Institute of Zoology

Science for Conservation
Annual Report of the Institute of Zoology 2011/12
**IOZ Research Strategy**

**Our Aim**

To undertake and promote relevant high quality zoological and conservation research, to help ZSL achieve its conservation objectives and to inform and influence conservation policy.

**Our Objectives**

1. Encouraging and rewarding excellence in the performance and communication of science, conservation and animal husbandry.

2. Attracting and engaging a diverse range of people and organisations in the science of zoology and conservation – from students to leaders in their field.

3. Using our unique convening role as a leading learned society to foster and achieve international excellence in science relevant to our core conservation priorities.

4. Managing and developing a relevant and useful body of zoological knowledge.

5. Providing policy makers, conservationists and the general public with the information needed to make informed decisions on conservation issues.

6. Raising the profile of conservation issues and priorities, and ensuring they are well represented at policy level and in the media.

**Our Activities**

**HEFCE funded programme**

With the Zoological Society of London (ZSL)

- **Science Plan**
  - Biodiversity patterns and processes
  - People and the environment in a changing world

**Reproductive monitoring**

- Annual programme of evening Scientific Meetings
- Biannual international symposia on topical themes in conservation biology
- Technical publications to support best practice in zoos (International Zoo Yearbook) and in field conservation (Conservation Reports)

**HEFCE funded programme**

With the University College London (UCL)

- **Science Plan**
  - Biodiversity and macroecology

- **Consortium**
  - Biodiversity, Evolution and Environment

- **Other activities**
  - Journal of Zoology and Animal Conservation
  - Feedback reports: Promoting best practice in zoos and field conservation

**With other organisations**

- **With institutions in London**
  - We maintain and develop research links with Genetics, Evolution and Environment, and other relevant departments at UCL.

- **With other organisations**
  - We collaborate with most relevant outside bodies for our core research interests.

**With other organisations**

- **With the Zoological Society of London (ZSL)**
  - We respond to research questions and contribute to ZSL’s Conservation Programmes.

**With other organisations**

- **With other organisations**
  - We contribute to London-wide activities in ecology and evolution through membership of the Centre for Ecology and Evolution.
In the last twelve months, the Earth's human population passed the 7 billion mark. More than three times as many people are alive today compared with when I was born in the late 1930s. All of these people need the basic essentials of life – food to eat, clean water to drink, clothes to wear, somewhere to call home. This in turn places increasing pressures on the finite resources and productive capacity of our planet. As more land is turned over to agriculture and industry, more rivers are dammed for power, diverted for irrigation and tapped for drinking water, and more of the ocean is fished, the wilderness and the wildlife it supports disappears rapidly. Wild spaces are increasingly being reduced to a series of protected islands in a sea of human transformation. Even these protected areas are under a growing threat from incursions by people and non-indigenous species, and from climate change.

If humanity is to co-exist with wildlife, answers are needed to some basic questions about nature and the effects that humans have on it. Wildlife must be monitored to find out which populations, species and ecosystems are under most threat. Where wildlife is disappearing, why exactly is this happening? Once conservation scientists know what is driving the decline of a species or population, they must work out how to stop or reverse that decline, turning their knowledge of that system into practical action. These issues provide the motivation for much of the work carried out by the scientists at the Institute of Zoology. The pages that follow describe some of the ways in which their science identifies and addresses some of the fundamental problems facing animals and their habitats around the world.

The Institute of Zoology is a small organisation, with about 100 staff and students working on conservation science. It could not do nearly so much of this important work without the support of its many partners in research and education (a full list of these takes up pages 35–39), most notably through its academic affiliation with University College London, and the equally dedicated staff in ZSL’s Conservation Programmes and Living Collections. It could also not function without support from the wide range of organisations that fund its research (pages 30–31). I should like to take this opportunity to thank all of these partners for their continued support of the Institute.

Professor Sir Patrick Bateson
President of the Zoological Society of London
London has long been the world centre of biological research, and still represents, by a considerable margin, the world’s largest single conglomeration of biodiversity researchers. It has huge resources of preserved material in the Natural History Museum, at the Royal Botanic Gardens, Kew, at the Linnean Society, and at the Zoological Society. It is home to several of the world’s foremost halls of academia in the colleges of the University of London, with various departments ranking as international centres of expertise in ecology, evolution, taxonomy, genetics, palaeontology and conservation. In an era of concern about environmental change, its place at the heart of political power adds to London’s importance as an international hub for biodiversity issues.

London is of course also home to the Institute of Zoology. As one of the world’s foremost independent conservation research organisations, it makes sense that we should look for ways to integrate more closely with the huge array of research expertise on our doorstep, and this is something we are always seeking to do. In 2011, we took a major step in that respect by formally changing our university partnership, to become affiliated with University College London. A formal partnership with a university is a condition of our core government funding, and for the past decade we had been affiliated with the University of Cambridge. The relationship with Cambridge had been positive and useful and had resulted in many excellent research collaborations, but really close ties between the two organisations had been hampered by our geographic separation. Moreover, while the interests of the two organisations were very similar, the review of Institute research carried out in 2010 by HEFCE had highlighted that more opportunities lay in complementarity than in overlap. We did not take the decision to part ways lightly, but I am pleased to say that Cambridge understood our reasons, and that we parted amicably.

The new affiliation links us to another of the world’s leading universities. UCL is a major European focus for biological and biomedical research, with active programmes in evolutionary biology and environmental research. Its Centre for Mathematics and Physics in the Life Sciences and Experimental Biology (CoMPLEX) programme has established a successful interaction between biology and mathematics, and its Environment Institute and Centre for Biodiversity and Environmental Research are concerned with many aspects of global change. We are very excited about this new relationship, and the new challenges and opportunities that it brings.

Tim Blackburn
Director of the Institute of Zoology
This year saw the introduction of a new Research Theme at the Institute. The Evolution and Molecular Ecology Theme, headed by Trent Garner (below), will focus on the evolutionary processes that shape biodiversity across systems and at all scales. In addition to molecular genetics, the research will involve experimental ecology, modelling, long-term population studies, behaviour and the development of theory, amongst other methods and approaches. Much of the research falls under three broad topics: genetic variation and distribution; the genomic basis of phenotypic plasticity; and co-evolution.

2011 also saw the retirement of the Institute’s longest-serving staff member Daphne Green (above), who joined ZSL in 1966 to work in the Nuffield Institute of Comparative Medicine. Daphne became an expert on radioimmunoassay and ELISA assays, and ran one of only two labs in the UK that could carry out faecal hormone analyses in wild species. We wish her well in her retirement.

In 2011 ZSL received a generous legacy gift of £110,000 from Edna Groves (below) to further research carried out at the Institute. Born in Brixton, Edna’s father worked as a policeman at Albany Street Station. As a member of the constabulary her father could visit the Zoo for free and Edna was a regular visitor. Edna became a Lifetime Fellow of ZSL and visited IoZ, where she discussed research projects with staff. We are very grateful for Edna’s generosity, which will support research and conservation science at the IoZ.

In April Senior Research Fellow Kate Jones (left) moved to University College London as Chair of Ecology and Biodiversity in the Department of Genetics, Evolution and Environment. Kate will hold a joint appointment with the Zoological Society of London. In her new post, she will continue her research into processes that drive global patterns of biodiversity, and continue to develop innovative ways to monitor biodiversity.
monitoring, and genetic and health management. The book considers a wide range of taxa, although there is a predominance of bird and mammal studies that reflects the published research in this field. The structure and content are designed to be used by people wanting to bridge the research-management gap, such as conservation managers wanting to expand their thinking about reintroduction-related decisions, or researchers who seek to make useful applied contributions to reintroduction.

IoZ scientists John Ewen, Karina Acevedo-Whitehouse, Tony Sainsbury and Rosie Woodroffe contributed to the chapters focused on health management.

Becki Lawson (left) was awarded funding from the Winston Churchill Memorial Trust to visit institutions in the USA specialising in wildlife disease investigation and health surveillance. Becki’s project, ‘Optimising a citizen science approach to national wildlife health surveillance’, aims to develop her research for the Garden Bird Health initiative. Becki used the Travel Fellowship to visit scientists at Cornell, Princeton and Tufts universities and the National Wildlife Health Center, Madison, to gather information that she can use to expand public-based wildlife health surveillance in Britain.

In July IoZ researchers Nathalie Pettorelli (above right) and Seirian Sumner (above left), with support from the L’Oréal-UNESCO For Women in Science programme, brought together some of the UK’s most prominent women scientists for the third Soapbox Science. Held at London’s Southbank, the event aims to showcase UK women in science and inspire the next generation of scientists, giving them the confidence to push through existing barriers, and help change societal norms that often stand in the way of women in science.

John Ewen co-edited a new book on reintroduction biology, which was published in January 2012. The book brings together contributions from reintroduction experts around the world, and uses an issue-based framework that advocates a strategic approach to reintroduction. The authors recommend that all actions should be guided by explicit theoretical frameworks and based on clearly defined objectives. Issues covered include husbandry and intensive management,
Professor Bill Holt left the institute last year, leaving behind him a 40 year legacy of successful Reproductive Biology research at ZSL. We have been privileged to host such a dedicated and insightful scientist who, together with his numerous colleagues, made a significant impact on this important field. His enthusiasm and gentlemanly approach has earned him great respect across the world and we thank him for his contribution.

Bill joined ZSL in 1969, obtained his PhD from the Royal Veterinary College in 1979 and headed the Reproductive Biology Research Group from 1995. In addition, Bill served as Acting Director for the Institute of Zoology between 1999 and 2000, and again from 2006 to 2007, and continues as an ex-officio member of the ZSL Ethics Committee. During his career, Bill has published over 220 journal articles, conference papers and books and has been awarded over £4 million in grant income. His research advanced our knowledge of the biology and preservation of semen and the use of reproductive biotechnologies in the conservation of wild species. In recognition of his contributions to the field, Bill was awarded the 2011 Brian Setchell Medal by the British Andrology Society. Bill has long been involved with international efforts to promote and coordinate the applications of genome resource banking for conservation, through the Frozen Ark Project and the Health and Safety Committee of the International Embryo Transfer Society. Bill has successfully supervised numerous PhD and MSc students and continues to be an excellent scientific mentor, colleague and friend to many. His influence extends well beyond ZSL too, with Bill being awarded Honorary Professorships at University College London, the Royal Veterinary College London and the University of Bedfordshire. He is also an Honorary Research Associate of the Smithsonian Institute, USA. Bill now joins the University of Sheffield as a Visiting Professor and continues to supervise two PhD students, one at Brunel University and one at the University of Portsmouth.
Over the year research undertaken at IoZ has continued to improve our understanding of zoological process and respond to a wide range of conservation issues. As a result of this work, some of which is described below, ever-more accurate predictions about population changes in the light of environmental pressures can be made.

**Unintended consequences of conservation actions: managing disease in complex ecosystems**

Infectious diseases are a serious threat to biodiversity and vaccination can be used to successfully protect affected species from it. However, single species are always part of a larger group, called communities, with which they interact. Therefore, conservation actions for one species could potentially affect the survival of another. When both species are known to be at risk of extinction, it is important to understand how protecting one from disease may endanger the other. We used two threatened carnivores cohabiting in the Serengeti as a case study: lions and cheetahs. In this ecosystem, lions are threatened by regular outbreaks of the Canine Distemper Virus (CDV) which can kill a third of the population at once. Cheetahs are not affected by CDV, but, because lions are known to have an important impact on cheetah numbers, we wanted to investigate how removing CDV, thus protecting lions, may impact cheetah numbers. Using mathematical tools and computer simulations, we found that by removing CDV, the risk of extinction for the cheetahs could be almost doubled. We demonstrated the potential for unintended consequences of conservation actions when those are targeted at a single species.


**Investing in evolutionary history**

Decision-making about the focus of conservation investment has become a central part of both academic research and conservation action. It has been strongly argued that maximising phylogenetic diversity should be one of the main goals of priority-setting for conservation. There are two main arguments for choosing prioritisation techniques that aim to conserve the maximum possible amount of evolutionary history. The first is a pragmatic perspective; phylogenetic distinctiveness (PD) is a compound metric of all forms of genotypic, phenotypic (‘feature’ or ‘character’ diversity) and functional diversity, both measurable and unmeasurable, so maximising PD thereby provides biological systems with the most options to respond to a changing world. The second is from more of an ethical perspective, whereby maximising the conservation of PD best preserves the immense history of the Earth.

We evaluated how one measure of evolutionary history developed at ZSL (EDGE) has been implemented in mammals. We assessed how robust this method is to changes in knowledge of taxonomy and extinction risk, and examined how mammalian species that rank highly in EDGE score are representative of the collective from which they are drawn. We found that the majority of the changes in species ranks between this and the previous version of the EDGE list were due to changes in Red List status. The 195 changes in mammal conservation status, which principally represent changes to more threatened categories of Red List status, are of serious concern; they are leading to a net deterioration in...
conservation status across the group and an erosion of biodiversity. This study also revealed the number of reassessments of mammalian species extinction risk category owing to non-genuine impacts on status, such as changing taxonomy, new information and reassessment of the quality of existing data used for assessments in the light of new understanding. While such changes are potentially problematic for priority-setting schemes, such as EDGE, the expanding knowledge of species conservation status is undoubtedly a positive advance for conservation.

By avoiding priority lists that are dominated by highly threatened species, an approach that uses a roughly equal weighting of extinction risk and PD buffers high-ranking species from change, in cases such as mammals where the range of the two component scores is similar (roughly two orders of magnitude). TheEDGE programme (www.edgeofexistence.org), which implements practical on-the-ground conservation actions for focal species from the top 100 list of EDGE species, makes use of this benefit.

A genomic approach to the spread of ranavirus in the UK

Amphibians are in the midst of a particularly striking extinction crisis and considerable research into ranaviruses and other parasites has revealed the significant impact of infectious diseases. The UK public has been reporting unusual die-offs of the common frog *Rana temporaria* for over 25 years, with reports initially localised to south-east England but now widespread. Ranavirus, a large double-stranded DNA virus of the family Iridoviridae, was shown to be the cause of these mass mortalities in the early 1990s and research into the pathogen has continued at IoZ since. We have used cell culture to isolate virus from diseased amphibians from different time points, host species and locations and are currently using next generation sequencing technologies to acquire whole genome sequences of these isolates. This genomic approach offers insights into the UK origins and spread of these viruses as well as adaptations to new hosts and localities. The collection of further frog mortality reports from members of the public has also been an ongoing project (the Frog Mortality Project) between IoZ and the amphibian conservation charity, Froglife. We now have a database of more than 5,000 reports spanning 20 years, with data on mortality, pond and local habitat management. These data are being modelled within a cutting edge spatio-temporal framework to evaluate contrasting hypotheses explaining UK ranavirus emergence, including the modifying effect of climate change on an endemic pathogen and spread via human-mediated translocations.

