great Britain	EAZA Reptile Taxon Advisory Group	
Royal Veterinary College/ZSL	EAZA Research Committee	
Spoon-billed sandpiper Husbandry Advisory Group	EAZA Rhino Taxon Advisory Group	
UK Elephant Welfare Group	EAZA Sulawesi Macaque EEP	
Universities Federation for Animal Welfare (UFAW)	EAZA Threatened Asian Songbird Alliance	
University of Glasgow	European Alliance of Rehabilitation Centres and Sanctuaries	
University of Liverpool	European College of Zoological Medicine	
University of Warwick		
University of Oxford		

COLLABORATING INSTITUTIONS

Association of Private Land Rhino Sanctuaries	IUCN/SSC Asian Wild Cattle Specialist Group	Save the Rhino International
Adudu Nantu International Foundation for Nature Conservation	IUCN/SSC Tapir Specialist Group	Sumatran Orangutan Conservation Project
Anglia Ruskin University	Jane Goodall Institute	Technische Universitat Braunschweig
Antwerp Zoo	Katala Foundation	Thermo Scientific
AQUASIS	Kenya Wildlife Service	Twycross Zoo
Askham Byran College	Kinabatangan Orangutan Conservation Programme (KOCP)	Universidad Michoacana de san Nicolas de Hidalgo
Bangor University	Knowsley Safari Park	Universidad Veracruzana
Belfast Zoo	Leibniz Institute for Zoo and Wildlife Research	University College London
BIAZA	Liverpool John Moores University	University of Aberystwyth
Big Life	Liverpool Museums	University of Beja
Blair Drummons Safari Park	Loro Parque Fundacion	University of Birmingham
Bristol Zoo	Lowland Tapir Conservation Initiative	University of Bolton
Canterbury Christchurch University	Macaca nigra Project	University of Bournemouth
Cardiff University	Manchester Metropolitan University	University of Cambridge
Chengdu Research Base of Giant Panda Breeding	Mauritian Wildlife Foundation	University of Canterbury
Cikananga Integrated Conservation Foundation	Mkomazi Game Reserve	University of Chester
CIRMAD	Murdoch University	University of Copenhagen
Coleg Cambria	Myerscough College	University of Exeter
Complutense University of Madrid	Natural Resources Wales	University of Glasgow
Copenhagen Zoo	Nottigham Trent University	University of Keele
Danau Girang Field Centre	Nuffield Foundation	University of Kent
Dublin Zoo	Okapi Conservation Project	University of Leeds
Durrel Institute for Conservation and Ecology (DICE)	OuTrop	University of Leicester
EAZA	OVAG	University of Liverpool
Fundacion BioParc	Oxford Brookes University	University of Manchester
Gashaka Biodiversity Project	Paignton Zoo	University of Nottingham
George Adamson Wildlife Trust	PBCFI	University of Oxford
Giraffe Conservation Foundation	Philippines Biodiversity Conservation Foundation Inc.	University of Portsmouth
Glyndwr University	Port Lympne Wild Animal Park	University of Salford
Halkyn Grazing Association	Pro Bosque Fundacion	University of Sheffield
Harper Adams University	Queens University Belfast	University of Worcester
Howletts Wild Animal Park	Reaseheath College	Vincent Wildlife Trust
Hutan	Royal Veterinary College	Wellcome Trust Sanger Institute
Imperial College London	Royal Zoological Society of Scotland	Wildlife Trust of India
Indonesia Hornbill Society	Sabah Wildlife Department	Wildlife Vets International
Instituto de Pesquisas Ecológicas	Sangare Conservancy	Zoo Outreach Organisation
	Satucita Foundation	Zoological Society of London
		Zurich Zoo

SUPPORTED RESEARCH PROJECTS

Conservation Grant Projects

African Wild Dog Breeding, Veterinary and Reintroduction Programme, *George Adamson Wildlife Trust*

Bees, Wasps and Ants of Cheshire – A Conservation Assessment, *Liverpool Museums*

Blue Crowned Laughing Thrush Conservation Programme, *He Fen-qi*

Bongo Surveillance Project, *Sangare Conservancy & Kenya Wildlife Service*

Carry Out Nesting Patrol to Secure and Incubate Painted Terrapin Eggs From Poaching, *Satucita Foundation*

