Science for Conservation

Annual Report of the Institute of Zoology 2009/10
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
We undertake research and research training in the following themes (see pages 8–17):
- Biodiversity and macroecology
- Behavioural and population ecology
- Genetic variation, fitness and adaptability
- Wildlife epidemiology
- Reproductive biology

We provide education through MSc and PhD programmes.

Science Plan
The major topics:
- Biodiversity patterns and processes
- How can we explain and model biological diversity at a range of spatial, temporal and biological scales?
- People and the environment in a changing world
- How can we manage wild species and habitats sustainably alongside human population growth and development?

With the Zoological Society of London
We respond to research questions and contribute to ZSL's Conservation Programmes (see pages 20–21):
- Conservation Breeding and Reintroduction; EDGE; Indicators and Assessments; Marine and Freshwater; Wildlife Health
- Africa; South and Central Asia; South East Asia; UK, Europe and Mongolia

We respond to research questions and contribute to ZSL's living animal collection:
- Animal Health and Welfare research
- Reproductive monitoring

We run a programme of meetings and publications (see page 22):
- Journal of Zoology and Animal Conservation
- 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)

ZSL

Universities and other institutions
We maintain and develop research links with institutions in London:
- We maintain and develop research links with academic bodies, especially the Centre for Ecology and Evolution. We run MSc courses in Wild Animal Health and Wild Animal Biology with the Royal Veterinary College and an MSc in Conservation Science (see page 27).
- Our research is influenced by London-based conservation issues.

With institutions in London
- Collaboration with most relevant outside bodies for our core research interests (see page 33).
- Our meetings facilities and programme of talks communicate science and conservation.

University of Cambridge
We contribute to the Tropical Biology Association programme and Cambridge Student Conference.

With other organisations
- Our meetings facilities and programme of talks communicate science and conservation.
UK science has a long history of innovation and excellence. In the case of the Zoological Society of London (ZSL), that is a history that goes back 184 years to its founding as one of the world’s first learned societies aiming to promote the study of zoology. ZSL initially pursued this aim by setting up the world’s first scientific zoo, but as the focus of the zoo changed from academic resource to visitor attraction, the scientific mantle was taken up by the Institute of Zoology. For more than 40 years, the Institute has pursued its research agenda, which is now focused on its aim to undertake and promote relevant high-quality zoological and conservation research, to help ZSL to achieve its conservation objectives and to inform and influence conservation policy.

For the dedicated scientists and students that carry out that research, it will be extremely gratifying to see the conclusions of a review of the Institute by its principal funding body, the Higher Education Funding Council for England (HEFCE, reported on page 3), that concludes that the Institute is a unique, distinctive and world-class organisation. This uniqueness derives not just from the high-quality scientific research the Institute produces, but also in how the knowledge gained from that research is applied to real world issues facing conservation practitioners, governments and wider society. Institute scientists provide policy advice to more than a dozen departments of UK government, including Defra, the Ministry of Defence, the Department for International Development, Natural England and UK Customs and Excise, and to more than a dozen foreign governments, from Ecuador to Indonesia. The national and international policy relevance of Institute research can clearly be seen in the work reported in the pages that follow.

The scientific rigour and impartiality of the Institute also makes it an invaluable source of independent and authoritative advice to NGOs. Institute scientists collaborated with more than 50 UK and international NGOs in 2007/2008 alone, as well as a range of multi-governmental organisations, including several branches of the United Nations. The Institute is also building capacity in conservation science worldwide by educating students on its Masters and Doctoral study programmes. Its Masters alumni alone come from almost 50 countries worldwide, and from six of the seven continents.

The value provided by the Institute from the funding it receives is clear, but it could not do so much without the support of its many partners in research and education (a full list of these takes up pages 33–36), most notably through its academic affiliation with the University of Cambridge, and postgraduate teaching links with the Royal Veterinary College and Imperial College. On behalf of ZSL, I congratulate the Institute for its continued success and impact, and hope that its unique position in the research community continues to be recognised.