Analysing disease risks associated with translocations

Translocations are expected to be used increasingly to counter the undesirable effects of anthropogenic changes to ecosystems, including loss of species. Methods to assess the risk of disease associated with translocations have been compiled in a comprehensive manual of disease-risk analysis for movement of domestic animals. In a recent study this manual was used to devise a qualitative method for assessing the probability of the occurrence of disease in wild animals associated with translocations. The analyses included hazards present throughout the translocation pathway derived from the interactions between host immunity and the parasite, the effect of parasites on populations, the effect of non-infectious disease agents, and the effect of stressors on host–parasite interactions. We used the reintroduction of Eurasian cranes *Grus grus* to England to demonstrate our method. Of the 24 hazards identified, one was classified as high risk and five were medium risk. Seventeen other hazards were considered low or very low risk. In the absence of better information on the number, identity, distribution and pathogenicity of parasites of wild animals, there is uncertainty in the risk of disease to translocated animals and recipient populations. Surveys of parasites in source and destination populations and detailed health monitoring after release will improve the information available for future analyses of disease risk. It is intended that this method can be adapted to assess the risks of disease in other translocated populations.
Research at the Institute of Zoology is organised into four Research Themes:

**Biodiversity and Macroecology** page 10

**Behavioural and Population Ecology** page 12

**Evolution and Molecular Ecology** page 14

**Wildlife Epidemiology** page 16

Each Research Theme group is made up of several research fellows, postdoctoral research assistants and PhD students, and is led by a Senior Research Fellow or Professor. Most staff work across several Research Themes in broad internal and external collaborations.

The following pages outline some of the outcomes of current research programmes in each theme.
New analytical approaches to maximise the value of camera trap data

Camera traps are devices designed to capture images of wild animals automatically by linking a camera to a movement sensor. This enables researchers to see which species are present in an area, how abundant they are, and what they are up to, without having to be present, providing a window on the lives of animals that are too rare or shy to observe directly. While camera traps have been around for over a century, with the advent of mass-produced, low cost models, they have become a central tool for anyone seeking to study, monitor or conserve many species of animal. However, the full potential of camera traps has yet to be realised, and these two papers are part of a series developing new analytical approaches to extract the maximum value from camera trap data. Rowcliffe et al. (2011) show how the positions of animals relative to the camera in images can be used to quantify the sensitivity of camera traps, giving an example where the distance that cameras can ‘see’ is effectively greater for larger species, and during drier weather. The ability to measure camera sensitivity is important because this variable is a key determinant of the rate at which records of a given species accumulate, so controlling for sensitivity will help to extract an unbiased index of animal abundance from trap rate data. Rowcliffe et al. (2012) use information on the patterns of movement in front of the camera in order to quantify the sinuosity of animal movement paths, and use this information to quantify the extent to which traditional radio-tracking studies underestimate total distances moved by animals. Distance moved is an important behavioural-ecological variable, linking to energy use and the mechanisms of population persistence. However, this study suggests two- to ten-fold under-estimation in existing radio-tracking studies, highlighting a need for improved methods in this area.


Postcopulatory mechanisms of inbreeding avoidance in the hihi

A high number of threatened bird species occur on islands, particularly in small, isolated populations. Inbreeding is common in these populations and often has negative repercussions on individual fitness and genetic variation. Where costly inbreeding has the potential to occur, natural selection is predicted to favour mechanisms to avoid mating between close relatives. We have previously shown inbreeding depresses hatching success and nestling survival in the hihi Notiomystis cincta. We have now tested whether female hihi have evolved mechanisms to avoid mating with their close relatives. Hihi are a highly promiscuous species, but do form social pair bonds with a single male. Therefore, females could avoid mating with relatives in two ways, either by choosing less related social male partners to breed with or by fertilising their eggs with sperm from less related extra-pair individuals. We found that females do not discriminate against related males to form social pair bonds, but their offspring are fathered by less related individuals. This suggests female hihi have postcopulatory mechanisms of inbreeding avoidance. There are a number of mechanisms that could explain our findings: for example, higher compatibility and fertilisation success between less related gametes, sperm ejection.
The proposed unified framework for biological invasions. The proposed framework recognises that the invasion process can be divided into a series of stages, that in each stage there are barriers that need to be overcome for a species or population to pass on to the next stage, that species are referred to by different terms in the terminology depending on where in the invasion process they have reached, and that different management interventions apply at different stages. Different parts of this framework emphasise views of invasions that focus on population, process, or species. The unfilled block arrows describe the movement of species along the invasion framework with respect to the barriers.

A proposed unified framework for biological invasions

The last two decades have seen an explosion of research on human-mediated species invasions. However, invasion biologists have pursued their research using a great variety of terminologies, dissecting and pursuing the invasion process in different ways. This is problematic because it hinders comparison of patterns and processes in invasions, and leads to the reinvention of concepts and hypotheses. Much of the difference stems from taxonomy: most plant ecologists adopt a framework that views invasions as a series of barriers that a species negotiates to become invasive, while most animal ecologists adopt a framework that views invasions as a series of stages that a species must pass through on the pathway from native to invasive alien.

We proposed a unified framework for invasion biology that combines the key elements of the barrier (plant) and stage (animal) models, and that can be applied to all human-mediated invasions. Amongst the insights provided by the new framework are that the stage and barrier models differ in focus rather than substance: the animal framework focused on the status a species attains, while the plant framework focused on the barriers to progress from one state to the next. The unified framework also shows how a terminology for invasion biology maps onto both stages and barriers. This helps to clarify to which stages in the invasion process different terms refer, which has important implications for streamlining the transfer of research results to management of invasions for conservation. Moreover, the framework allows different management measures to be mapped onto the invasion process. This helps to clarify the responses to invasions that are most likely to be relevant or successful at different stages, and hence where the responsibility for different management interventions is likely to lie.

Determinants of species abundance in the Quaternary vertebrate fossil record

Researchers interested in using the recent fossil record to understand past ecosystems typically want to know not only which species existed when the fossil deposits were formed, but also wider information about their former abundance and rarity. However, the process of fossilisation is inherently biased, meaning that patterns of abundance shown by species preserved in the fossil record are very unlikely to match true patterns of abundance in original prehistoric faunas. This problem is compounded by the fact that nearly all of the ecosystems represented in the fossil record bear little relationship to anything still around today, making it very difficult to tease apart the biases in the fossil record and clarify the nature of the relationship between past abundance and fossil abundance. Studies of the very recent prehistoric past provide a unique opportunity to understand this important problem. In particular, fossil assemblages deposited since the end of the last Ice Age glaciation, during the Holocene interval, represent species that lived in environments extremely similar to today. By looking at the well-documented Holocene bird fossil record from Sweden, and comparing patterns of abundance of bird fossils with the modern Swedish avifauna, we reveal that likelihood of being preserved in the fossil record is indeed related to abundance in source communities. However, a far more important predictor of fossil abundance is body size — large-bodied species are much more likely to be preserved than smaller species. These findings have important implications for using the Holocene record in establishing environmental baselines for restoration ecology.


Our research in behavioural ecology and population ecology has two major interlinked aims: to test fundamental hypotheses in behavioural and population ecology and to use our knowledge of the behavioural and population ecology of wild species, and the human populations that interact with them, to inform conservation policy and management.

Jealous females?
In the mating game, males are traditionally viewed as competitors, while females are portrayed as choosy. However, there is now mounting evidence of more flexible sex roles for males and females. We explored patterns of competition between females in an animal society where both males and females occupy conventional sex roles (where males are the primary competitors and females invest most in reproduction) – and thus where mating was in consortship (a ‘mate-guarding’ association with a male partner who defends exclusive mating access to the female). Further work is now required to establish whether such aggression reflects an attempt by females to suppress the reproduction of their competitors, or whether this pattern might arise incidentally, since receptive females tend to be more active in the centre of the group and might therefore be more exposed to aggression from others. These findings reveal the importance that sex can have in shaping female social relationships in animal societies, and further suggest that access to mates may represent an extra cost of sociality to females.


Contact between endangered African wild dogs and domestic dogs: opportunities for pathogen transmission
Infectious diseases seriously threaten the populations of many endangered mammals, including African wild dogs *Lycaon pictus*. Extinction risks may be particularly high where the endangered host lives alongside a more abundant host species which can maintain infection with virulent pathogens. Domestic dogs *Canis familiaris* are often assumed to act as such ‘reservoir hosts’ for pathogens threatening wild dogs. We studied the densities and movement patterns of both domestic dogs and African wild dogs in a Kenyan rangeland, using Global Positioning System-collars and conventional radiotelemetry. Wild dogs lived at low population densities, and direct encounters between packs were rare. In contrast, domestic dogs lived at higher densities and encountered one another more frequently. These differences suggest that directly transmitted virulent pathogens would be more likely to persist within populations of domestic dogs than within wild dog populations. However, wild dog populations alone might maintain pathogens that are indirectly transmitted.
transmitted through vectors or environmental persistence. The risk of contact between the two host species was limited by their behaviour: domestic dogs were associated with human settlements, which would dogs avoided. Clustering of settlements, reflecting grazing traditions of local pastoralists, accentuated these patterns. Our study suggests that spillover of directly transmitted pathogens from domestic dogs to wild dogs might be frequent, which may explain the recent growth of the local wild dog population despite sporadic cases of rabies.

Mitigating the threat of disease is challenging, partly because uncertainty about disease dynamics makes it difficult to identify the best management approaches. Serious impacts on susceptible populations most frequently occur when generalist pathogens are maintained within populations of abundant reservoir hosts, and spill over into less abundant host species. We investigated interspecific and intraspecific transmission routes by comparing African wild dogs' exposure to six canine pathogens with behavioural measures of their opportunities for contact with domestic dogs and with other wild dogs. Domestic dog contact was associated with exposure to canine parvovirus, *Ehrlichia canis*, *Neospora caninum* and perhaps rabies virus, but not with exposure to canine distemper virus or canine coronavirus. Contact with other wild dogs appeared not to increase the risk of exposure to any of the pathogens. These findings, combined with other data, suggest that management directed at domestic dogs might help to protect wild dog populations from rabies virus, but not from canine distemper virus. However, further analyses are needed to determine the management approaches which are most appropriate for each pathogen.

The interaction between seaweed farming as an alternative occupation and fisher numbers in the central Philippines

Conservation in developing countries is often faced with tackling unsustainable exploitation of natural resources. The development of alternative sources of income is frequently promoted as an approach to reduce the number of people exploiting natural resources in the context of poverty. This approach is often based on the assumption that the rural poor exploit natural resources because they have no other options, and that if provided with more lucrative alternatives they will stop exploiting natural resources. Although this approach has been widely adopted in conservation projects, there has been very little assessment of its conservation impacts. We analysed the impact of an alternative occupation (seaweed farming) on fisher numbers in 10 communities on Danajon Bank, central Philippines. We wanted to know how seaweed farming had influenced fisher numbers. As historical records of fisher numbers are lacking, we developed two approaches to determine how fisher numbers had changed over time and the influence of seaweed farming. The results were mixed. Seaweed farming had reduced fisher numbers in some villages, a result that may be correlated with socioeconomic status, but in others there were increases in fisher numbers in line with human population growth. The heterogeneity of outcomes is consistent with suggestions that alternative occupations are not a substitute for direct conservation measures.

Natural population die-offs: causes and consequences for terrestrial mammals

With extreme climatic events expected to occur more frequently and with greater intensity in the coming decades, there is increasing awareness that such events represent a growing threat to biodiversity. In particular, extreme natural events, such as cyclones, droughts and floods, have been shown to trigger episodes of high mortality in wildlife populations in relatively short time-windows. These population die-offs have been documented across different taxonomic groups and in a wide range of circumstances; yet, a consensus on how to define them has not emerged and the elements favouring the occurrence of these abrupt population losses remain surprisingly understudied. These issues hamper our ability to identify populations most at risk. Our study provided a functional definition of natural population die-offs, an assessment of extrinsic and intrinsic processes shaping these die-offs, and a framework for assessing the vulnerability of terrestrial mammals to natural and anthropogenically caused extreme events. With this framework, we hope to identify populations most at risk and support previous efforts to assess the vulnerability of species to climate change.


The Evolution and Molecular Ecology Research Theme aims to deepen our knowledge of the evolutionary processes that shape biodiversity across systems and at all scales. Although the tools of molecular genetics are commonly employed by members of the theme, projects also involve experimental ecology, modelling, long-term population studies, behaviour and the development of theory, amongst other methods and approaches, to inform conservation practice and policy and add to our basic understanding of evolution.

Inbreeding and inbreeding depression of early life traits in a cooperative mammal

Mating between relatives, or inbreeding, often results in inbreeding depression in which inbred offspring are smaller in size and/or have lower survival. Until recently, most inbreeding research has been conducted on captive or laboratory species but there is a growing awareness of the importance of studying inbreeding in the wild in order to better understand the interplay of inbreeding with natural environmental conditions. To date, inbreeding has been little studied in cooperative breeders, where the close proximity of kin is generally expected to have led to the evolution of inbreeding avoidance mechanisms. We collaborated with scientists from Cambridge and Zurich to analyse skin samples collected in the Kalahari from large numbers of individually recognisable meerkats Suricata suricatta. We have established a genetic pedigree and used this to explore the effects of inbreeding on variation in growth, behaviour and survival. This research has shown that nearly half of the population of meerkats is inbred to some extent. Furthermore, we have shown that inbred pups weigh less, are smaller, grow at reduced rates and have lower survival than outbred pups. Previous studies on other wild populations of animals have found evidence for the effects of inbreeding being more pronounced in stressful environmental conditions. In meerkats, where helpers play a large role in raising the dominants’ pups, the social setting is an important component of a meerkat’s environment. Our study showed some tentative evidence for the positive effects of the social environment in ameliorating the effects of inbreeding depression such that inbred pups reared in groups with more helpers suffered from less pronounced inbreeding depression. Although we found a higher than expected level of inbreeding in meerkats, very close relatives appeared to avoid inbreeding and future work on the same population may reveal how meerkats achieve close kin recognition. All data for this study comes from the Kalahari Meerkat Project, which was established primarily in order to conduct research on the evolution of cooperative behaviour. The study system was established and continues to be run by the Universities of Cambridge and Zurich, while this particular research was funded by a NERC PhD grant through the University of Edinburgh.

Estimating selfing from genetic marker data

Many plants and some invertebrate animals (e.g. snails, earthworms, molluscs) are hermaphrodites and can do self reproduction to different degrees. For such species, it is of great interest to know the proportion of progeny derived via self-fertilisation (selfing rate), its variation among individuals, populations and species, and to understand the causes of this variation. Methods have been developed to estimate the selfing rate of a population from a sample of individuals genotyped for several marker loci. These methods are based on the homozygosity excess (or inbreeding) or/and identity disequilibrium at marker loci, assuming perfect genotype data (without errors and mutations), the absence of biparental inbreeding and the presence of inbreeding equilibrium. In practice, however, these assumptions are often violated, which leads to biased selfing rate estimates. We propose a new method to reconstruct the pedigree of a sample of individuals taken from a monocious diploid population practising mixed selfing and outbreeding reproduction, using multilocus genotypic data. Selfing and outcrossing events are then detected when an individual derives from identical parents and from two distinct parents, respectively. Selfing rate is estimated by the proportion of selfed offspring in the reconstructed pedigree of a sample of individuals. The method accommodates genotyping errors, and is robust to biparental inbreeding and inbreeding disequilibrium. Both simulated
Global habitat suitability for seven octocoral suborders, showing the global hotspot for octocorals in the Northeast Atlantic.