Community-based conservation of the Philippine Cockatoo *Cacatua haematuropygia* and its habitats (Philippine Cockatoo Conservation Programme; PCCP), *Katala Foundation*

Conservation and reintroduction of Goodeids, *Universidad Michoacana de san Nicolas de Hidalgo*

Conservation education and raising awareness on orangutans and forest functions around the Batang Toru forest, Tapanuli, North Sumatra, Indonesia, *Sumatran Orangutan Conservation Project*

Conservation of the Babirusa and its Critical Habitat, the Nantu Forest, Sulawesi, *Adudu Nantu International Foundation for Nature Conservation*

Conservation of the Grey-breasted Parakeet, Ceará, Brazil, *Loro Parque Fundacion & AQUASIS*

Conservation of the Mauritius Olive White-eye *Zosterops chloronothos* by the management of a reintroduced population on the predator free-island of Ile aux Aigrettes, and the monitoring and management of the mainland population, *Mauritian Wildlife Foundation*

Conservation status of the Majestic Helmeted hornbill (*Rhinoplax vigil*) in Indonesia, *Indonesia Hornbill Society*

Conserving Kidepo Valley National Park's endangered Rothschild's giraffe through integrated and collaborative conservation research, *Giraffe Conservation Foundation*

HUTAN - "Kinabatangan Orang-utan Conservation Programme" (KOCP)

Ecuador Amazon Parrot Research and Monitoring Programme, *Pro Bosque Fundacion*

Enhancing the conservation of the Nigeria-Cameroon chimpanzee in the Kom-Wum Forest Reserve, through conservation education in the communities and schools, *CIRMAD*

Factors Underlying the High Variance in Black Rhinoceros Reproductive Output, *Kenya Wildlife Service & Manchester Metropolitan University*

Field survey of Tomistoma in the Sabangau forest, Central Kalimantan, Borneo Indonesia, *Fundacion BioParc & OuTrop*

Gashaka Biodiversity Project, *Chester Zoo*

Giant Armadillo Project: Conservation and Ecology of Xenarthra in Brazil, *Royal Zoological Society of Scotland & Instituto de Pesquisas Ecológicas*

Grauer's gorillas and chimpanzees in eastern Democratic Republic of Congo (Kahuzi-Biega, Maiko, Tayna and Itombwe landscape): Evaluation of the 2012-2022 IUCN conservation action plan, *Jane Goodall Institute*

Health and Conservation of Eastern Gorillas: A One-Health Study of Blood-Borne Parasites and Retroviral Infections, *Murdoch University*

HUTAN Hornbill Conservation Project (HHCP), *Hutan & KOCP*

In-situ conservation of the Palawan Forest Turtle in Roxas, Palawan, *PBCFI*

Long-term conservation management of the Echo Parakeet *Psittacula eques*, restoring the species and developing management techniques, *Mauritian Wildlife Foundation*

Long-term conservation management of the Pink Pigeon *Nesoenas mayeri*, restoring the species and developing management techniques, *Mauritian Wildlife Foundation*

Lowland Tapir Conservation Initiative (LTCI): Pantanal & Cerrado Tapir Programs, *Lowland Tapir Conservation Initiative & IUCN/SSC Tapir Specialist Group*

Multi-species home range mapping, an aerial approach; fine scale habitat assessment through the use of drone technology, *Danau Girang Field Centre & Sabah Wildlife Department*

Okapi Conservation Project

Palawan Deer Research and Conservation Program (PDRCP), *Katala Foundation*

Partula Field Programme Consortium, *Zoological Society of London*

Preservation of Javan endemic species through captive breeding and in-situ programmes, in the Cikananga Conservation Breeding Centre (West Java, Indonesia), *Cikananga Integrated Conservation Foundation*

Propagation and conservation of critically endangered plant species of Mauritius, *Mauritian Wildlife Foundation*

Protecting the free-ranging black rhino population of the Chyulu Hills National Park, Kenya, *Big Life*

Reproductive Strategies of the Worlds' Biggest Fish: Using Genetic Markers to Elucidate Reproductive Techniques in a Tropical Elasmobranch, *Manchester Metropolitan University*