Professor Sir Patrick Bateson
President of the Zoological Society of London
We seem to be cursed at the moment to live in interesting times. Last year, I concluded my introduction to Science for Conservation with a prediction of a period of financial austerity. While that was hardly a rare insight in the circumstances, it has nevertheless been proved accurate, if a little understated. We have had a change of government, and the resulting coalition seems set on eradicating Britain’s huge budget deficit in one parliament, in part through severe cuts in public spending. IoZ has so far managed to escape the financial turmoil relatively unscathed. Whether we continue to do so depends on how the Comprehensive Spending Review due out in October 2010 translates the scary noises currently being made by the government into budgetary action.

If Wikipedia is to be believed, the ‘Chinese curse’ is actually the first of three curses of increasing severity. The second is sometimes rendered as ‘May the government be aware of you.’ In October 2009, the Higher Education Funding Council for England (HEFCE) announced that it was instituting a review of the Special Factor funding it grants to IoZ. The aims of the review were to assess whether HEFCE was the appropriate body to fund IoZ, whether it was appropriate for IoZ to receive funding over and above what it would receive were it a normal university zoology department, and what the appropriate level of funding for IoZ should be, based on our distinctiveness, quality and efficiency. You can read more about the outcome in the IoZ News section opposite, but the bottom line was an extraordinary validation of the value that IoZ provides for the funding it receives. HEFCE even approved an increase to the IoZ grant, at least for the 2010/2011 funding year.

My three years as Director of IoZ have been interesting times indeed. It has been hard work dealing with the pressures of the HEFCE review, and before that the RAE, but these pressures have been made easier by the quality of our staff and students, which speaks for itself. Looking forward, I might be tempted to wish for a less interesting year to come. However, I am mindful of the last, and most severe, of the three curses: ‘May you find what you are looking for.’

Tim Blackburn
Director of the Institute of Zoology
The last twelve months saw a review of the core funding that IoZ receives from the UK government via the Higher Education Funding Council for England (HEFCE). HEFCE had not reviewed its funding to IoZ for almost a decade, and so this process was long overdue. The review entailed IoZ submitting a case for continued support against seven assessment criteria: Extent of funded activities; The relationship to HEFCE’s strategic aims and objectives; Public value and benefit; The relationship between the public value and benefit, and the QR-rated activity; Value for money; Comparison with other providers of zoological research, both within the HE sector and elsewhere; and Accountability for the use of public funds. HEFCE then convened an Advisory Group of subject specialists to consider IoZ’s submission, and to offer advice to HEFCE on any future level and method of funding.

The report of the Advisory Group was extremely complimentary of IoZ’s work. The Group concluded that IoZ met all the review criteria, and indeed is a unique, distinctive and world-class organisation. They also noted that the level of HEFCE funding is broadly appropriate given the range and quality of our activities, and that IoZ is focusing on the right areas of activity. Finally, the Advisory Group concluded that IoZ is making a significant contribution to HEFCE’s strategic aims and objectives, and hence it is appropriate for HEFCE to remain the principal funder. As a result of this, the HEFCE Board agreed that its funding to IoZ should continue at a similar level, and approved an increase in funding to IoZ for 2010/2011 of 2% over the level in the previous year.

We can be very proud of the outcome of a governmental review that recognises the quality and value of the work done at IoZ, but it is worth injecting a note of caution. HEFCE were clear that IoZ funding should reflect the broad decisions about research funding that take into account the pressure of public funding in the coming years. Exactly how any government cuts will impact on the UK research sector is currently unclear, though it is likely that the climate will not be so positive in the immediate future. Nevertheless, IoZ enters this period in a position of strength. As HEFCE representative David James wrote in notifying us of their Board’s decision, ‘Of course the future of public funding is very uncertain for everyone, but I hope your colleagues at the Institute see this as a clear endorsement of their work.’

Congratulations are due to Nathalie Pettorelli for winning a L’Oreal Women in Science Fellowship. This award provides Nathalie with £15,000 to support her project entitled Developing a global monitoring framework for protected areas. Nathalie was one of four recipients chosen from over 200 applicants across all areas of UK science. She is also the second winner from IoZ in the four years that the award scheme has been running, which reflects well on the quality of, and support for, our female scientists.