Accuracy (measured by root mean squared errors of estimates over 100 replicates, RMSE) of four methods (new method; inbreeding method; inbreeding disequilibrium method; InStruct method) as a function of the actual simulated selfing rate. Fifty offspring are taken at random from a population, with each offspring genotyped at 10 loci, each having 10 alleles with frequencies in a uniform Dirichlet distribution.

and empirical data were analysed by the new and previous methods to compare their statistical properties and accuracies. The new method is found to be more robust and accurate than others in various situations, and to be more accurate by several fold in some cases.

Shifting behaviour: epigenetic reprogramming in eusocial insects

They fight, punish, reward and coerce their friends. They are promiscuous, selfish, altruistic, deceptive and manipulative. They are farmers, predators and scavengers. They dispense law and order. Eusocial insects – bees, wasps, ants and termites – are the soap opera stars of the non-human animal kingdom. Much of that behaviour centres around an extreme division of labour, with individuals becoming queens, workers and sometimes soldiers. Once it starts, this process is usually irreversible – much as embryonic stem cells have no alternative but to become part of a kidney or cartilage once the biological ‘switch’ is thrown. Recent research into honeybees and other social insects is painting a fascinating picture of the mechanisms that underlie those processes in both insects and cells. We develop a conceptual framework that seeks to unite these processes at the regulatory level of the genes.

Social insect castes and cell differentiation are examples of plasticity in the phenotype. The same genome allows for different behaviours (in insects) and cell functions through a reprogramming of the expression of shared genes. We know quite a lot about cell differentiation: a key process is the chemical ‘tagging’ of a creature’s DNA that does not affect its sequence (that is, above and beyond the DNA sequence, or epigenetic) and helps control both reprogramming and cell commitment. The question that we discuss is whether the processes before, during and after the ‘switch’ at both the cellular and colony levels of biological organisation are controlled by similar epigenetic mechanisms. These are really exciting times for sociobiologists, with the powerful idea that the punctuated epigenetic landscape controlling caste differentiation may well be the same as that which controls cell differentiation – and that the same ancient molecular regulatory processes have been co-opted to produce the fascinating array of social complexities in insects as well as cells.

Global habitat suitability of cold-water octocorals

Three-quarters of Octocoralia species are found in deep waters. These cold-water coral colonies can form a major constituent of structurally complex habitats. The global distribution and the habitat requirements of deep-sea octocorals are poorly understood due to the expense and logistic difficulties of sampling in the deep sea. We used habitat suitability modelling to predict global deep-sea octocoral distribution using a database of geolocated specimens and environmental data, such as ocean temperature currents. Many octocorals utilise a form of calcium carbonate called calcite in the construction of parts of their skeleton. In order to efficiently extract calcite from the water column, the concentration of calcite needs to be high. More than 97% of octocoral records were found in waters saturated or supersaturated for calcite. The calcite saturation state was found to be a key factor in determining habitat suitability. This result has implications for the future of many octocorals as ocean acidification is known to reduce the calcite saturation state. All seven octocoral suborders demonstrated a habitat preference for continental shelves and margins, particularly the North and West Atlantic and Western Pacific Rim. We suggest that approximately 17% of oceans are suitable for at least one suborder but 3.5% may be suitable for all seven. The resulting distribution estimates create a useful resource for researchers, managers and conservationists.
transmission to new hosts bitten. Such ‘vector competency’ was assessed using the WN02 virus clade, with the effect of temperature examined by incubating mosquitoes at either 27°C or 30°C prior to testing groups at various time points post-exposure. The results showed that C. quinquefasciatus has a moderate ability to be a WNV vector, its competence being comparable to USA strains of this mosquito. Rates of infection, dissemination and transmission all increased with time post-exposure to WNV, and after 28 days, 44% of mosquitoes tested could transmit the virus. Vector efficiency (i.e. the proportion of basic ingested infections that result in salivary transmission ability) increased from 14 days. Temperature significantly increased the proportion of mosquitoes infected, but not their transmission of WNV. Thus, we found limited indication that there would be seasonal differences in transmission. We demonstrate that Galapagos C. quinquefasciatus is a competent WNV vector, and therefore should be considered an animal and public health risk for the archipelago and controlled wherever possible. Future steps will examine further species of mosquito in Galapagos, and their biting behaviour, to help determine whether WNV would circulate in this important conservation region.

Multiple emergence of genetically diverse amphibian-infecting *Batrachochytrium dendrobatidis*

Since the discovery of the amphibian-infecting pathogenic fungus *Batrachochytrium dendrobatidis (Bd)* during the 1990s, it has been found on every continent on Earth except Antarctica, and is responsible for dozens of extinctions and local extinctions. One of the puzzling aspects of the disease has been the extremely high genetic similarity found between isolates from diverse habitats worldwide. We examined the genomes from a global panel of *Bd* isolates both from amphibian habitats experiencing die-offs (such as the recent mountain chicken *Leptodactylus fallax* epizootic on Montserrat), and others that only harbouried the disease. By doing so, we identified three separate and divergent lineages that we have named *BdGPL*, *BdCAPE* and *BdCH*. Our data show that *BdGPL* is the most common lineage (found on all five continents we tested) and also the type associated with mass-mortalities and extinction. We therefore called this lineage the Global Panzootic Lineage. *BdCAPE* is also found in more than one continent, and *BdCH* only in Switzerland.

*BdGPL* uniquely has features within the genome that may have resulted from hybridisation between two parental strains. Both *BdGPL* and *BdCAPE* have been spread via trade in amphibians: once by accidental cohousing in a zoo (*BdCAPE*), and the other transported many times by international trade (*BdGPL*). Our study highlights the urgent action required to prevent future panzootics, which may require new measures to prevent transmission of infectious diseases. As for many other threatened species, tightening the biosecurity associated with trade is key to preventing accelerated evolution and spread of hyper-virulent diseases in the future.
Evidence of the spread of emerging infectious disease in migrating birds

Trichomonas gallinae is a protozoan parasite that is well known as a cause of the disease trichomonosis in pigeon, dove and raptor species worldwide. The parasite emerged as a novel infection of British songbirds in 2005, leading to epidemic mortality associated with significant declines of breeding populations of greenfinches Carduelis chloris and chaffinches Fringilla coelebs in the central and western counties of England in 2006. Sequence data and platform-based multilocus typing tools confirm that a single clonal strain of T. gallinae is the causative agent of this emerging infectious disease. Continued epidemic spread of the disease with a pronounced shift in geographical distribution towards eastern England occurred in 2007. This was followed by international spread to southern Fennoscandia where cases were confirmed at multiple sites in the summer of 2008, once again affecting finch species with similar signs of disease. Sequence data showed no variation between the British and Fennoscandian parasite strains. Epidemiological and historical ring return data support bird migration as a plausible mechanism for the observed pattern of disease spread, and suggest the chaffinch as the most likely primary vector. We believe this to be the first documented case of the spread of a protozoal emerging infectious disease by migrating birds. Seasonal epidemic mortality due to finch trichomonosis continues to occur in the late summer months of each year in Great Britain. Both the greenfinch and chaffinch have large and widespread populations across Europe and into Russia. Continued disease surveillance, in combination with census monitoring, is required to determine the impact of this emerging infectious disease on European finch populations.


Diverse paramyxoviruses found in fruit bat populations

Bats are an incredibly diverse and widely distributed taxonomic order. Approximately 1,200 species of bats exist, and bats are found on every continent except Antarctica. Like many other animals, some bats constitute a reservoir of zoonotic infections. Paramyxoviruses (e.g. measles and mumps viruses) are negative-stranded RNA viruses that occur in a wide range of animal species. Some paramyxoviruses of bats can transmit across species barriers, often with fatal consequences. We worked with a population of straw-coloured fruit bats *Eidolon helvum* in Ghana, West Africa. The large population (up to 1,000,000 individuals) roosts directly over a busy hospital in the capital city, Accra, and undergoes long-range migration. The species is also harvested for bushmeat in this region, giving it ample opportunity for contact with human and domestic animal populations. Given the possibility that this contact might facilitate cross-species virus transmission, we investigated the paramyxoviruses in this bat population. Paramyxoviruses have been successfully detected in bat urine before so we collected urine non-invasively from plastic sheeting underneath the roosts over a two-month period. From these samples we were able to detect high diversity of novel paramyxoviruses using consensus-PCR. These findings were significant because some of the detected viruses are closely related to those already known to be fatal in humans. Also, the level of viral diversity in reservoir populations is fundamental to understanding and predicting viral emergence. Finally, detecting such a high prevalence and genetic diversity of novel paramyxoviruses in a short period of time might suggest a unique relationship exists between bats and paramyxoviruses. Given the high rate of bat-human contact at the study site, the zoonotic potential of the detected viruses needs to be investigated further.

Global environmental agreements such as the Convention on Biological Diversity (CBD) have set stringent goals for biodiversity conservation. Scientifically robust biodiversity indicators are required to track progress towards these goals and define the status and trends of biodiversity; the Indicators and Assessments (IAU) unit was formed in 2006 for this purpose. The unit is a joint Institute of Zoology and Conservation Programmes initiative, and comprises around 20 staff and students.

This year, work has expanded to build novel understanding of wildlife population dynamics in the Arctic, to develop new methods for forecasting impact on wildlife of changes in environmental policy, and to understand how robust our comprehension of invertebrate biodiversity patterns is in the context of data uncertainty. Many of the projects are providing science to inform global biodiversity policy for the Convention on Biological Diversity 2020 strategic plan.

Arctic野生动物 responses to climate and land use change

The polar regions are places of compelling beauty, and are home to some of the world’s most charismatic wildlife. However, rapid changes in climate occurring at the poles, and the accelerating rate of resource exploitation in these unique polar ecosystems, are adversely impacting wildlife populations. Working with the Conservation of Arctic Flora and Fauna (CAFF) Circumpolar Biodiversity Monitoring Program (CBMP) in the Arctic, we have developed new means to understand the temporal and spatial dynamics of Arctic populations. Arctic species are suffering mixed fortunes, with declining trends particularly evident for those species dependent on sea ice. A focus on marine populations uncovered recent declines in the Bering Sea and Aleutian Islands for seven mammal species (beluga Delphinapterus leucas, Steller’s sea lion Eumetopias jubatus, harp seal Phoca vitulina, sea otter Enhydra lutris, Pacific walrus Odobenus rosmarus, northern fur seal Callorhinus ursinus, grey whale Eschrichtius robustus); threats responsible include overharvesting, increased predation, loss of summer sea ice and depleted prey resource. We also explored the use of spatial techniques to identify environmental and climatic drivers of biodiversity change and were able to identify gaps in monitoring throughout the Arctic region. In conjunction with CBMP, these results are being used to inform monitoring and policy decisions in the Arctic.

Integrating uncertainty into conservation decisions

The conservation status of an ever-greater number of species is being assessed using tools for evaluating extinction risk, such as the IUCN Red List of Threatened Species. Baseline biodiversity data are important to understand how humans are impacting biodiversity, enable proactive conservation decision-making, and are the focus of Indicators and Assessments Unit projects, such as the sampled approach to Red Listing. However, the extent to which data from these new groups of species changes our understanding of macroecological patterns such as distribution threat, and thus our response to conservation problems, remains untested. Global priorities for biodiversity conservation have been largely biased towards vertebrate species and terrestrial ecosystems, and an understanding of the drivers of extinction risk in freshwater invertebrates will therefore contribute to a more accurate picture of biodiversity.
However, the high levels of data uncertainty in IUCN Red List assessments for freshwater invertebrates could bias the results of broad-scale studies based on these assessments. A species is assigned to the Data Deficient (DD) category when there is inadequate information to make an assessment of its risk of extinction. To date, all invertebrate taxa with systematic risk assessments show high proportions of DD species: 35% of dragonflies and damselflies, 49% of freshwater crabs and 21% of crayfish are currently listed as DD. Vertebrate groups are typically better known. Our findings demonstrated that the three taxonomic groups we looked at showed considerable differences not only in distribution of extinction risk, but also in the influence of data uncertainty on those distributions. Global patterns of extinction risk, and therefore our understanding of the plight of threatened species in those groups, were not only dependent on the absolute number of DD species in the taxon, but also on the distribution among families and realms of these DD species. Broadening the coverage of biodiversity assessments to under-studied taxa and systems is essential to developing a more representative picture of biodiversity. Our study shows that despite recent efforts towards achieving this goal, high levels of data deficiency challenge the integration of these assessments into conservation decision-making and supports the need for increased efforts in invertebrate research and conservation.


Informing policy decisions
In order to influence global environmental policy effectively, conservation scientists need to be able to provide robust predictions of the impact of alternative policies on biodiversity and measure progress towards goals using reliable indicators. In response to the Convention on Biological Diversity’s (CBD) 2010 target of reducing significantly the rate of biodiversity loss, we helped develop two biodiversity indicators: the Red List Index (which monitors change in extinction risk) and the Living Planet Index (which tracks changes in population abundance). Both are used to good effect to inform policy makers about how biodiversity is changing. However, to date, they have not been used in a predictive framework.

With Emily Nicholson (University of Melbourne) and E.J. Milner-Gulland (Imperial College London), we developed a framework for using biodiversity indicators predictively to inform policy choices at a global level. We used two case studies to illustrate the approach, in which we projected the impacts of feasible policies on trends in biodiversity and tried to pick up the impacts in relevant indicators. The policies were based on targets agreed at the Convention on Biological Diversity for 2020. In the first case study we compared protected area policies for African mammals, assessed using the Red List Index; in the second example we used the Living Planet Index to assess the impact of a complete halt, versus a reduction, in bottom trawling.

We found that under our scenarios of expansion, and increasing protected area effectiveness, biodiversity indicators can aid in decision-making and are able to differentiate between the impacts of the different policies. Overwhelmingly, it appears that increasing the effectiveness of protected area management will have a far greater positive impact on wildlife trends, than merely increasing the size of protected areas. Our results are a first attempt to use predictive models and indicators to credibly track trends and inform policy. To be useful and relevant, scientists must make testable predictions about the impact of global policy on biodiversity to ensure that targets such as those set by the CBD catalyse effective and measurable change.


ZSL Conservation Programmes

Research carried out at IoZ focuses on scientific issues relevant to the conservation of species and their habitats. This work directly supports ZSL’s field conservation programmes, which are currently run in more than 60 countries worldwide. The combination of applied and pure research means that we are engaged in and can inform conservation policy and practice at all levels, in partnership with governments, NGOs and local communities.

2012 Chagos Expedition
ZSL played an integral part in the campaign for the creation of the Chagos Marine Reserve in 2010, both through the provision of scientific information and through awareness-raising exercises. The establishment of the largest no-take marine reserve in the world protected over 640,000 km$^2$ of the Indian Ocean and was a significant step in the conservation of marine biodiversity, a priority area for ZSL. Large no-take marine reserves such as this provide protection from exploitation for internationally threatened migratory species, though the quest to quantify and qualify this benefit with robust evidence is ongoing.