Restoration and reforestation of the Grande Montagne Nature Reserve (Rodrigues) with native plants to recreate the upland forest community, *Mauritian Wildlife Foundation*

Sichuan Forest Biodiversity Project, *Oxford Brookes University*

Socio-ecology and conservation of spider monkeys in Mesoamerica, *Universidad Veracruzana & Liverpool John Moores University*

Southern Cebu Biodiversity Conservation Program, *Philippines Biodiversity Conservation Foundation Inc.*

Survey & Monitoring of Rodrigues Fruit Bat *Pteropus rodricensis* population. Sensitization of the Rodriguan population. Training in the assessment of bat-related fruit damage in Mauritius, *Mauritian Wildlife Foundation*

The conservation of the Mauritius Fody *Foudia rubra*. Long-term management and population monitoring of the Ile aux Aigrettes population, *Mauritian Wildlife Foundation*

The Ecology of Bornean Hornbills, *Hutan & Kinabatangan Orangutan Conservation Programme (KOCP)*

The Nigerian Montane Forest Project, *University of Canterbury*

The translocation and management of the Mauritius Cuckoo-shrike *Coracina typica* and the Mauritius Paradise Flycatcher *Terpsiphone (bourbonensis) desolata*, *Mauritian Wildlife Foundation*

Understanding the impacts of grassland communities on Bengal Florican populations in Cambodia, *Imperial College London*

West Visayan Threatened Endemic Species Conservation Programme, *Philippines Biodiversity Conservation Foundation Inc.*

Conservation Studentship Projects

A united front: estimating abundance and habitat use of squirrels and pine martens in the Howe of Cromar, *Imperial College London, MSc*

Behavioural study of Asian elephant (*Elephas maximus*) calves at Udawalawe National Park, Sri Lanka, to understand more about their nocturnal behaviour, *Royal Veterinary College, MSc*

Forest products from non-forest? The role of different land uses which could be incentivized under REDD+ in providing economically important wild harvested species in rural Madagascar, *Imperial College London, MSc*

Habitat associations in the São Tomé Fiscal *Lanius newtoni*, *Nottingham Trent University, MSc*

Plant diversity and the impact of prominent anthropogenic activities on vegetation cover in the Lebialem Mone Forest landscape, *University of Beira MSc*

Population structure and ecology of the Critically Endangered Bermuda Skink *Plestiodon longirostris*, *University of Kent, MSc*

The use of supervised classification of Landsat 8 images to quantify black rhino browse availability, *Manchester Metropolitan*

University, MSc

Understanding the behaviours of endangered proboscis monkeys (*Nasalis larvatus*) and how they are affected by ecotourism in the Lower Kinabatangan Wildlife Sanctuary (Sabah, Malaysia), *University of Portsmouth, MSc*

Understanding the impacts of grassland communities on Bengal Florican populations in Cambodia, *Imperial College, London MSc*

Richard Hughes Scholarship The field application of a hormone extraction kit to determine if in situ management of African elephants (*Loxodonta africana*) and reproductive success of Black rhinoceros (*Diceros bicornis*) is related to adrenal physiology, *Manchester Metropolitan University, MSc*

Biological and Data Sample Requests

Agonistic behaviour in multi-male groups of chimpanzees (*Pan troglodytes*) in Zoos and Wildlife Parks, *University of Copenhagen, MSc*

Assessment of parasite species for Montserrat species, *University of Salford, External Professional Researcher*

Asian elephant (*Elephas maximus*) immunogenetics and EEHV serology, *Copenhagen Zoo, External Professional Researcher*

Deciduous enamel growth in great apes, *University of Kent, External Professional Researcher*

Developing behavioural indicators, as part of a wider set of indicators, to assess the welfare of elephants in UK zoos (WC1081), *University of Nottingham and DEFRA, External Professional Researcher*

Developing Next Generation DNA Sequencing approaches for the whole mitochondrial genome – Forensic and conservation applications, *University of Leicester, BSc*

DNA as a tool for monitoring tiger populations, *Zoological Society of London, External Professional Researcher*

EHV amongst European zoo equids, *Leibniz Institute for Zoo and Wildlife Research, External Professional Researcher*