Congratulations are also due to Andrew Cunningham, who was the recipient of a prestigious Royal Society Wolfson Research Merit Award. The aim of this award scheme is to provide academic organisations with additional support to enable them to retain respected scientists of outstanding achievement and potential. The award will help support Andrew in his project entitled Infection and spillover dynamics of zoonotic viruses in African bats, and provides clear evidence of his high standing in the research community.

Elli Leadbeater has been awarded an Early Career Fellowship from the Leverhulme Trust to work at IoZ on the behaviour and genomics of honey wasps. Honey production is inextricably linked to the honeybee, a hugely important and endangered pollinator of agricultural crops. Yet, the little-studied social honey wasps are of enormous biological interest as they produce a honey harvest that humans consume. This project will establish the extent to which features of foraging organisation are shared, from a behavioural and genomic perspective, in the honey wasp and honeybee.

It is with great sadness that we have to say goodbye to Alex Rogers, who is leaving for a Chair at the University of Oxford. Alex’s contributions to the scientific and conservation work of IoZ have been outstanding, and it is no surprise that such a prestigious post has come his way. We wish him all the best for the future, but look forward to seeing him regularly, as he plans to continue to collaborate with staff at ZSL.

On 14 June 2010, IoZ scientists Seirian Sumner, Kate Jones and Charlotte Walters transformed Speakers’ Corner in Hyde Park, London into an arena for public learning and debate centred round the National Science and Engineering Week’s 2010 theme of ‘Earth’ (see page 32). Scientists at Speakers’ Corner hosted 16 UK scientists, who stood on soapboxes to speak to the public about their science. Speakers were assigned to one of three themed sessions: Evolution of the Earth (e.g., biodiversity, evolution, palaeontology), Earth Challenges (e.g., climate change, population growth, biodiversity loss), Earth Solutions (e.g., sustainable energy, GM crops, biodiversity conservation). A new set of speakers was brought on every hour, keeping the topics, crowds and discussions varied and fluid. It was such a stimulating experience for the speakers that many had to be asked politely to step down in order to allow the next speaker on! The event was reported on in Science and New Scientist Blog.
Assessing the impact of *Batrachochytrium dendrobatidis* on amphibians in Sardinia

The island of Sardinia is a European hotspot of amphibian endemism and threat. Of the nine native species of frogs, toads and salamanders on Sardinia, seven are restricted solely to the island and six are classified as threatened according to the IUCN Red List. In 2007 a collaboration between the Sardinian NGO Zirichiltaggi and IoZ researchers confirmed the presence of the fungal parasite *Batrachochytrium dendrobatidis* (*Bd*). Chytridiomycosis, the disease caused by *Bd*, has been linked to amphibian species extinctions and population declines worldwide, and potentially represents a very serious threat to amphibians on Sardinia. Funded by the People's Trust for Endangered Species, the Zirichiltaggi-IoZ collaboration has conducted extensive surveys on the island to ascertain the geographic distribution and host-specificity of *Bd* on Sardinia. As yet, the only hosts associated with infection by *Bd* are the endangered Sardinian brook newt, *Euproctus platycephalus*, which has been described as Europe’s rarest amphibian species, and the Sardinian painted frog, *Discoglossus sardus*, which has suffered mass mortalities consistent with chytridiomycosis at three infected sites. As yet, the population-level impacts of *Bd* and the transmission dynamics responsible for maintaining infection within populations are not known. However, future research conducted by Zirichiltaggi and IoZ will aim to address just these issues, which are vital for obtaining a better understanding of *Bd* on the island, and informing the management and conservation of Sardinian amphibians.