In March ZSL scientists Heather Koldewey and Catherine Head participated in the first scientific expedition to the archipelago since the reserve was established. Heather and Catherine’s work focused on monitoring long-term reef condition and determining the implications of human impact on coral reef biodiversity in cryptic species groups. Their findings will contribute to the longest time-series of reef condition in the Indian Ocean. So far these records have demonstrated that rates of coral recovery and resilience in Chagos are unmatched anywhere else in the world.

In addition to this work, ZSL’s Marine and Freshwater team, along with multiple partners including the Universities of Western Australia, Oxford and St Andrews, have embarked on a ground-breaking initiative to collect baseline information on the species present in the Chagos archipelago. Developing and adapting new and existing technologies to monitor crucial habitats, such as seamounts, the 2012 expedition incorporated the first video-based surveys of Chagos using Stereo Baited Underwater Video Systems. Over the course of this expedition the team filmed over 150 seabed sites. Building on these surveys, the partners are now developing pelagic monitoring systems to assess shark and tuna assemblages.

Chagos Community Environment Project
ZSL is not only committed to documenting the status of the ecosystems in Chagos, but also to raising awareness within the Chagossian community and building their capacity to protect their unique biological heritage. To achieve this ZSL, along with partners such as the Royal Society for the Protection of Birds, Royal Botanic Gardens, Kew and Coral Cay Conservation, held Chagos Environment Fun Days in July in both London and Manchester.

The Fun Days brought together over 600 of the UK based Chagossian community. ZSL’s marine conservation and education staff aimed to immerse the visitors in the marine and island wildlife found in Chagos through a variety of engaging activities, whilst also providing a taste of what conducting conservation science in the region involves. The London School of Diving gave participants a chance to discover SCUBA and find out how ZSL’s scientists survey the Chagos reefs.

Following on from the fun days, 13 participants from London and Manchester were given the opportunity to participate in an eight-week environmental training programme. This group was selected on the basis of their enthusiasm to learn more about the environment of Chagos and how it might be best conserved. ZSL’s mission was to give these young Chagossians the practical and theoretical knowledge they would need to become both ambassadors for the protection of Chagos and possible active conservationists in the future.

Pygmy Sloth Expedition
Found only on the Isla Escudo de Veraguas in Panama, the tiny pygmy three-toed sloth Bradypus pygmaeus is both a top 100 EDGE species (a list calculated on the basis of a species’ evolutionary distinctiveness and the level of threat that they face) and one of the 100 most endangered species in the world (as selected by the IUCN Species Specialist Groups and listed in the book ‘Priceless or Worthless?’).

© H. Koldewey
The pygmy three-toed sloths and a number of other endemic species are supported by a range of habitats on the Isla Escudo de Veraguas, which lies 17 km off the coast of Panama. Unfortunately these precious ecosystems and the species they support are currently under threat due to exploitation for use as firewood and in construction. There is also anecdotal evidence that suggests the sloths themselves are directly threatened by hunting. In order to effectively protect this fascinating species and its habitat we need to establish a baseline of the current state of the population and its environment. For this reason, ZSL researchers Craig Turner and David Curnick, along with bat expert Alanna Maltby, travelled to the Isla Escudo de Veraguas in 2012 to carry out initial assessments of the sloth populations and their mangrove habitat.

Craig and David completed over 70 transects through the mangrove forests, thought to be the sloth’s primary habitat, mapping their extent and encountering more than 60 sloths. These encounters informed the current estimates of a sloth population of less than 200 individuals, much smaller than originally expected, and revealed that mangroves cover just over 10 ha of the island.

A further expedition is scheduled for early 2013 and recently a young Panamanian conservationist, Diorene J. Smith, has been appointed as the EDGE fellow for this species. As a part of her fellowship Diorene received training in field conservation monitoring and reporting techniques during the EDGE fellows training course, which was held in Kenya in late 2012. In addition, over £3,500 was raised through an online campaign to support ZSL’s pygmy sloth conservation work.

Mountain Chicken Frogs Bred at ZSL London Zoo
The spread of the deadly fungal pathogen chytridiomycosis is driving amphibian populations around the world to extinction. It was the detection of this disease, which had already decimated populations of the critically endangered mountain chicken frog *Leptodactylus fallax* on Dominica, which led to 50 mountain chicken frogs being airlifted from the island of Montserrat in 2009. This transfer happened just in time, as within weeks of the disease first being discovered in Montserrat mountain chicken populations had begun to plummet. Of the 50 mountain chicken frogs that were rescued from Montserrat, 12 were transported to secure conservation breeding facilities at ZSL London Zoo, whilst the remainder were split between the Durrell Wildlife Conservation Trust in Jersey and Parken Zoo in Sweden. In addition to chytridiomycosis, the mountain chicken frogs, so named for their large size and desirability as a food source, were also threatened by habitat loss and hunting by local communities.

ZSL London Zoo is now the only place in the world housing mountain chicken frogs from both Montserrat and Dominica. These frogs are kept in temperature-controlled conservation breeding units that include automated spray systems and dedicated areas for rearing live food. In addition, anyone entering the facility must comply with stringent bio-security protocols, which include wearing paper suits, masks and gloves. These measures ensure that no pathogens will be transferred from the outside world to the amphibians.

In 2012 the dedication of ZSL staff to the preservation of this species was rewarded by the delivery of a huge brood of 76 froglets to two of ZSL’s female mountain chickens. Once fully grown the frogs will be released into a protected, disease-free area in the wild. The safe delivery of these froglets provides a welcome lifeline for one of the most endangered amphibians in the world.

Establishment of Technology for Nature Centre
From tracking elusive carnivores in the Serengeti to eavesdropping on bat calls with the iBats smart-phone application, cutting-edge technology is opening exciting new opportunities in conservation. In particular, the rapid advances currently occurring in telemetry, cameras, sound-recording and satellite technology have the potential to revolutionise conservation interventions worldwide. ZSL has consistently been at the forefront of the development and utilisation of innovative technological solutions to conservation challenges. By establishing the Technology for Nature centre in early 2012, in partnership with Microsoft Research and University College London, ZSL is ensuring this will remain the case. Within this centre the partners will develop and advance ground-breaking systems and devices that will enable researchers to better record the behaviour and distribution of wild animals, as well as to monitor the status of the natural world and its most threatened ecosystems.

The Technology for Nature partners are particularly focused on advancing tools in remote sensing and analytics, as well as developing opportunities for crowd sourcing and citizen science. Such tools will both increase the impact of conservation interventions and enable organisations to effectively measure and monitor the success of their work. One such tool is InstantWild, launched by ZSL in 2011. Utilising a network of remote camera traps and cell-phone networks, InstantWild allows users to view and identify species in photographs moments after the image is captured in the wild.

Pressures on the natural world are increasing exponentially. Harnessing the potential of technology to monitor and communicate these will be essential to protect species and the ecosystems they rely on. The establishment of the Technology for Nature centre is an important, and encouraging, step in increasing the impact of conservation and protecting our global biological heritage.
A major part of IoZ’s work is facilitating the communication of science amongst researchers and professional zoologists, and to the public. We achieve this through a varied programme of meetings, and the publication of scientific journals and books.

**Forthcoming Science and Conservation Events:** [http://www.zsl.org/science/events](http://www.zsl.org/science/events)

---

**PUBLICATIONS**

*Journal of Zoology*

Published monthly, the *Journal* includes hypothesis-driven studies that advance our knowledge of animals and their systems. The 2012 Thomas Henry Huxley Review ‘Clones, hermaphrodites and pregnancies: nature’s oddities offer evolutionary lessons on reproduction’, by John Avise, was published in January. A new series of Hidden Gems, featuring papers of historical interest from the digitised *Proceedings and Transactions of the Zoological Society of London*, and the *Journal of Zoology* podcast are available via the *Journal* homepage.

*Animal Conservation*

*Animal Conservation* provides a forum for rapid publication of novel research into the conservation of animal species and their habitats. Feature Papers and commentaries, published in each issue, continue to be well received. Three themed virtual issues: *Conservation Conflicts*, *Marine Mammal Conservation* and *Camera Trapping*, were published during the year.

*International Zoo Yearbook*

Volume 46 of the *International Zoo Yearbook* adds to its reputation as an invaluable resource for researchers, students and animal managers. The focus of the current volume is New World Primates, guest edited by Gustl Anzenberger (University of Zurich) and Anthony Rylands (Conservation International). Papers included describe the status of Neotropical primate species, *in situ* and *ex situ* conservation projects and field studies, and highlight advances in the maintenance, husbandry and breeding of species of conservation concern.

*Conservation Science and Practice* book series

Each book in the Wiley-Blackwell/ZSL *Conservation Science and Practice* series aims to address the multidisciplinary aspects of conservation by looking at how biological scientists and ecologists are interacting with social scientists to effect long-term, sustainable conservation measures. Titles published this year include *Applied Population and Community Ecology: The Case of Feral Pigs in Australia*, *Tropical Forest Conservation and Industry Partnership: An Experience from the Congo Basin* and *Reintroduction Biology: Integrating Science and Management.*
MEETINGS

Symposia
ZSL's symposia bring together groups of international experts to discuss important topics in conservation science, providing an opportunity for leaders to exchange ideas on best practice and communicate their research.

Economics as if life mattered: can we shape economic policy to save species?
Wildlife conservation projects are subject to constraints of global economic policy and historically such policies have fostered exploitation over protection of biodiversity. Economic factors often stand in the way of effective conservation, contribute to the failure to achieve long-term results and, ultimately, are behind the agony of choice we face when trying to save species from extinction. Numerous visions of a new economy, with the interests of people and the planet at the centre, are beginning to emerge. The May symposium, organised by Kristen Steele (International Society for Ecology and Culture), Aniol Esteban (new economics foundation) and Ian Bateman (University of East Anglia), explored the ways in which the current global market economy hinders conservation. Current economic incentives used in conservation, such as assigning market values to species and sustainable use, were discussed and possibilities for conservation policy to influence the broader movement for economic change were examined.

Science and Conservation Events
ZSL's popular Science and Conservation Events lecture series is free and open to the public. Held on the second Tuesday of each month throughout the academic year, each meeting provides an overview of the latest developments in conservation and zoological research. This year’s programme included lectures on ‘Selling conservation: lessons from Selfridges’, ‘Shallow seas’, ‘Conservation in China: unique challenges or global lessons?’, ‘The global decline of mangroves: is there a sustainable future?’, ‘Extreme natural events: an overlooked driver of biodiversity loss?’, ‘The Sargasso Sea’ and ‘The evolution of life history and parasitism: the good, the bad and the ugly’.

Science for Conservation Seminar Series
This series provides our staff and students with the opportunity to learn more about the work of visiting researchers, collaborators and invited speakers. A range of subjects was covered during the year, including ‘Climate change and species extinction risk: a trait-based approach’, ‘Breeding without breeding: molecular markers-based breeding’, ‘The curious case of the disappearing devil’ and ‘Remote camera trapping in Australia: species, programs, methods and challenges’.

Antelope conservation in the 21st century: from diagnosis to action
The drastic decline in wildlife populations since 1970 has hit antelopes particularly severely, with more than a quarter of species now threatened by extinction. However, antelopes have received far less conservation attention than many of their mammalian relatives and, in the absence of immediate action, several species are in imminent danger of extinction in the wild. The November symposium, organised by Jakob Bro-Jørgensen (University of Liverpool/UCN Antelope Specialist Group) and David Mallon (Manchester Metropolitan University/UCN Antelope Specialist Group, Co-chair), explored current trends in global antelope populations and the factors that drive major threat processes. Various conservation priorities were evaluated, taking account of both biological and socio-economic aspects. Topics addressed included how to turn habitat loss into conservation-friendly land use in a world of environmental change, how antelope–livestock interactions affect resource competition and disease transmission, how to render bushmeat hunting sustainable, and the usefulness of sport hunting, game ranching and reintroductions to conservation.

Stamford Raffles Lecture
The 2012 Stamford Raffles Lecture was given by Tim Birkhead FRS, Professor of Behavioural Ecology, University of Sheffield. ‘Darwin, Sex and Sexual Selection’ described how Darwin’s concept of sexual selection transformed our understanding of animal behaviour. Although Darwin knew that the males of many species are promiscuous, he assumed females to be monogamous. However, we now know that promiscuity is common among females. Professor Birkhead explored how this has changed our view of many aspects of reproduction and how it has helped to explain the remarkable diversity in copulatory behaviour, anatomy and physiology.

(top right) Stamford Raffles speaker, Tim Birkhead
(centre left) The organisers of the Sargasso Sea Meeting
ZSL recognises outstanding achievements in conservation and zoological research through its annual presentation of awards and prizes. In 2011 the following awards were presented:

**ZSL Scientific Medal**
Presented to research scientists with no more than 15 years postdoctoral experience for distinguished work in zoology. Awarded to:
*Tom Little*, University of Edinburgh, for significant contributions to our understanding of the evolution of host–parasite interactions and for promoting interdisciplinary approaches to tackle broad issues in biomedical science.
*Jon Slate*, University of Sheffield, for influential research into microevolutionary processes in wild populations, using data from long-term field and laboratory ecological studies combined with cutting-edge genomics technologies and statistical genetic approaches.

**Marsh Award for Conservation Biology**
For contributions of fundamental science and its application to the conservation of animal species and habitats. Awarded to:
*Jane Hill*, University of York, for outstanding contributions to our understanding of how habitat degradation and climate change affect insect distribution and abundance. Jane has also identified methods for improving biodiversity in oil palm plantations and shown that even small forest fragments can contribute substantially to regional diversity.

**Marsh Award for Marine and Freshwater Conservation**
For contributions of fundamental science and its application to conservation in marine and/or freshwater ecosystems. Awarded to:
*Brendan Godley*, University of Exeter, for providing new insights into marine biodiversity and, in particular, the complex life histories and migration strategies of marine turtles. In recent years his research has included sustainable fisheries, the ecological impacts of marine renewable energy resources and climate change.

**Thomson Reuters Zoological Record Award**
Presented for the public communication of zoology. Awarded to:
*Nigel Paterson*, Director and Producer of the BBC TV series *Planet Dinosaur*.

**ZSL Thomas Henry Huxley Prize and Marsh Award**
Presented for the best zoological doctoral thesis produced in the UK. Awarded to:
*Kate Jordan*, University of Warwick, for her thesis ‘Exploring the generative architecture of intramembranous ossification’.

**ZSL Stamford Raffles Award**
Presented for distinguished contributions by amateur zoologists. Awarded to:
*Dan Danahar*, Biodiversity Coordinator and teacher of Environmental Science at Dorothy Stringer School, Brighton, for outstanding contributions to biodiversity conservation, education and sustainability through a range of activities, including the highly successful Big Biodiversity Butterfly Count, and the ongoing development of the Big Nature Centre, in support of Brighton and Hove’s bid for the city to become a UNESCO Biosphere Reserve.