Equine sarcoids in African wild equids, *European Endangered Species Programme (EEP) Research*

Evolutionary analysis of genetic variation in the serotonin transporter in primates, *University of Cambridge, External Professional Researcher*

Genetic sampling of Bermuda skinks, *University of Manchester, External Professional Researcher*

Gold Dust: uncovering the mystery of eyelashes, *University College London, PhD*

Inter-species variation in the corneal epithelial stem cell niche, *University of Liverpool, External Professional Researcher*

Investigations into fungal substrate preferences and fungus growth in *Atta cephalotes* at Chester Zoo, *University of Chester, BSc*

Investigating malaria in apes, *Welcome Trust Sanger Institute, External Professional Researcher*

Is behavioural research in zoos valuable for conservation efforts in the wild? *University of Leeds, BSc*

Keeper-animal relationships in a zoo setting, *University of Bolton, External Professional Researcher*

Molecular basis of melanism in the jaguar, *Anglia Ruskin University, External Professional Researcher*

Northern Bald Ibis research, *European Endangered Species Programme (EEP) Research*

Owl pellet dissection, *Coleg Cambria, External Professional Researcher*

Quantifying body shape and locomotor anatomy in birds, crocodylians and lizards, *University of Liverpool, PhD*

Scottish wildcat pelage and genetic studies, *European Endangered Species Programme (EEP) Research*

Scimitar Horned Oryx morphometrics and genetics, *European Endangered Species Programme (EEP) Research*

The evolution and conservation of domestic equids, *Complutense University of Madrid, External Professional Researcher*

Thermoregulation and welfare of captive Asian elephants, *Queen's University Belfast, External Professional Researcher*

To assess the incidence of Diabetes mellitus in wild and domestic dogs, *University of Liverpool, PhD*

University of Liverpool School of Veterinary Science Skeletal donation, *University of Liverpool, External Professional Researcher*

Undergraduate training Projects

Askham Bryan College

Does zoo visitor abundance and noise affect the behaviour of captive Giant Otters?

Bangor University

Does the rate of passing visitors affect the number of individuals expressing vigilance in captive Caribbean Flamingo (*Phoenicopterus ruber*) flock?

Effects of human interferences on the frequency of vigilance behaviours in *Phoenicopterus ruber* and *Phoenicopterus chilensis*

Vigilance in response to disturbance levels in Caribbean Flamingos (*Phoenicopterus ruber*) at Chester Zoo

Glyndŵr University

Does observer density affect the behaviour of captive chimpanzees?

Liverpool John Moores University

Does footfall affect the welfare of captive animals? (Species observed: Meerkat, Painted Dog; Chimpanzee; Columbian Spider Monkey; Brow-antlered Deer)

Comparative study of association patterns in several primate species in captivity?

The 'visitor effect': Does the number of visitors affect the behaviour of primate species? (Species observed: Mandrills and Columbian Spider Monkeys)

Manchester Metropolitan University

Social behaviour in captive chimpanzees

Studying movement in animals (27 students in total)

Reaseheath College

Impact of zoo visitors on the behaviour of Lar Gibbons at Chester Zoo

Impact of zoo visitors on the behaviour and enclosure use of the Red Pandas (*Ailurus fulgens*) at Chester Zoo

Royal Veterinary College/ZSL

Effects of visitor number and noise levels on the behaviour of zoo-housed Sulawesi Crested Macaques

University of Aberystwyth

Visitor effects on chimpanzees in captivity

University of Bournemouth

Positive behaviours in chimpanzees in captivity due to keepers, visitors and enclosures

University of Chester

Activity budgets of the Sitatunga

An investigation into the space utilization of *Elephas maximus* in relation to public presence

Behaviour and space utilisation in captive Okapi: An assessment of zoo visitor impact

Do habitats and visitors have an effect on different fish species in captivity?

Does aggression in chimpanzees occur more in the inside enclosure or the outside enclosure?

Does the behaviour of captive chimpanzees alter with public spectatorship?

Does visitor density affect enclosure utilization in chimpanzees?

Does the behaviour of chimpanzees *Pan troglodytes* differ between outdoor and indoor areas of their enclosure?

Does personality influence dominance rank in female chimpanzees?