PanTheria

Kate Jones and colleagues have completed the first global dataset of the life histories and ecologies of all mammals. The database called ‘PanTheria’ (Pan – global and Theria – mammals) is the most comprehensive of its kind in the world, containing data on body size, population density, gestation lengths and litter sizes for over 5,000 species from bats to whales. Collating this information from the scientific literature was an enormous task that has been ongoing for over ten years and has involved over 20 people in three different countries. The database has been used to explore factors that predispose different mammalian species to extinction – from human encroachment to slow reproductive rate – invaluable for conservation management. In a further collaboration with Nick Isaac, the database has been converted into an online interactive website, where registered users can input data from the literature into the database – now called ‘YouTheria’ – i.e., you – putting the data in! Now the database is being used to test further hypotheses about species abundance, ecology and evolution. In 2011 a special issue of *Philosophical Transactions of Royal Society* will be published, which explores many of the patterns and underlying processes in these data.

Coordinating group life in wild primates

Where it is beneficial for animals to live in groups, then individuals need to coordinate their activities so that the group remains cohesive. The ZSL Tsarobis Baboon Project has been investigating how baboons that live on the edge of the Namib Desert coordinate their activities. For instance, at a broad scale, we found...
that female reproductive state was important. Many fertile females lowered group synchrony because males were distracted by mating opportunities, and many pregnant females increased synchrony as females concentrated on foraging to find enough food to meet their increasing appetites. At a finer scale, when foraging, females dined with their male partners when pregnant, were followed by males when fertile, and generally tended to coordinate their foraging with their close female friends. Our findings allow us to better understand how social animals with different needs and motivations remain cohesive and avoid group fission.

Postmortem evidence of interactions of bottlenose dolphins with other dolphin species in south-west England

The UK Cetacean Strandings Investigation Programme (CSIP) has previously recorded harbour porpoises (*Phocoena phocoena*) found stranded in various coastal regions of the UK that had died as a result of violent interactions with bottlenose dolphins (*Tursiops truncatus*). In a paper published in the *Veterinary Record* last year, pathology consistent with bottlenose dolphin interaction was described in several other cetacean species found stranded in south-west England. They comprised four common dolphins (*Delphinus delphis*), one juvenile Risso’s dolphin (*Grampus griseus*) and one adult striped dolphin (*Stenella coeruleoalba*). Although the observed traumatic lesions were often not as severe as those found in harbour porpoises, it is probable that the interactions did contribute to stranding and/or death in several of the examined animals. A number of causes have been suggested for these interactions in UK stranded harbour porpoises and it is possible that similar factors may also be implicated in the cases described in this study.


Developing tools to monitor bushmeat hunting

Monitoring threats to biodiversity in the tropics using established methods is frequently difficult and costly, and there is an increasing need for innovative approaches. In this research programme, we addressed how the impacts of bushmeat hunting can be monitored in ways that balance scientific rigour with practical feasibility. First, we evaluated the reliability of catch and effort data reported by hunters in Equatorial Guinea, comparing it with the results of direct observations of these variables, and finding a good correlation between methods (Rist *et al.* 2010). Since self-reporting can achieve much greater temporal and spatial coverage of hunting activities for a fraction of the cost, it is clearly a much more cost-effective way to monitor hunting impacts in this case. Second, we show how hunting and habitat interact to determine the abundance of animals in the same study site, highlighting the need to take habitat variability into account when assessing hunting impacts (Rist *et al.* 2009).

Research at the Institute of Zoology is organised into five Research Themes:

- **Biodiversity and Macroecology** page 8
- **Behavioural and Population Ecology** page 10
- **Genetic Variation, Fitness and Adaptability** page 12
- **Wildlife Epidemiology** page 14
- **Reproductive Biology** page 16

Each Research Theme group is made up of several research fellows, post-doctoral research assistants and PhD students, and is led by a Senior Research Fellow or Reader. 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.
Extinction dynamics in a freshwater cetacean

An extensive series of interviews in riverside fishing communities across the middle-lower Yangtze River drainage has provided substantial new information into the extinction of the Yangtze River dolphin or baiji (*Lipotes vexillifer*), probably the first large mammal species to have become extinct in over 50 years. The species was formerly believed to have experienced major range collapse during its decline, but new analyses demonstrate that baiji population decline was not associated with any major contraction in geographic range even in the decade immediately before its probable global extinction, possibly because the species apparently underwent large-scale periodic and seasonal movements across the river system. Range contraction and fragmentation may therefore not be general biogeographic characteristics for declining populations of mobile species in connected landscapes. However, although local ecological knowledge can provide a unique source of data for conservation, it is unlikely to remain constant over time. Loss of perspective about past ecological conditions caused by lack of communication between generations may create ‘shifting baseline syndrome’, in which younger generations are less aware of local species diversity or abundance in the recent past. Although Yangtze informants across all age classes were strongly aware of the