**ZSL Frink Medal**
Presented to a professional scientist for substantial and original contributions to zoology. Awarded to:
*Paul Harvey CBE FRS* (above), University of Oxford, for pioneering approaches in evolutionary biology which allow for the statistical analysis of species characteristics to infer directions and magnitudes of evolution, and for demonstrating how measures of phylogenetic tree shape changed under different speciation and extinction processes.

**ZSL Silver Medal**
For contributions to the understanding and appreciation of zoology, including such activities as higher and public education in natural history and wildlife conservation. Awarded to:
*Martin Fisher*, Fauna and Flora International, Editor of *Oryx: the International Journal of Conservation*, for significant contributions to the publication of applied conservation science, particularly by practitioners tackling real-world conservation issues in developing countries, and for related outreach and mentoring activities.

**ZSL Frink Medal**
Presented to a professional scientist for substantial and original contributions to zoology. Awarded to:
*Paul Harvey CBE FRS* (above), University of Oxford, for pioneering approaches in evolutionary biology which allow for the statistical analysis of species characteristics to infer directions and magnitudes of evolution, and for demonstrating how measures of phylogenetic tree shape changed under different speciation and extinction processes.

**ZSL Scientific Medal**
Presented to research scientists with no more than 15 years postdoctoral experience for distinguished work in zoology. Awarded to:
*Tom Little*, University of Edinburgh, for significant contributions to our understanding of the evolution of host–parasite interactions and for promoting interdisciplinary approaches to tackle broad issues in biomedical science.
*Jon Slate*, University of Sheffield, for influential research into microevolutionary processes in wild populations, using data from long-term field and laboratory ecological studies combined with cutting-edge genomics technologies and statistical genetic approaches.

**Marsh Award for Marine and Freshwater Conservation**
For contributions of fundamental science and its application to conservation in marine and/or freshwater ecosystems. Awarded to:
*Brendan Godley*, University of Exeter, for providing new insights into marine biodiversity and, in particular, the complex life histories and migration strategies of marine turtles. In recent years his research has included sustainable fisheries, the ecological impacts of marine renewable energy resources and climate change.

**Thomson Reuters Zoological Record Award**
Presented for the public communication of zoology. Awarded to:
*Nigel Paterson*, Director and Producer of the BBC TV series *Planet Dinosaur*.

**ZSL Scientific Medal**
Presented to research scientists with no more than 15 years postdoctoral experience for distinguished work in zoology. Awarded to:
*Tom Little*, University of Edinburgh, for significant contributions to our understanding of the evolution of host–parasite interactions and for promoting interdisciplinary approaches to tackle broad issues in biomedical science.
*Jon Slate*, University of Sheffield, for influential research into microevolutionary processes in wild populations, using data from long-term field and laboratory ecological studies combined with cutting-edge genomics technologies and statistical genetic approaches.

**Marsh Award for Marine and Freshwater Conservation**
For contributions of fundamental science and its application to conservation in marine and/or freshwater ecosystems. Awarded to:
*Brendan Godley*, University of Exeter, for providing new insights into marine biodiversity and, in particular, the complex life histories and migration strategies of marine turtles. In recent years his research has included sustainable fisheries, the ecological impacts of marine renewable energy resources and climate change.

**Thomson Reuters Zoological Record Award**
Presented for the public communication of zoology. Awarded to:
*Nigel Paterson*, Director and Producer of the BBC TV series *Planet Dinosaur*.

**ZSL Thomas Henry Huxley Prize and Marsh Award**
Presented for the best zoological doctoral thesis produced in the UK. Awarded to:
*Kate Jordan*, University of Warwick, for her thesis ‘Exploring the generative architecture of intramembranous ossification’.
ZSL Charles Darwin Award and Marsh Prize
Presented for the best zoological project by an undergraduate student attending a university in the UK. Awarded to:
Marius Wenzel, University of Aberdeen, for his project: ‘Patterns of dispersal, genetic structure and phylogeography of European populations of the red-billed chough (Pyrrhocorax pyrrhocorax)’.

ZSL Prince Philip Award and Marsh Prize
Awarded to an A-Level (or Higher) student for the best zoological project involving some aspect of animal biology. Awarded to:
Shona Crawford-Smith, St Mary’s School, Shaftesbury, for her project: ‘A study of the artificial habitat preference of the white-clawed crayfish (Astropotamobius pallipes) at Bristol Zoo Gardens’.
St Mary’s School, Shaftesbury represented by Dee Webb.

ZSL Award for Outstanding Contributions to the Zoo Community
Awarded to:
Jeremy Mallinson, Director Emeritus at the Durrell Wildlife Conservation Trust.

ZSL Honorary Fellowship
Awarded to persons who, by their association with the Society, have promoted the objectives of the Society. Awarded to:
Lord Claus Moser.

The Zoological Society of London thanks the Marsh Christian Trust and Thomson Reuters for their generous support of the awards programme.
During 2011 over 4,100 book titles were added to the online catalogue, 2,580 journal issues accessioned and 2,255 loans were made to Fellows and ZSL staff. The ZSL Library online catalogue at http://library.zsl.org was used 16,600 times.

ZSL Library celebrated the bicentenary of the birth of Edward Lear by featuring his works on the ZSL website and a display of original watercolours (8,10). ZSL is fortunate to have 12 original watercolours by Lear, seven of which were used as a basis for lithographic colour plates published in Transactions of the Zoological Society.

To celebrate the Queen’s Diamond Jubilee, ZSL’s Royal Charter was featured as the ‘Artefact of the month’ (11) on the ZSL website and photographs of the Queen visiting ZSL London Zoo in 1990 were displayed in the Reading Room, along with related ephemera, including a copy of the menu card for the ‘Coronation Reception’. A display in the ZSL Reception featured Her Majesty’s visit to ZSL London Zoo in 1976.

To celebrate World Book Day 2012 and National Science Week some of the oldest books in the Library: Historiae animalium (8) / Conradi Gesneri (Konrad Gessner). Tiguri: Froschover, 1551–1585, were displayed on the website. These amazing volumes attempted to record and classify all knowledge of the animal world as it was known at that time.

The Library was featured in an article about Learned Society Libraries in CILIP Update, and the art collection was highlighted in the January issue of the Public Catalogue Foundation’s newsletter.

The ZSL Archives were featured in an article in the January 2012 issue of History Today; ‘Handsome gifts to a Young Society’ by Roger Rideout. Interest in the Archives has continued to increase with researchers consulting the Daily Occurrences for ZSL London Zoo and ZSL Whipsnade Zoo, press cuttings, zoo guides and the photographic collection, journals of Eustace Poles, manuscripts of Brian Houghton Hodgson, the unbuilt Tecton Elephant House papers and material on the Zoo during World War II.

The letters of Alfred Russel Wallace have been scanned for the Alfred Russel Wallace Correspondence Project, and the volumes of The natural history of Carolina, Florida and the Bahama Islands, containing the figures of birds, beasts, fishes, serpents, insects and plants... together with their descriptions in English and French... by Mark Catesby, 1731–1743, were consulted for a census of surviving copies.

Recent donations include the Coulton Portfolio presented by Professor Alexander, ZSL’s former Secretary. The portfolio consists of drawings of vertebrate animals from the collection of Charles Hamilton Smith (1776–1859). An extensive bequest of books was received from Malcolm Whitehead, a former member of ZSL staff, Fellow and member of ZSL Council.

The Retrospective Book Cataloguing project continues, with over 7,000 records added by the end of June 2012. The project involves adding details of all books in ZSL Library for which there is no existing electronic record, increasing their availability and accessibility. This is a key project in helping ZSL to deliver the strategic aim of facilitating access to zoological and conservation knowledge. This project is being funded with thanks to a bequest from Connie Nutkins, a former member of staff of IoZ, who left a generous gift in her will to the Library.

ZSL has contributed catalogue details to AIM25, a major project to provide easy access to the catalogues of archives in London and the M25 area. The AIM25 website has received 121 million hits since it was started in December 2000 (http://aim25.ac.uk/).

We are extremely grateful for the continued help of our dedicated team of volunteers and the many Fellows and Friends of ZSL who continue to support the Library with their time, by donating books, archives, zoo ephemera and funds for the conservation of items in our collections.

‘Artefact of the Month’ August 2011 to July 2012

1. Ostrich egg with plan of Whipsnade painted onto it c1940.
2. Bat drawings in the manuscripts of Samuel Richard Tickell (1811–1875) to celebrate the Year of the Bat. See page 34.
4. The war memorial at ZSL London Zoo.
5. A letter from Joseph Hooker to Brian Houghton Hodgson to commemorate Joseph Hooker who died 100 years ago on 10 December 1911.
6. A letter from Captain Robert Scott to commemorate the 100-year anniversary of his expedition reaching the South Pole.
7. A letter from Charles Dickens, Junior, to celebrate the bicentenary of his father, Charles Dickens.
9. Lagotis cuvieri watercolour by Edward Lear.
10. Euplectes franciscans watercolour by Edward Lear.
11. The Royal Seal attached to the ZSL’s Royal Charter, Queen Elizabeth enthroned.
12. Memoir of the life and public services of Sir Thomas Stamford Raffles.
Education and training are central to IoZ’s activities and we have a strong commitment to hosting research projects, particularly those leading to a PhD degree.

Our PhD students are co-registered at a university department but most spend the majority of their time at IoZ. In the 2011–2012 academic year PhDs were awarded to Rose Cairns (University of Leeds) for her critical analysis of the discourses of conservation and science on the Galapagos islands; Robin Curtis, (University College London) for his research into the importance of resources in determining butterfly population abundance at multiple scales; Gillian Eastwood (University of Leeds) for her study on the potential ecology of West Nile Virus on the Galapagos islands; Nick Hill (Imperial College London) for his research on the interactions between seaweed farming and fishing in Danajon Bank, central Philippines; Alanna Maltby (Imperial College London) for her study on the evolution of echolocation in bats; Peter Minting (University of Sussex) for his research into the effects of Batrachochytrium dendrobatidis on natterjack toad Bufo calamita populations in the UK; Alison Peel (University of Cambridge) for her study of the epidemiology of Lagos bat virus and henipaviruses in straw-coloured fruit bats Eidolon helvum; Olutolani Smith (Imperial College London) for her research into the population genetics and structure of the Sumatran tiger.

Our MSc courses in Wild Animal Health and Wild Animal Biology were the subject of a major review in order to improve the flexibility of delivery, in line with the European Credit Transfer System. The courses are now available to students studying for a Certificate, Diploma and MSc degree, and changes to the curriculum have increased collaborative teaching opportunities. In 2011 24 students graduated from the MSc courses. Kristen Steele received the award for the MScWAB student with the highest aggregate marks, and also the prize for the best research project for her work on the ecological correlates and conservation of European eel Anguilla anguilla populations in the Thames estuary. After taking a post at the International Society for Ecology and Culture, Kristen returned to ZSL in 2012 to organise the symposium Economics as if life mattered: can we shape economic policy to save species? Mhairi Fleming received the prize for the MScWAB student with the highest aggregate marks, and also the prize for the best research project for her behavioural assessment of dental pain in Malayan sun bears Helarctos malayanus. Our graduates continue to take up important positions in conservation medicine and wildlife health; for example, Wigganson Matandiko, who graduated in 1998 is now Head of the Veterinary Unit at the Zambia Wildlife Authority, and Sreejith Radhakrishnan, who graduated in 2009, is Assistant Forest Veterinary Officer at Periyar Tiger Reserve in Kerala, India. Kristen returned to ZSL in 2012 to organise the symposium Economics as if life mattered: can we shape economic policy to save species? Mhairi Fleming received the prize for the MScWAB student with the highest aggregate marks, and also the prize for the best research project for her behavioural assessment of dental pain in Malayan sun bears Helarctos malayanus. Our graduates continue to take up important positions in conservation medicine and wildlife health; for example, Wigganson Matandiko, who graduated in 1998 is now Head of the Veterinary Unit at the Zambia Wildlife Authority, and Sreejith Radhakrishnan, who graduated in 2009, is Assistant Forest Veterinary Officer at Periyar Tiger Reserve in Kerala, India.

The MSc course in Conservation Science, run in partnership with Imperial College, the Royal Botanic Gardens Kew and Durrell Wildlife Conservation Trust, continues to attract many more applicants than can be accommodated, despite a rise in fees this year necessitated by the changing financial climate. In 2011 31 students graduated. Jeremy Cusack received the TH. Huxley Award for best overall grade, Rebecca Short received the Joseph Hooker Award for the best coursework grade, and Alyson Pavitt received the Gerald Durrell Award for the best project, with her study into the temporal range dynamics, distribution patterns and dispersal of odonata in Britain. The Conservation Science MSc is completing its sixth year in 2012, an occasion marked by a review of the performance of the course. This was achieved by carrying out anonymous questionnaires with alumni, lecturers and prospective employers to establish how the quality of the experience provided during the course is perceived, the experience of students since graduating, and how potential employers perceive the quality of graduates produced. The results suggest that the course is largely achieving its goal of producing skilled graduates who are well placed to take an active role as conservationists in the workplace. The vast majority of responding alumni felt that the course had made them more employable, and had indeed found paid employment in a conservation-related role. Similarly, employers generally had a very favourable view of graduates, both in absolute terms and relative to those from comparable courses. We aim to build on this encouraging picture by continuing to improve course content and structure to produce excellent graduates, and to facilitate their passage into conservation careers. One particular initiative in this respect is the introduction of a bursary scheme, which will be used to help improve the diversity of intake.
and tracks the fate of those species in order to inform science and environmental policy. Red Lists at all scales (global, regional and national) are one of the most important and robust tools for informing decision-making in nature conservation. This year, a report entitled *Evolution Lost: Status and trends of the World's vertebrates* was published, detailing the response of vertebrate species to growing human mediated threats. This report received significant media coverage and was launched at the Global Legislators Forum, at the Convention on Biological Diversity. The grant also supported updates to the global IUCN Red List; the website is now able to provide free access to assessments of 59,508 species. The online web portal for National Red List data has seen usage increase by 65% on last year. Fifty countries have provided national threatened species assessment data, and the site holds information on more than 70,000 species worldwide. The website has received visitors from more than 90 countries, with a steadily increasing number of both unique hits and repeat visitors. Six international, peer reviewed journal articles comprising developments and data analysis were also published in *Science, Conservation Biology, Oryx* and *Philosophical Transactions of the Royal Society of London.*

In 2011 we received our annual core income from HEFCE via the University of Cambridge. 54% of our income came from other sources. In total 43 new grants were received during the year.
Fish products constitute 90% of Greenland's national employment and fish and shrimp fishery to Greenland cannot be overstated. The industry is responsible for damaging by ground gear and left more mortality of non-target organisms from the ecosystem and there is enhanced habitat. Target organisms are removed with both direct and indirect impacts on the benthic ecosystem. Trawl nets cause severe structural damage to the seafloor in regions subjected to varying degrees of trawling impact. Image analysis approaches will be further developed through a new collaboration with the Technology for Nature initiative (ZSL, University College London and Microsoft Research). This work will establish a scientific basis upon which to assess change in the benthic ecosystem and critically, will directly inform marine management policy on the west Greenlandic shelf.