Does the number of zoo visitors have an effect on the behaviour of ring-tailed lemurs?

Effects of visitor density on the behaviour of Asian Elephants (*Elephas maximus*) housed at Chester Zoo, England

Evaluating suitability and environmental complexity of vivaria for captive constrictive *Serpentes*

Feeding laterality and tail use in Spider Monkeys

How do visitor numbers affect Mandrill enclosure use and behaviour?

Impact of zoo visitor density on the behaviours of the Sumatran tigers (*Panthera tigris sumatrae*) at Chester Zoo

Life history traits, including defence mechanisms of swallowtail butterflies

Laterality of hand use in Chimpanzees (*Pan troglodytes*): Is hand preference stable and heritable?

Measuring the behaviour of the Sulawesi Macaques indoors and outdoors, applying with visitor effects

Mixed-species exhibits effects on individual behaviour and welfare (Species observed: Onager, Camel, Tapir, Capybara)

The effect of visitor numbers on the behaviour of Painted Dogs

To understand what behavioural patterns differ between juvenile and adult meerkats

The effects of visitors on the spider monkeys at the zoo: stressful or enriching?

The effects of visitors on Spider Monkeys at Chester Zoo: stressful or enriching?

The development and establishment of relationships between social animals (Species observed: chimpanzees)

The impact of enrichment on captive animals

The effects of zoo visitors on the behaviour and enclosure use of chimpanzees

The effect of zoo visitors on the behaviour and enclosure use of Asian elephants

Visitor effect and interest in a range of Aves: enclosure and education implications (Species observed: Andean Condor; Humboldt Penguin; Southern Cassowary)

Visitor effects on Humboldt Penguins *Sphensiscus humboldti*: the effect of various factors on penguin behaviour

Vigilance behaviours in the Sitatunga

University of Keele

Spectacle, Space and Charismatic Megafauna: Observing Bit Cats at Chester Zoo (Species observed: Cheetahs, Jaguar and Sumatran Tigers)

University of Nottingham

The social status, behaviour and association of the common chimpanzee at Chester Zoo

University of Worcester

Measuring the frequency and duration of play, friendly and aggressive behaviours, shown by captive chimpanzees in relation to enclosure design and enrichment

Antwis, R. E., **Fidgett, A. L.**, & Preziosi, R. F. (2015). Using science to improve ex situ husbandry of amphibians. [Oral presentation]. Paper presented at the 8th European Zoo Nutrition Conference, 22-25 January 2015, Arnhem, The Netherlands.

Antwis, R. E., Michaels, C. J., Preziosi, R. F., & **Fidgett, A. L.** (2015). Understanding the interactions of diet and lighting on frogs and their symbiotic bacteria to improve ex situ husbandry of amphibians [Oral presentation]. Paper presented at the 11th AZA Nutrition Advisory Group Conference on wild animal nutrition, 27 -30 September 2015, Portland, USA.

Atencia, R., Stohr, E., Drane, A., Stembridge, M., Howatson, G., Lopez del Rio, P. R., Feltrer, Y., Tafon, B., Redrobe, S., Peck, B., Eng, J., **Unwin, S.**, Sanchez, C., & Shave, R. (2015). Hemodynamic responses to four different anaesthetic protocols in wild-born captive chimpanzees. *Journal of the American Veterinary Medical Association*, In Press.

Barton, C. (2015). Influencing the palm oil sector through effective partnerships [Poster presentation]. Paper presented at the Zoos & Aquariums Committing to Conservation (ZACC) Conference, October 2015, Denver.

Barton, C. (2015). Influencing the palm oil sector through effective partnerships [Poster presentation]. Paper presented at the BIAZA Research Conference, 7-8 July 2015, Dublin.

Barton, C., & **Unwin, S.** (2015). Influencing the palm oil sector through effective partnerships [Oral presentation]. Paper presented at the UN-GRASP Regional congress on Orangutan conservation, Kota Kinabalu, Sabah, Malaysia.

Bazley, S. (2015). Investigating the impact of interactive educational initiatives on visitors in a UK Zoo [MSc dissertation]. The Open University.