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**Healthy Mum – Eggcellent chicks: maternal diet key to chick survival**

Dietary ingested carotenoid biomolecules have been linked to both improved health and immunity in birds and other animals (including humans). We tested whether maternally invested egg carotenoids could offset the cost of parasitism in developing nestlings of an endangered New Zealand bird, the hihi (*Notiomystis cincta*). Bloodsucking mites (*Ornithonyssus bursa*) are a globally widespread parasite that frequently infest hihi nests, reducing chick quality and inhibiting population growth following reintroduction management. Our study clearly showed the negative effects of parasitism on nestlings, and revealed that maternally derived carotenoids could compensate this cost, resulting in growth parameters and ultimate mass achieved being similar to nonparasitised young. Our study offers a unique example of a direct positive relationship between enhanced maternal investment of carotenoids and an ability to cope with a specific and costly parasite in young birds. As *O. bursa* infestations reduce population viability in hihi, our findings also highlight the importance of key nutritional resources for endangered bird populations to better cope with common parasite infestations.


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**Mean growth of male (black symbols) and female (white symbols) hihi nestlings in four treatments:** *Ornithonyssus bursa* treatment and carotenoids ( )); *O. bursa* treatment but no carotenoids ( ); carotenoids but no *O. bursa* treatment ( ); and neither *O. bursa* treatment nor carotenoids ( ).

Bars accompanying the symbols are standard errors. The curves show mean projected growth with the solid lines showing projected growth of male and female nestlings that receive mite treatment and/or carotenoids, and dotted lines showing projected growth of nestlings receiving neither mite treatment nor carotenoids.

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**Mass (g) vs. Days after hatching**

river ecosystem’s escalating environmental degradation, older informants were more likely to recognise declines in commercially important fish species. Younger informants were also significantly less likely to have even heard of baiji or the possibly extinct Yangtze paddlefish. This rapid rate of cultural baseline shift suggests that once even megafaunal species cease to be encountered on a fairly regular basis, they are rapidly forgotten by local communities.


These frequency distributions of mean effect sizes from a wide range of studies on exotic birds show that migrating and dichromatic species tend to have lower establishment success in novel environments (negative effect sizes), while species with large geographic ranges, able to occupy many different habitats, and with broad diets, tend to have higher establishment success (positive effect sizes).

Following birds along the invasion pathway

Biological invaders represent one of the primary threats to the maintenance of global biodiversity, human health, and the success of human economic enterprises. Thus, there is a pressing need to understand the process of biological invasion. For birds, the identities of introduced species have historically depended on a combination of societal demands for species with certain characteristics, and the availability of species for capture, transport and release. However, both societal demands and availability have changed over time, which should lead to changes in the characteristics of species introduced more recently. Blackburn et al. (2010) quantified temporal changes in selectivity of introduced bird species by comparing the characteristics of 423 species listed in a seminal 1981 catalogue of introduced birds with those of 122 species introduced more recently. We demonstrated differences between these two groups of species in the frequencies with which different taxa are represented, in the geographic range sizes of species, and in their biogeographic regions of origin. These differences relate to changes in attitudes, legislation and vectors of transport relating to exotic species.

Once an exotic species has been introduced, the most consistent predictor of whether or not it establishes a viable population is the number of individuals released into the non-native location (propagule pressure). However, the reasons why we expect propagule pressure to be important – because larger propagules ameliorate the effects of demographic, environmental or genetic stochasticity, or of Allee effects – also predict an influence of species traits on success. A second study by Blackburn et al. (2009) used quantitative meta-analysis to assess the effect of different categories of species traits in the successful establishment of non-native bird species. Traits that predispose species to Allee effects tended to decrease establishment success, whereas traits that enable a species to cope with novel environments tended to increase success. The breadth of habitats a species uses has the strongest mean effect of all variables analysed. These results suggest that considering the traits of biological invaders in terms of the small-population paradigm from conservation biology may be a productive avenue for future research.