Kirsty Kemp was awarded £200,005 from Sustainable Fisheries Greenland for the project ‘Community responses to trawling impact’. This project looks at indices of diversity and ecosystem function of the macrobenthic community (corals, sponges, worms, echinoderms) living at 200–500 m depth off the west coast of Greenland. This habitat has been severely impacted by bottom trawling for the commercially valuable shrimp *Pandalus borealis*. Trawling is a highly destructive activity with both direct and indirect impacts on the benthic ecosystem. Trawl nets cause severe structural damage to the seafloor habitat. Target organisms are removed from the ecosystem and there is enhanced mortality of non-target organisms damaged by ground gear and left more susceptible to predation and competition. However, the economic importance of the shrimp fishery to Greenland cannot be overstated. The industry is responsible for 25% of national employment and fish and fish products constitute 90% of Greenland’s total export revenues; shrimp alone account for 60%. The UK is by far the largest market, importing 50% of global cold-water shrimp produce. Before 2011 no system was in place to assess the impact that the existing trawl fishery has had historically, or to monitor the impact of ongoing trawling activity on the benthic ecosystem of the west Greenlandic shelf. In 2011 Sustainable Fisheries Greenland initiated a 3-month pilot study, undertaken by ZSL and the Greenland Institute of Natural Resources, to trial the feasibility of image-based surveying techniques in this region. This new initiative was promising and funding was secured to improve, implement and expand upon the techniques to derive biodiversity and species richness measures, and basic measures of community function and habitat structure from image data and physical sampling of the seafloor in regions subjected to varying degrees of trawling impact. Image analysis approaches will be further developed through a new collaboration with the Technology for Nature initiative (ZSL, University College London and Microsoft Research). This work will establish a scientific basis upon which to assess change in the benthic ecosystem and critically, will directly inform marine management policy on the west Greenland shelf.

Andrew Cunningham was awarded €573,100 from the European Commission for the project ANTIGONE: ANTicipating the Global Onset of Novel Epidemics, a European research network of fourteen academic partners from seven European member states. ANTIGONE aims to identify the key factors that render zoonotic pathogens prone to cross the species barrier and gain efficient transmissibility among humans. It brings together a team of top researchers working on a broad range of important zoonotic viral and bacterial pathogens, with multi-disciplinary backgrounds from the human and veterinary medical field, as well as other relevant disciplines. ANTIGONE is funded by the European Commission and will run from 2011 to 2016.

**Funding**

Animal Health and Veterinary Laboratories Agency (AHVLA)
Birdlife International
Calgary Zoological Society
Centre for Ecology and Evolution
Columbus Zoo and Aquarium
Darwin Initiative
Defra
ESPA-NERC
European Association of Zoos and Aquaria
European Commission
Exodus Travels Ltd
HEFCE
IFREMER
International Livestock Research Institute (Kenya)
International Whaling Commission
King Saud University
Mohamed bin Zayed Species Conservation Fund
Natural England
NERC
New Zealand Department of Conservation
Royal Society
Rufford Foundation
Saint Louis Zoological Park
Society for General Microbiology
Sustainable Fisheries Greenland
Veterinary Laboratories Agency
Vodafone Foundation
Wildlife Trust, USA
Winston Churchill Memorial Trust Fellowship
WWF International

---

Rosie Woodroffe was awarded a total of £1.7 million by Defra for two projects on bovine tuberculosis (TB) transmission between badgers and cattle. TB is a huge problem for British farmers, and badgers’ ability to transmit infection to cattle makes TB control both challenging and controversial. The first project evaluates how TB transmission might be influenced by testing badgers and culling those found to be infected. Although such management might be expected to reduce TB transmission to cattle, badgers respond to culling by ranging more widely, potentially spreading the disease more widely. The second project works on farms in TB-affected areas of Cornwall to investigate ways to keep badgers and cattle apart without culling. Collars using the same technology found in vehicle sat-nav systems will reveal full details of badger and cattle movements, so that points of contact – and possible transmission – can be better understood.

Kirsty Kemp was awarded £200,005 from Sustainable Fisheries Greenland for the project ‘Community responses to trawling impact’. This project looks at indices of diversity and ecosystem function of the macrobenthic community (corals, sponges, worms, echinoderms) living at 200–500 m depth off the west coast of Greenland. This habitat has been severely impacted by bottom trawling for the commercially valuable shrimp *Pandalus borealis*. Trawling is a highly destructive activity with both direct and indirect impacts on the benthic ecosystem. Trawl nets cause severe structural damage to the seafloor habitat. Target organisms are removed from the ecosystem and there is enhanced mortality of non-target organisms damaged by ground gear and left more susceptible to predation and competition. However, the economic importance of the shrimp fishery to Greenland cannot be overstated. The industry is responsible for 25% of national employment and fish and fish products constitute 90% of Greenland’s total export revenues; shrimp alone account for 60%. The UK is by far the largest market, importing 50% of global cold-water shrimp produce. Before 2011 no system was in place to assess the impact that the existing trawl fishery has had historically, or to monitor the impact of ongoing trawling activity on the benthic ecosystem of the west Greenlandic shelf. In 2011 Sustainable Fisheries Greenland initiated a 3-month pilot study, undertaken by ZSL and the Greenland Institute of Natural Resources, to trial the feasibility of image-based surveying techniques in this region. This new initiative was promising and funding was secured to improve, implement and expand upon the techniques to derive biodiversity and species richness measures, and basic measures of community function and habitat structure from image data and physical sampling of the seafloor in regions subjected to varying degrees of trawling impact. Image analysis approaches will be further developed through a new collaboration with the Technology for Nature initiative (ZSL, University College London and Microsoft Research). This work will establish a scientific basis upon which to assess change in the benthic ecosystem and critically, will directly inform marine management policy on the west Greenlandic shelf.

Andrew Cunningham was awarded €573,100 from the European Commission for the project ANTIGONE: ANTicipating the Global Onset of Novel Epidemics, a European research network of fourteen academic partners from seven European member states. ANTIGONE aims to identify the key factors that render zoonotic pathogens prone to cross the species barrier and gain efficient transmissibility among humans. It brings together a team of top researchers working on a broad range of important zoonotic viral and bacterial pathogens, with multi-disciplinary backgrounds from the human and veterinary medical field, as well as other relevant disciplines. ANTIGONE is funded by the European Commission and will run from 2011 to 2016.

**Funding**

Animal Health and Veterinary Laboratories Agency (AHVLA)
Birdlife International
Calgary Zoological Society
Centre for Ecology and Evolution
Columbus Zoo and Aquarium
Darwin Initiative
Defra
ESPA-NERC
European Association of Zoos and Aquaria
European Commission
Exodus Travels Ltd
HEFCE
IFREMER
International Livestock Research Institute (Kenya)
International Whaling Commission
King Saud University
Mohamed bin Zayed Species Conservation Fund
Natural England
NERC
New Zealand Department of Conservation
Royal Society
Rufford Foundation
Saint Louis Zoological Park
Society for General Microbiology
Sustainable Fisheries Greenland
Veterinary Laboratories Agency
Vodafone Foundation
Wildlife Trust, USA
Winston Churchill Memorial Trust Fellowship
WWF International

---

Rosie Woodroffe was awarded a total of £1.7 million by Defra for two projects on bovine tuberculosis (TB) transmission between badgers and cattle. TB is a huge problem for British farmers, and badgers’ ability to transmit infection to cattle makes TB control both challenging and controversial. The first project evaluates how TB transmission might be influenced by testing badgers and culling those found to be infected. Although such management might be expected to reduce TB transmission to cattle, badgers respond to culling by ranging more widely, potentially spreading the disease more widely. The second project works on farms in TB-affected areas of Cornwall to investigate ways to keep badgers and cattle apart without culling. Collars using the same technology found in vehicle sat-nav systems will reveal full details of badger and cattle movements, so that points of contact – and possible transmission – can be better understood.

Kirsty Kemp was awarded £200,005 from Sustainable Fisheries Greenland for the project ‘Community responses to trawling impact’. This project looks at indices of diversity and ecosystem function of the macrobenthic community (corals, sponges, worms, echinoderms) living at 200–500 m depth off the west coast of Greenland. This habitat has been severely impacted by bottom trawling for the commercially valuable shrimp *Pandalus borealis*. Trawling is a highly destructive activity with both direct and indirect impacts on the benthic ecosystem. Trawl nets cause severe structural damage to the seafloor habitat. Target organisms are removed from the ecosystem and there is enhanced mortality of non-target organisms damaged by ground gear and left more susceptible to predation and competition. However, the economic importance of the shrimp fishery to Greenland cannot be overstated. The industry is responsible for 25% of national employment and fish and fish products constitute 90% of Greenland’s total export revenues; shrimp alone account for 60%. The UK is by far the largest market, importing 50% of global cold-water shrimp produce. Before 2011 no system was in place to assess the impact that the existing trawl fishery has had historically, or to monitor the impact of ongoing trawling activity on the benthic ecosystem of the west Greenlandic shelf. In 2011 Sustainable Fisheries Greenland initiated a 3-month pilot study, undertaken by ZSL and the Greenland Institute of Natural Resources, to trial the feasibility of image-based surveying techniques in this region. This new initiative was promising and funding was secured to improve, implement and expand upon the techniques to derive biodiversity and species richness measures, and basic measures of community function and habitat structure from image data and physical sampling of the seafloor in regions subjected to varying degrees of trawling impact. Image analysis approaches will be further developed through a new collaboration with the Technology for Nature initiative (ZSL, University College London and Microsoft Research). This work will establish a scientific basis upon which to assess change in the benthic ecosystem and critically, will directly inform marine management policy on the west Greenlandic shelf.

Andrew Cunningham was awarded €573,100 from the European Commission for the project ANTIGONE: ANTicipating the Global Onset of Novel Epidemics, a European research network of fourteen academic partners from seven European member states. ANTIGONE aims to identify the key factors that render zoonotic pathogens prone to cross the species barrier and gain efficient transmissibility among humans. It brings together a team of top researchers working on a broad range of important zoonotic viral and bacterial pathogens, with multi-disciplinary backgrounds from the human and veterinary medical field, as well as other relevant disciplines. ANTIGONE is funded by the European Commission and will run from 2011 to 2016.

**Funding**

Animal Health and Veterinary Laboratories Agency (AHVLA)
Birdlife International
Calgary Zoological Society
Centre for Ecology and Evolution
Columbus Zoo and Aquarium
Darwin Initiative
Defra
ESPA-NERC
European Association of Zoos and Aquaria
European Commission
Exodus Travels Ltd
HEFCE
IFREMER
International Livestock Research Institute (Kenya)
International Whaling Commission
King Saud University
Mohamed bin Zayed Species Conservation Fund
Natural England
NERC
New Zealand Department of Conservation
Royal Society
Rufford Foundation
Saint Louis Zoological Park
Society for General Microbiology
Sustainable Fisheries Greenland
Veterinary Laboratories Agency
Vodafone Foundation
Wildlife Trust, USA
Winston Churchill Memorial Trust Fellowship
WWF International
The Zoological Society of London

Officers
Professor Sir Patrick Bateson FRS (President)
Professor Geoff Boxshall FRS (Secretary)
Paul Ruttenman CBE BSc (Econ) FCA (Treasurer)

Senior Management
Ralph Armond MA (Director General)
Jonathan Ballaing PhD (Director of Conservation Programmes)
Tim Blackburn DPhil (Director of the Institute of Zoology)
David Field BSc MBA (Zoological Director)
Ian Meyrick BA FCIP (Human Resources Director)
Michael Russell FCMA (Finance Director)
Rich Storton MA (Marketing Director)
James Wren BA (Hon.) (Development Director)

ZSL/University College London Joint Committee

University College London
Professor Andrew Pomiankowski (Head of Genetics, Evolution and Environment)
Professor Mary Collins (Dean of Life Sciences)
Committee Chair
Professor John Carroll (Head of Biosciences and Associate Dean)
Dr Helen Chatterjee (Senior Lecturer in Biology and Deputy Director of Museums, Collections and Public Engagement)

ZSL
Ralph Armond (Director General)
Professor Geoff Boxshall FRS (Natural History Museum, ZSL Secretary)
Professor Ian Owens (Imperial College London)
Sir Cyril Chantler (appointed Chair UCL Partners)

In attendance:
Arun Mistry (Director of Finance, Faculty of Biomedical Sciences, UCL)
Loren Moyse (Director of Administration, Faculty of Life Sciences, UCL)
Professor Tim Blackburn (Director of the Institute of Zoology, ZSL)
Ian Meyrick (Human Resources Director, ZSL)
Michael Russell (Finance Director, ZSL)
Christina Herterich (Institute Administration Manager, ZSL); Committee Secretary

Institute of Zoology

Tim Blackburn DPhil (Director of the Institute of Zoology)

Senior Research Staff
Andrew Cunningham BVMS PhD Dip ECZM (Wildlife Population Health) MRCVS; Deputy Director, Institute of Zoology; Theme Leader, Wildlife Epidemiology
Chris Carbone DPhil, Theme Leader, Biodiversity and Macroecology
Guy Cowlshaw PhD, Theme Leader, Behavioural and Population Ecology
Trent Garner PhD, Theme Leader, Evolution and Molecular Ecology
William Holt PhD, Theme Leader, Reproductive Biology •
Sarah Durant PhD
Paul Jepson BVMS PhD Dip ECZM (Wildlife Population Health) MRCVS, Postgraduate Tutor
Kate Jones PhD, UCL and ZSL Chair, Ecology and Biodiversity
Jinliang Wang PhD
Rosie Woodroffe PhD

Postdoctoral Research Staff
Jon Bielby PhD
Monika Bähr PhD
Patricia Brekke PhD
Kate Ciborowski PhD
Ben Collen PhD
Stephanie Dreier PhD
John Ewen PhD
Tom Hart PhD
Aidan Keane PhD
Kirsty Kemp PhD
Becky Lawson MA VetMB MSc PhD Dip ECZM (Wildlife Population Health) MRCVS
Ellouise Leadbeater PhD
Rhianm Lloyd PhD •
Sinead Murphy PhD
Nathalie Pettorelli PhD
Nichola Raihani DPhil •
David Redding PhD
Marcus Rowecliffe PhD
Seirian Sumner PhD
Samuel Turvey DPhil
Christopher Vesselinovitch DPhil

Postgraduate Research Assistants
Liam Brerley
Ricardo Castro Cesar de Sa LVM MSc MRCVS
Kate Colville MA VetMB MSc MRCVS •
Clare Duncan •
Tim Hopkins
Louise McRae MSc
Huma Pearce •
Victoria Price •
Rebecca Vaughan-Higgins BSc BVMS MRCVS
CertAVP (zoo medicine) PhD •