Bird, S. (2015). Partners for Pine Martens [Oral presentation]. Paper presented at the BIAZA Conservation Conference, 7-8 December 2015, Bristol.

Chang, B. (2015). Encouraging feedback-seeking in the workplace through contemplation [Report]. Sheffield, University of Sheffield.

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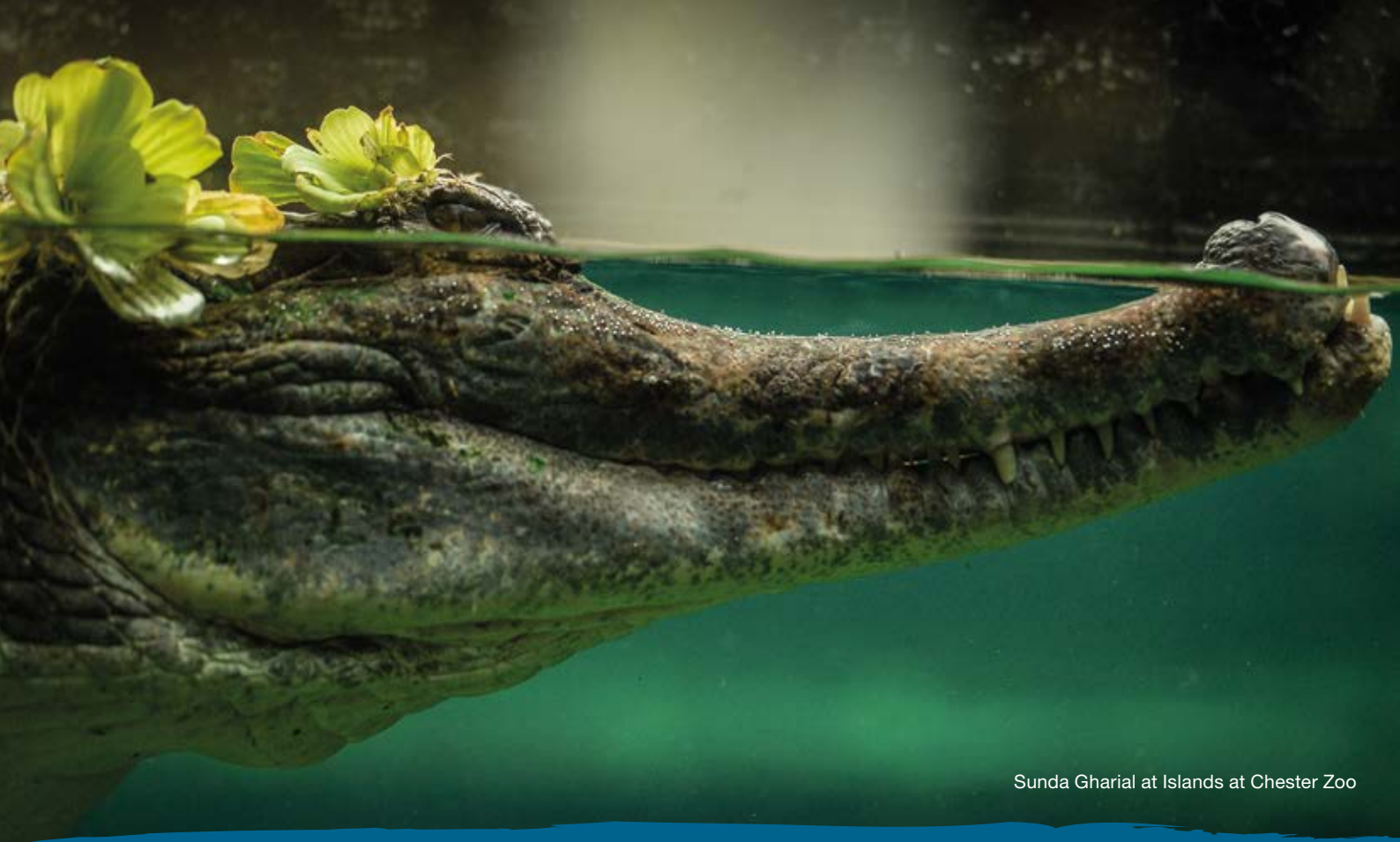
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Sunda Gharial at Islands at Chester Zoo



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