Cooperation and punishment in fish

Cooperation is an evolutionary puzzle. The theory of evolution by natural selection predicts that individuals will benefit from selfish behaviour, yet cooperation is common in nature. In recent years, researchers have come to appreciate that punishment is a potent force that sustains cooperation where individuals would otherwise be tempted to cheat. Punishment is relatively easy to explain if the punisher is the victim of the cheating individual. However, humans are willing to punish cheats even if they were not the victim and if they do not expect to encounter the cheat again in the future. Explaining how costly punishment can evolve, in the absence of any direct benefit to the punisher, is therefore a key challenge for evolutionary biologists and economists alike.

Although a prevalent view is that punishment can be explained in terms of group-level, rather than individual-level benefits, a recent study on cleaner fish provides the first evidence that punishers can reap direct benefits from punishing cheats even if they were not the primary victim. Cleaner fish provide a cleaning service to their reef-fish clients by removing skin ectoparasites. However, there is a conflict since cleaners prefer to ‘cheat’ by eating mucus and other living tissue and clients often leave in response to being bitten by cheating cleaners. Sometimes cleaner fish work in mixed-sex pairs to clean a joint client. In this situation the male cleaner fish, who is larger than and dominant to the female, aggressively chases the female if she bites the joint client and causes it to leave. Thus, the male seems willing to invest in punishment even though the client is the primary victim of a biting female. Our study showed that males benefit from investing in punishment because females cooperate more in future interactions with clients. If females are less likely to cheat, then the male’s dinner is less likely to make an early departure. The evolution of punishment in humans might also yield direct benefits to punishers, but further work will be needed to test this idea.


A genetic basis for mate choice in social primates?

Genes of the major histocompatibility complex (MHC) play a critical role in the immune system. Since the diversity of MHC genes an individual possesses increases the number of pathogens it can react to, theory predicts that individuals should seek mates with dissimilar MHC genes to maximise MHC diversity in their offspring. Indeed, this pattern has been reported across a range of vertebrates from fish to mammals. However, it has rarely been studied in social species. We therefore investigated this pattern in a wild population of desert baboons. Surprisingly, we found no evidence of mate choice for MHC dissimilarity. However, further analysis of the population’s genetic structure revealed high levels of juvenile outbreeding as a result of baboon social dynamics (males move between groups while females stay put). This generates high levels of genetic diversity such that most potential mates

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.
are likely to carry dissimilar MHC genes simply by chance. These findings indicate that social structure may play a crucial role in mediating the need for individuals to select mates on the basis of MHC dissimilarity.


Can bushmeat support sustainable livelihoods?

Bushmeat is an important component of the informal economy throughout West and Central Africa. However, the potential impacts of unsustainable hunting on livelihoods need to be better understood in order to formulate effective policy to ensure the sustainability of bushmeat hunting for both development and conservation reasons. We collected data through interviews with households and hunters, a village offtake survey, hunter camp consumption diaries and hunter follows in a village in continental Equatorial Guinea which supplies substantial quantities of bushmeat to the urban market, to evaluate (1) whether hunting is predominately for income or consumption and through choice or necessity, (2) the factors influencing household production of and consumption and expenditure on bushmeat and (3) the impact of this hunting across a range of temporal, spatial and taxonomic scales.

Hunting for trade to the urban market was a major component of household incomes, carried out by around 60% of poor-to-middle income households, while richer households had other income-generating activities. Bushmeat formed a minor component of household expenditure and was less widely consumed than alternative, cheaper protein sources. Bushmeat was a necessity good, with consumption and expenditure related less than proportionately to income. While they preferred the security of a regular wage, hunting was an important source of fall-back income for men in the absence of preferable alternative livelihood opportunities.