Postgraduate Research Students
Claudia Amphlett
Claire Asher
Kate Baker
Farid Belbachir
Emily Bell
Lucie Bland
Paddy Brook
Sarah Brooke
Jessica Bryant
Emmeliana Bujak
Rose Cairns
Aléonor Chauvenet
Frances Clare
Fay Clark
Chris Clements
Murray Collins
Jennifer Crees
David Daversa
Tammy Davies
Julieta Decarre
Martina Di Fonzo
Caitlin Douglas
Simon Dures
Gillian Eastwood
Aisyah Faruk
Henry Ferguson-Gow
Helen Cross
Robin Curtis
Tommy Davies
Julietta Decarre
Martin Di Fonzo
Caitlin Douglas
Simon Dures
Gillian Eastwood
Rhys Farrer
Alison Peel
Stephen Price
Nadia Richman
Jennifer Sears
Su Shan
Lisa Signone
Freyaa Smith
Olutolani Smith
David Stanton
Leila Walker
Charlotte Walters
Oliver Wear
Jamie Wombwell
Veronica Zamora-Gutiérrez

Zoo Council

The Zoological Society of London

In attendance:
Arun Mistry (Director of Finance, Faculty of Biomedical Sciences, UCL)
Loren Moyse (Director of Administration, Faculty of Life Sciences, UCL)
Professor Tim Blackburn (Director of the Institute of Zoology, ZSL)
Ian Meyrick (Human Resources Director, ZSL)
Michael Russell (Finance Director, ZSL)
Christina Herterich (Institute Administration Manager, ZSL); Committee Secretary
Administrative and Support Staff
Christina Herterich LLM ACIS LPC (Institute Administration Manager)
Amrit Dehal BSc (Administrator – Information Systems)
Ishidra Dudhwa BA Hons Accounting & Finance (Administrator – Finance)
David Hitchcock (Administrator – Buildings & Capital Projects)
Joanne Keogh (PA/Administrator to Director, Administration Manager and Theme Leaders)
Lynne Rushton BSc Hons (Administrator – Health & Safety)

Research Technicians
Gemma Cuculas (Research Technician) •
Olivia Daniel (Research Technician)
Robert Deaville BSc (Cetacean Strandings Programme Manager)
Christopher Durrant (Research Technician)
Ellie Dyer (Research Technician)
Veronica Gomez-Pouroy (Research Technician)
Dado Gotelli (Chief Technician)
Shinto John MLT (Microbiology Technician)
Gabriela Peniche BSc Biol. VN MSc (Pathology Technician)
Matthew Perkins BSc (Pathology Technician)
Ian Warren (Laboratory Technician)

Project Administrators
Stefanie Deinet BA MSc (Living Planet Index Administrator)

Honorary Research Fellows
Dr Andrew Balmford, University of Cambridge
Professor Malcolm Bennett, University of Liverpool
Professor Tim Coulson, Imperial College London
Dr Peter Daszak, Consortium for Conservation
Dr Matthew Fisher, Imperial College London
Professor John Gittleman, University of Virginia, USA
Professor Katherine Homewood, University College London
Dr E J Milner-Gulland, University of Oxford
Professor Ian Warren, Royal Veterinary College

Honorary Research Associates
Jon Bridle
Jakob Bro-Jørgensen
Boris Dyubya
Simon Goodman
Marcela Kelly
Julie Leonard
Jonathan Loh

Visiting Research Fellows
Karina Acevedo-Whitchose
Tiffany Bogich

Scientific Publications and Meetings

Journals and Meetings
Linda DaVella BA (Head of Scientific Publications and Meetings)
Fiona Fisken BSc (Managing Editor, *International Zoo Yearbook*)
Anne Braze BSc (Journals Manager) •
Elina Rantanen PhD (Journals Assistant)
Megan Orpwood-Russell (Scientific Events Co-ordinator)

Editors Journal of Zoology
Nigel Bennett PhD (Editor-in-Chief)
Virginia Haysen PhD
Andrew Kitchener PhD
Rob Knell PhD
Mark-Oliver Rüdel PhD
Jean-Nicolas Wolff PhD
Reviews: Steven LeComber PhD

Editors Animal Conservation
Karina Acevedo-Whitchose PhD
Res Altwegg PhD
Trevor Branch PhD
Darren Evans PhD
Trent Garner PhD
Matthew Gompmer PhD
Ian Gordon PhD
Jeff Johnson PhD
Todd Katzer PhD
Nathalie Pettorelli PhD

Editors International Zoo Yearbook
David Field BSc MBA
Caroline Lees MSc
Kristin Leus LIC PhD
R. E. Miller DVM DACZM
Alex Rübel Dr Med Vet
Miranda Stevenson MBA PhD

Library
Ann Sylph MSc MCUP (Librarian)
Michael Palmer MA (Deputy Librarian/Archivist)
James Godwin (Library Assistant)
Ruth Jones MSc (Assistant Librarian)
Emma Milnes MA (Retrospective Book Cataloguer)

• departures
Ismerle Adeola
Alex Ashford
Leigh Barrett
Sultana Bashir
Kieran Bates
Claire Bedford
Amel Belbachir
Lawrence Bellamy
Rebecca Boulton
Ruth Bramwell
Sarah Brook
Zoe Brooke
Lola Brooks
Ellie Butcher
Madeline Castles
Anabel Clements
Amy Collins
Lucy Cook
Frazer Coomber
William Cornforth
Andrew Cozens
Daria Dadam
Alice Daish
Felicia Davies
Frances Davis
Maria del Mar Masdeu Cano
Adam Devenish
Nwando Dike
Lydia Doerr
Thomas Doherty-Bone
James Duffy
Annie English
Gema Escrivan Avila
Alice Fitch
Terri Freemantle
Marta Gavorek-Michalczewi
Jonas Geldmann
Pamela Giintenkamp
Michelle Goh
Rob Gordon
Zara Gorvett
Daphne Green
Jonathan Green
Joanna Haddock
Jade Hall
Daniel Hall
Nic Hannaford
James Hansford
Manuel Hernandez
Peter Hill
Rupert Houghton
Carla Jackson
Lasanthi Jayananda
Elizabeth Jones
Daniel Kachlerfess
Per Karlsson
Ryan Keen
Miles Keighley
Rachael Kemp
Daniela Kretz
Stephanie Landymore
Mike Laves
Sophie Ledger

Others working at the Institute, including volunteers working on projects in the field
Ismerle Adeola
Alex Ashford
Leigh Barrett
Sultana Bashir
Kieran Bates
Claire Bedford
Amel Belbachir
Lawrence Bellamy
Rebecca Boulton
Ruth Bramwell
Sarah Brook
Zoe Brooke
Lola Brooks
Ellie Butcher
Madeline Castles
Anabel Clements
Amy Collins
Lucy Cook
Frazer Coomber
William Cornforth
Andrew Cozens
Daria Dadam
Alice Daish
Felicia Davies
Frances Davis
Maria del Mar Masdeu Cano
Adam Devenish
Nwando Dike
Lydia Doerr
Thomas Doherty-Bone
James Duffy
Annie English
Gema Escrivan Avila
Alice Fitch
Terri Freemantle
Marta Gavorek-Michalczewi
Jonas Geldmann
Pamela Giintenkamp
Michelle Goh
Rob Gordon
Zara Gorvett
Daphne Green
Jonathan Green
Joanna Haddock
Jade Hall
Daniel Hall
Nic Hannaford
James Hansford
Manuel Hernandez
Peter Hill
Rupert Houghton
Carla Jackson
Lasanthi Jayananda
Elizabeth Jones
Daniel Kachlerfess
Per Karlsson
Ryan Keen
Miles Keighley
Rachael Kemp
Daniela Kretz
Stephanie Landymore
Mike Laves
Sophie Ledger

Deborah Leigh
Hila Levy
Stefania Lo Bianco
Jonathan Loh
Simon Mahood
Rafael Mares
Melissa Marr
Nicholas Masters
Vinamra Mathur
Niamh McHugh
Thalassa McMurdo-Hamilton
Rosemary Moorhouse-Gann
Katherine Moul
Amy Munro-Faure
Chloe North
Stefanie Oberprieler
Susanne Oford
Helen O’Neill
James Ounsley
Yuan Pan
Kevin Parker
Indi Pedrosan
Alison Peal
Matthys Petit
Robert Pickles
Cassandra Raby
Louise Raggett
Marcela Randau da Costa
Carvalho
Eveline Rijksen
Lucy Ritchie
Jo Roche
Inaki Rodriguez Prieto
Silvia Teresa Rodriguez Ramiño
Elizabeth Rowe
Christopher Rusi
Jon Russ
Margarida Saavedra
Christina Saliba
Catherine Sayer
Eleanor Smith
Robin Southon
Jenny Spencer
Fiona Spooner
Jonathan Summer
Benjamin Tapley
Michael Taylor
Rebecca Taylor
Ayako Tokumine
Jonathan Usherwood
Carmen Vazquez Martin
Heidi Vomdren
Mick Webber
Manuel Weber
Craig Williams
Faye Willman
StefanWiswedel
NadineWohl
Edward Wombwell
Erin Wright
Samid Yildirim
Bat drawings in the manuscripts of Samuel Richard Tickell (1811–1875) to celebrate the Year of the Bat
ZSL Library
Artefact of the month – September 2011
Determinants of Batrachochytrium dendrobatidis in European amphibian populations; Role of host movement and sexual behaviour in transmission of chytrid fungus in amphibians; IUCN Sampled Red List Index

Competition and coexistence of midwater taxa associated with emergence of ranavirus in Iberia

Museo de Historia Natural (Peru) Regional Red List Programme

Museo de Zooloogia (Venezuela) IUCN Sampled Red List Index

Museo di Storia Naturale dell’Università di Firenze (Italy) IUCN Sampled Red List Index

Museo National de la Historia Natural (Chile) IUCN Sampled Red List Index

Museo Tridentino di Scienze Naturali (Italy) IUCN Sampled Red List Index

Museum of Natural History (Switzerland) IUCN Sampled Red List Index

Museum National d’Histoire Naturelle (France) IUCN Sampled Red List Index

Museum für Naturkunde (Germany) IUCN Sampled Red List Index

Nanjing Normal University (China) Conservation of the Yangtze River dolphin; IUCN Sampled Red List Index

National Aeronautics and Space Administration (USA) Biodiversity indicators for 2010 and beyond; Determinants of occurrence, distribution and abundance of African mammals; The role of individual biology in determining population-level processes

National Agricultural Research Foundation (Greece) IUCN Sampled Red List Index

National Birds of Prey Conservation Project

National Institute for Medical Research Modelling amphibian response to Batrachochytrium dendrobatidis

National Institute for Public Health and the Environment (The Netherlands) IUCN Sampled Red List Index

National Institute of Water and Atmospheric Research (New Zealand) IUCN Sampled Red List Index

National Museum (South Africa) IUCN Sampled Red List Index

National Museum of Natural History of Spain IUCN Sampled Red List Index

National Museum of Nature and Science (Japan) IUCN Sampled Red List Index

National Museum of Wales IUCN Sampled Red List Index

National Oceanic and Atmospheric Administration (USA) IUCN Sampled Red List Index

National Science Foundation (USA) IUCN Sampled Red List Index

National Taiwan Ocean University IUCN Sampled Red List Index

National University of Ireland, Cork Deep-sea fauna of oceanic islands

National University of Ireland, Galway Deep-sea fauna of oceanic islands; IUCN Sampled Red List Index

National University of Mongolia Regional Red List Programme

National University of Singapore IUCN Sampled Red List Index

Natural England Health surveillance for species recovery programmes; Evaluating threat to the sand lizard from parasites harboured by the introduced wall lizard; Conservation genetics of adders in the UK; Assessing the conservation issue of Aegopogon snakes introduced onto Crested dragons

Natural History Museum Cetacean strandings investigation; The Frozen Ark project; IUCN Sampled Red List Index; Developing species identification systems for bat echolocation calls; Health surveillance for species recovery programmes

Natural History Museum of Bern (Switzerland) IUCN Sampled Red List Index

Natural History Museum of Crete (Greece) IUCN Sampled Red List Index

Natural History Museum of Zimbabwe IUCN Sampled Red List Index

Naturalis (The Netherlands) IUCN Sampled Red List Index

Nature Conservancy IUCN Sampled Red List Index

Nature Protection Trust (Seychelles) IUCN Sampled Red List Index

NatureServe (USA) IUCN Sampled Red List Index

Netherlands Institute for Ecology Deep-sea fauna of oceanic islands

New York State Department of Health (USA) West Nile virus emergence in Galapagos

New York State Diagnostic Laboratory (USA) Guam and the US Virgin Islands; Samburu-Laitipia Wild Dog Project

New York State Museum (USA) Camera trapping as a census tool

New Zealand Department of Conservation Sexual selection and the hiti

Nordens Ark (Sweden) IUCN Sampled Red List Index

North Carolina State Museum of Natural Sciences (USA) IUCN Sampled Red List Index

North of England Zoological Society IUCN Sampled Red List Index; Chytridiomycosis emergence in Dominica

North-West University (South Africa) Behavioural Ecology of Pyxicephalus adspersus; Testing the ‘Out of Africa’ hypothesis for the emergence of lethal amphibian chytridiomycosis; IUCN Sampled Red List Index

Northern Michigan University (USA) IUCN Sampled Red List Index

Norwegian Institute for Nature Research The role of individual biology in determining population-level processes in vertebrates

Old Dominion University (USA) IUCN Sampled Red List Index

O’Malley Fisheries (Ireland) Deep-sea fauna of oceanic islands

Omsk State Pedagogical University (Russia) IUCN Sampled Red List Index

Organización Zootropica (Guatemala) IUCN Sampled Red List Index

Paignton Zoo and Environmental Park Health surveillance for species recovery programmes

Palacky University Olomouc (Czech Republic) IUCN Sampled Red List Index

Pamukkale University (Turkey) IUCN Sampled Red List Index

Parks Canada Protected areas: trends in biodiversity Pennsylvania State University (USA) IUCN Sampled Red List Index

People’s Trust for Endangered Species Chytridiomycosis in Leptodactylus fallax; Health surveillance for species recovery programmes

Pig Improvement Company Investigation of predictors of boar sperm fertility following cryopreservation

Queens University Belfast IUCN Sampled Red List Index

Queens University Canada IUCN Sampled Red List Index

Queensland Museum (Australia) IUCN Sampled Red List Index

Rams IUCN Sampled Red List Index

Razi University (Iran) IUCN Sampled Red List Index

Reibikoff Foundation (Portugal) Deep-sea fauna of oceanic islands

Receiver of Wreck, Maritime and Coastguard Agency Cetacean strandings investigation

Rewilding Europe Rewilding Europe

Rheoxygen University London Individual optimization and social constraints in group-living vertebrates

Romanian Bat Protection Organisation Monitoring bat biodiversity in Eastern Europe

Rothamsted Research Management of bumble bee abundance; Role of host species in chick brood parasitism; Determinants of occurrence, distribution and abundance in African mammals; A national plan for carnivore conservation in Tanzania