Over the period of this study, overall offtake, number of active hunters and average distance from the village at which hunters operated did not change substantially, with hunters switching back and forth between long-established camps. Although the proportion of the two most common species (Cephalophus monticola and Atherurus africanus) increased in the offtake, species presumably less robust decreased slightly, as did catch per unit effort (CPUE). Apparent sustainability in economic terms may be masking gradual local extirpation of more vulnerable species before and during this study. This research underlines the need to develop alternative livelihoods for hunters and sources of protein for urban consumers to protect both vulnerable species and households, and is the basis of a new ZSL project in Equatorial Guinea to evaluate and implement potential bushmeat alternatives.


Carnivore biodiversity in Tanzania: revealing the distribution patterns of secretive mammals using camera traps

Biodiversity monitoring is critical to assess the effectiveness of management activities and policy change, particularly in the light of accelerating impacts of environmental change, and for compiling national responses to international obligations and agreements. Monitoring methods able to identify species most likely to be affected by environmental change, and to pinpoint those changes with the strongest impacts, will enable managers to target efforts towards vulnerable species and significant threats. IoZ scientists, the Wildlife Conservation Society (WCS) and the Tanzania Wildlife Research Institute (TAWIRI) have carried out the largest survey of Tanzania’s carnivores. Eleven surveys were conducted over 430 camera-trap stations and 11,355 trap-days. Twenty-three out of 35 carnivore species known to occur in Tanzania were recorded and we reported major extensions to the known distribution of the bushy-tailed mongoose, previously thought to be rare. The research also revealed that many species, such as leopard, are particularly fussy about where they live, actively avoiding certain areas. Importantly, all the species surveyed tended to avoid croplands, suggesting that habitat conversion to agriculture could have serious implications for carnivore distribution.

This study is the first to combine camera-trap data with niche analyses to reveal patterns in the habitat use and spatial distribution of otherwise elusive and poorly known species, and to inform reserve design and land-use planning. This methodology represents a potentially powerful tool that can inform national and site-based wildlife managers and policy makers as well as international agreements on conservation. The project continues to map carnivore distribution across the country, working closely with the wildlife authorities to support local conservationists and to generate information that is used to inform conservation planning.
The aim of the Genetic Variation, Fitness and Adaptability Research Theme is to develop and apply empirical and theoretical methods to describe patterns of relatedness among individuals, populations and species. Our research aims to test hypotheses on the effects of genetic diversity on individual fitness and population persistence and to apply this knowledge of genetic structure and genetic diversity/fitness relationships to the management of animal populations.

Range expansion and hybridisation in petrels
Historical records suggest that the petrels of Round Island (near Mauritius, Indian Ocean) represent a recent, long-distance colonisation by species originating from the Atlantic and Pacific Oceans. The majority of petrels on Round Island appear most similar to Pterodroma arminjoniana, a species whose only other breeding locality is Trindade Island in the South Atlantic. Patterns of genetic differentiation in petrels from Round Island and Trindade were analysed and indicated that the two populations exhibit low but significant levels of differentiation. Estimates of migration rate between islands using genetic data are also low, supporting the hypothesis that these populations have recently separated but are now isolated from one another. A second population of petrels, most similar in appearance to the Pacific species P. neglecta, is also present at Round Island. Observations of birds at Round Island suggest that the two petrel species are hybridising. Vocalisations recorded on the island also suggest that hybrid birds may be present within the population. Genetic data support this hypothesis and indicate that there may have been many generations of hybridisation and back-crossing between P. arminjoniana and P. neglecta on Round Island. Our results provide an insight into the processes of dispersal and the consequences of secondary contact in petrels.


Fitness benefits in social wasps
A key step in the evolution of sociality is the abandonment of independent breeding in favour of helping. In cooperatively breeding vertebrates and primitively eusocial insects, helpers are capable of leaving the group and reproducing independently, and yet many do not. A fundamental question therefore is why do helpers help? Helping behaviour may be explained by constraints on independent reproduction and/or benefits to individuals from helping. We have simultaneously examined the reproductive constraints and fitness benefits underlying helping behaviour in a primitively eusocial paper wasp. We gave 31 helpers the...
Assignments) of the current $N_e$ of populations with overlapping generations, using the sex, age, and genetic information of a single sample of individuals taken at random from the population. Simulations show that EPA provides unbiased and accurate estimates of $N_e$ under realistic effort in sampling and establishing the level of genetic variation. Additionally, it yields estimates of other interesting parameters such as generation interval, the variances and covariances of lifetime family size, and the effective number of breeders of each age class.