Royal Botanic Gardens, Edinburgh IUCN Sampled Red List Index

Royal Botanic Gardens, Kew IUCN Sampled Red List Index

Royal Danish Academy of Fine Arts IUCN Sampled Red List Index

Royal Netherlands Institute for Ocean Research Deep-sea fauna of oceanic islands

Royal Society for the Protection of Birds Conservation of Gyps spp. vultures in India; Garden Bird Health Initiative; Health surveillance for species recovery programmes; Impact of disease in the decline of house sparrows in the UK; The Living Planet Index Garden wildlife health

Royal Veterinary College Enhancement of sperm cell survival by epithelial and evdatable epithelial cells; Predictors of boar sperm fertility following cryopreservation; Wildlife health bridge; Problem-solving in primates; Bat conservation and social constraints in group-living vertebrates; Epidemiology of parovirus in squirrels

Russian Academy of Sciences IUCN Sampled Red List Index

Rutgers University (USA) Comparative studies linking ecology, evolution and physiology; Ecology and evolution of invasive alien species

Sahara Conservation Fund Determinants of occurrence, distribution and abundance in African mammals

Saint Petersburg Scientific Research Center (Russia) IUCN Sampled Red List Index

Salmonella Reference Unit, Health Protection Agency Garden Bird Health Initiative

San Diego Natural History Museum (USA) IUCN Sampled Red List Index

San Diego Zoo (USA) IUCN Sampled Red List Index

ScaraNet IUCN Sampled Red List Index

Scenic Hudson (USA) IUCN Sampled Red List Index

Scottish Agricultural College Cetacean strandings investigation; Garden Bird Health Initiative

Scottish Salmonella Reference Laboratory Bird Health Initiative

Scipps Institute of Oceanography (USA) International Programme on the State of the Ocean

Sea Fisheries Research Institute (South Africa) IUCN Sampled Red List Index

Sea Mammal Research Unit Cetacean strandings investigation; Parasitism, immunity and sexual dimorphism in the Galapagos sea lion

Seawatch Foundation Cetacean strandings investigation

Senckenberg Naturmuseum Frankfurt (Germany) IUCN Sampled Red List Index

Settlement Virus Normal University (China) Disease threats and conservation of the Chinese giant salamander

Simon Fraser University (Canada) Odontorceptor gene expression in homing in Atlantic salmon

Smithsonian National Museum of Natural History (USA) IUCN Sampled Red List Index

Smithsonian Institute (USA) Genetics of caste determination in polistine wasps; Metabolic syndrome; a potential risk factor in African elephant infertility; Camera trapping as a census tool

South African National Biodiversity Institute IUCN Sampled Red List Index; Regional Red List Programme

South African National Biodiversity Institute IUCN Sampled Red List Index

South Australian Museum (Australia) IUCN Sampled Red List Index

Southeastern Louisiana University (USA) IUCN Sampled Red List Index

Species 2000 IUCN Sampled Red List Index

State Natural History Museum Braunschweig (Germany) IUCN Sampled Red List Index

State University of New York (USA) IUCN Sampled Red List Index

Station d’Ecologie Expérimentale du CNRS á Moulis (France) Determinants of Batrachochytrium dendrobatidis emergence in the Ivory Coast population; Ecology and evolution of introduced avian malaria

State Institute for Nature Protection (Croatia) Regional Red List Programme

State Museum of Natural History (Germany) Regional Red List Programme; IUCN Sampled Red List Index

Statistics Netherlands IUCN Sampled Red List Index

Stellenbosch University (South Africa) Comparative studies linking ecology, evolution and physiology; Ecology and evolution of invasive alien species; IUCN Sampled Red List Index

Stony Brook University (USA) West Indian mammal extinctions

Swedish Board of Fisheries IUCN Sampled Red List Index

Swedish Species Information Center IUCN Sampled Red List Index

Swiss Federal Institute for Forest, Snow and Landscape Research IUCN Sampled Red List Index

Tanzania National Parks Long-term demography of the Serengeti cheetah population; National Conservation Action Plan for Tanzanian mammals; A national plan for carnivore conservation in Tanzania

Tanzania Wildlife Research Institute Long-term demography of the Serengeti cheetah population; National Conservation Action Plan for Tanzanian mammals; A national plan for carnivore conservation in Tanzania; Determinants of occurrence, distribution and abundance in African mammals; CUT plan for large carnivore management in Tanzania

Tarangire Elephant Project (Tanzania) A national plan for carnivore conservation in Tanzania

Technical University of Denmark IUCN Sampled Red List Index

Collaborations 37
Staff Representation

Professional Affiliations

Agencia Nacional de Evaluación y Prospectiva (ANEP), Spain
Karina Acevedo-Whitehouse (Reviewer)
American Society of Ichthyologists and Herpetologists
Trent Garner (Member)
American Society of Tropical Medicine and Hygiene
Gillian Eastwood (Member)
Amphibian Ark Biobanking Advisory Group
Rhiannon Lloyd (Biobanking Officer)
Animal Health Information Specialists (UK and Ireland)
Ann Sylvester (Member)
Bat Conservation Trust, UK
Kate Jones (Trustee)
British Andrology Society
William Holt (Committee Member)
British Ecological Society
Jon Bielby (Member); Tim Blackburn (Council Member); Patricia Brekke (Member); Ellie Dyer (Member); Trent Garner (Member); Kirsty Kemp (Member); Nathalie Pettorelli (Member)
British Society for Parasitology
Jon Bielby (Member)
British Veterinary Zoological Society
Kate Calive (Member); Andrew Cunningham (Member)
Bushmeat Working Group
Guy Cowlishaw (Member); Marcus Rowcliffe (Member)
Centre for Ecology and Evolution
Tim Blackburn (Member, Steering Committee); Kate Jones (Member, Steering Committee)
Centro Interdisciplinario de Ciencias Marinas, Mexico
Karina Acevedo-Whitehouse (Honorary Professor)
Charity Archivists and Records Managers Group
Michael Palmer (Member)
Conservation Commons
Ben Collen (Member, Steering Committee)
Defenders of Wildlife
Rosie Woodroffe (Member, Scientific Advisory Board)
Department for Environment, Food and Rural Affairs
Andrew Cunningham (Member, Amphibian Health Advisory Committee); Trent Garner (Member, Amphibian Health Advisory Committee)
European Cetacean Society
Karina Acevedo-Whitehouse (Member)
European College of Zoological Medicine
Andrew Cunningham (Diplomat, Chair, Wildlife Population Health); Anthony Sainsbury (Member)
European Society for Evolutionary Biology
Trent Garner (Member)
European Wildlife Disease Association
Becki Lawson (Member, Student Activities Council)
Fisheries Society of the British Isles
Kirsty Kemp (Member)
Frozen Ark
William Holt (Member, Steering Group); Rhiannon Lloyd (Member, Steering Group)
Gametes Society
Trent Garner (Member)
GEO-BON
Nathalie Pettorelli (Member)
Herpetologist’s League
Trent Garner (Member)
Hihi Recovery Group
Patricia Brekke (Member)
International Advisory Group for the Northern Bald Ibis
Andrew Cunningham (Committee Member)
International Association for Ecology and Health
Karina Acevedo-Whitehouse (Member)
International Council for Exploration of the Sea
Paul Jeppson (Member, Ad hoc Advisory Group on the Impact of Sonar on Cetaceans)
International Embryo Transfer Society
William Holt (Co-chair, CANDES Regulatory Committee)
International Foundation for Science
Marcus Rowcliffe (Member, Scientific Advisory Committee)
International Union for the Study of Social Insects
Serian Sunner (Member, Secretary for British Section)
IUCN SSC
Tim Blackburn (Member, Invasive Species Specialist Group); Monika Böhm (Member, Snake and Reptile Red List Authority); Ben Collen (Member, Red List Committee; Co-Chair, National Red List Working Group; Member, Red List Technical Working Group; Member, Hippo Specialist Group); Andrew Cunningham (Member, Veterinary Specialist Group; Member, Conservation Breeding Specialist Group; Sarah Durant (Member, Cat Specialist Group); John Ewen (Member, Reintroduction Specialist Group); Trent Garner (Member, Amphibian Specialist Group); Dada Gottelli (Member, Canid Specialist Group); Kate Jones (Member, Chiroptera Specialist Group); Anthony Sainsbury (Member, Wildlife Health Specialist Group); Samuel Turvey (Member, Cetacean Specialist Group); Sarah Durant (Co-ordinator, Small Mammal Specialist Group); Rosie Woodroffe (Member; Co-ordinator, African Wild Dog Working Group; Member, Canid Specialist Group; Member, Wildlife Health Specialist Group)
Kenya Wildlife Service
Rosie Woodroffe (Member, Steering Group on Conservation and Management of Large Carnivores)
King Saud University
Tim Blackburn (Member, Distinguished Scientist Fellowship Scheme)
Laurentian University
Trent Garner (Adjunct Professor)
London Biology Librarians Group
Ann Sylph (Member)
London Invasive Species Initiative
Elie Dyer (Committee Member)
London Learned and Professional Societies Librarians Group
Michael Palmer (Member)
Marine Mammal Society
Karina Acevedo-Whitehouse (Member; Committee Member; Sea Lion Carcinoma Working Group)
Mexican National Science Academy
Karina Acevedo-Whitehouse (Member)
Mexican Society of Marine Mammalogy
Karina Acevedo-Whitehouse (President Elect; Committee Member, Veterinary Specialist Group)
Nature Conservation Trust, South Africa
Sarah Durant (Trustee)
New Zealand Department of Conservation
John Ewen (Co-chair, Hihi Recovery Group)
Office International des Epizooties
Andrew Cunningham (Member, Ad hoc Group on Amphibian Diseases)
Rainforest Life
Ben Collen (Member, Environmental Advisory Committee)
RAMS
Nathalie Pettorelli (Invited Expert, Scientific and Technical Review Panel)
Royal Veterinary College
Andrew Cunningham (Visiting Professor)
Sheep Trust
William Holt (Trustee)
Societas Europaea Herpetologica
Trent Garner (Member, Conservation Committee)
Society for Conservation Biology
Nathalie Pettorelli (Member)
Society for the Study of Amphibians and Reptiles
Trent Garner (Member)
Society of Vector Ecology
Gillian Eastwood (Member)
Student Conference on Conservation Science
Guy Cowlishaw (Member, Conference Advisory Committee)
UK Cetacean and Marine Turtle Biodiversity Action Plan Steering Group
Paul Jeppson (Member)
UNEP-WCMC
Ben Collen (Honorary Fellow; Lead Author, Global Environmental Outlook)
University College London
Tim Blackburn (Honorary Professor); Andrew Cunningham (Honorary Professor); Ellie Dyer (Honorary Research Associate)
University of Birmingham
Tim Blackburn (Honorary Professor)
University of Liverpool
Andrew Cunningham (Honorary Senior Research Fellow)
University of Oxford
Tim Blackburn (Visiting Professor)
Wildlife Disease Association
Anthony Sainsbury (Member, Scientific Committee, European Section)
Working Dogs for Conservation
Rosie Woodroffe (Member, Science Advisory Board)
World Congress of Herpetology
Trent Garner (Member, Executive Committee)
Zebra Foundation for Veterinary Zoological Education
Beki Lawson (Council Member)
Zirnhilttagi, Sardinia
Jon Bielby (Member); Trent Garner (Member)

Editorial Positions

Animal Conservation
Karina Acevedo-Whitehouse (Editor); Jon Bielby (Associate Editor); Tim Blackburn (Associate Editor); Peddy Brock (Associate Editor); Trent Garner (Editor); Nick Isaac (Associate Editor); Nathalie Pettorelli (Editor)
Animal Reproduction Science
William Holt (Member, Editorial Board)
Biological Reviews
Guy Cowlishaw (Member, Editorial Board)
Computational and Mathematical Methods in Medicine
Jinliang Wang (Member, Editorial Board)
Cryobiology
William Holt (Member, Editorial Board)
Diseases of Aquatic Organisms
Andrew Cunningham (Editor)
EcoHealth
Jon Bielby (Reviews Editor); Andrew Cunningham (Member, Editorial Board)
Ecological Applications
Trent Garner (Member, Editorial Board)
Emu: Austral Ornithology
John Ewen (Associate Editor)
Endangered Species Research
Andrew Cunningham (Editor); Marcus Rowcliffe (Editor)
European Journal of Wildlife Research
Anthony Sainsbury (Associate Editor)
Global Ecology and Biogeography
Kate Jones (Editor)
Journal of Applied Ecology
Nathalie Pettorelli (Associate Editor)
Journal of Evolutionary Biology
Jinliang Wang (Member, Board of Reviewing Editors)
Journal of Zoology
Jon Bielby (Member, Editorial Board); Trent Garner (Member, Editorial Board); Nichola Raihani (Member, Editorial Board)
Latin American Journal of Aquatic Mammals
Karina Acevedo-Whitehouse (Editor)
Neobiota
Tim Blackburn (Editor)
Proceedings of the Royal Society B: Biological Sciences
Guy Cowlishaw (Member, Editorial Board)
Scientific Reports
Andrew Cunningham (Editor)
Tropical Conservation Science
Ben Collen (Associate Editor)
Wildlife Research
Andrew Cunningham (Associate Editor)


PhD Theses


Minting, P. (2012) An investigation into the effects of Batrachochytrium dendrobatidis (Bd) on natterjack toad (Bufo calamita) populations in the UK. University of Sussex, UK.


MScTheses – Conservation Science
Awarded by Imperial College London, UK


Bramwell, R. (2011) Do salinity and pH help protect natterjack toads from chytridiomycosis, a disease caused by the amphibian fungus Batrachochytrium dendrobatidis (Bd)?


Davey, A. (2011) Mapping the distribution and prioritising the control of Casuaria equisetifolia in the Turks and Caicos Islands.

Elliot, G. (2011) Mapping the spring and winter distribution of Kalmynia’s saiga population.


Knott, E. (2011) Changes in hunting policy: who bears the cost?


Thompson, B. (2011) Investigating the economic viability and practicability of a blue carbon pilot project: a case study from Panay Island, the Philippines.

MScTheses – Wild Animal Health
Awarded by the University of London, UK

Castanos, A. (2011) Prevalence of tick infestation in exotic reptiles imported into the UK through Heathrow Airport.


Jaffe, J. (2011) Anaesthesia with medetomidine-ketamine and dexmedetomidine-ketamine in mountain gorillas (Gorilla beringei beringei).


Wetten, S. (2011) Songbird chlamydiosis – an emerging infectious disease or missed endemic infection?


Pinion, V. (2011) Is pasture structure and plant composition the key to explaining the mass die-off of the Saiga antelope, Saiga tatarica tatarica, in the Borys region of Kazakhstan?


Vanlengerberghe, S. (2011) Developing a standardised system for the objective measurement of pathological lesions of feet in captive elephants in the UK and Ireland.


Youl, L. (2011) Optimising the qPCR assay for the detection of Batrachochytrium dendrobatidis: a comparison between BSA and a commercial DNA clean-up step.
For further information about the Institute of Zoology please contact:

Tim Blackburn
Director of the Institute of Zoology

Institute of Zoology,
The Zoological Society of London
Regent’s Park
London NW1 4RY

Telephone +44 (0)20 7449 6610
enquiries@ioz.ac.uk

www.zsl.org
@ZSLScience