Estimating parameters of populations with overlapping generations

Inbreeding and genetic drift (random fluctuations in frequency of genes) are two closely related yet distinctive processes characterising populations of finite sizes. They act and interact to cause the erosion of genetic variation, the decline in fitness and the increase in extinction risk due to the excessive accumulation and expression of deleterious mutations, and the loss of adaptive evolution. In real populations, many factors (such as population size, sex ratio, variance in fecundity and viability and mating system) affect the strength of inbreeding and genetic drift processes, but can be conveniently summarised into a single parameter, the effective population size ($N_e$). Using this parameter, one can not only explain the current levels of genetic variation and fitness of a population, but also predict their evolution in the future.

Many long-lived plant and animal species have overlapping generations. Although numerous models have been developed to predict the effective sizes ($N_e$) of populations with overlapping generations, they are extremely difficult to apply to natural populations because of the large array of unknown and elusive parameters involved. Unfortunately, little work has been done to estimate the $N_e$ of populations with overlapping generations in sharp contrast to the situation of populations with discrete generations for which quite a few estimators are available. In this study we propose an estimator (EPA, Estimator by Parentage Assignments) of the current $N_e$ of populations with overlapping generations, using the sex, age, and genetic information of a single sample of individuals taken at random from the population. Simulations show that EPA provides unbiased and accurate estimates of $N_e$ under realistic effort in sampling and establishing the level of genetic variation. Additionally, it yields estimates of other interesting parameters such as generation interval, the variances and covariances of lifetime family size, and the effective number of breeders of each age class.

is still unclear, although S. aureus has previously been identified as a high-risk pathogen to cetacean health, and streptococci have increasingly been associated with cetacean mortality events. Our work proposes including blow sampling in cetacean monitoring programmes. This would be extremely useful to identify spatiotemporal fluctuations in bacterial prevalence as indicators of changes in cetacean health.


Living the high life is risky business for toads under threat from fungus

Amphibians are the most threatened class of vertebrates and are being devastated by a key threatening process, the global emergence of the disease chytridiomycosis caused by the pathogenic fungus Batrachochytrium dendrobatidis (Bd). However, despite a decade of research since the discovery of this pathogen, it is still largely unclear what processes lead to the observed distribution of infection and why some populations survive infection while others succumb.

To address this problem, a five-year study by Imperial College, ZSL and the BiodivERsA project RACE sampled a thus-far unsurveyed region, the Iberian Peninsula, where Bd was first detected in 1997. The study focused on a species that is known to be susceptible to chytridiomycosis, the midwife toad Alytes obstetricans, and sampled over 120 sites and 3,000 individual amphibians. This survey, published in the journal Ecology Letters, provided the first high-resolution European map of infection for Bd. The analysis modelled the risk of infection for Alytes and showed that, while environmental variables are only weakly predictive of infection, they are strongly predictive of mortality. Specifically, high-altitude populations of Alytes were much more likely to suffer mass mortalities, and several of these
Evidence for regular ongoing introductions of mosquito disease vectors into the Galapagos Islands

Endemic wildlife on oceanic islands is highly susceptible to the introduction of diseases to which they are naive. Recently, the invasive mosquito *Culex quinquefasciatus* became established in the Galapagos Islands. This mosquito is a famous vector of diseases, such as avian malaria, which depleted the endemic Hawaiian avifauna following the introduction of the mosquito to those islands. *Culex quinquefasciatus* also is a known vector of West Nile virus, which can kill a wide range of taxa and which, should it reach Galapagos, is considered to pose a serious threat to the archipelago’s endemic wildlife. As part of a project to identify and mitigate disease threats to Galapagos wildlife, iOZ scientists in collaboration with scientists from Leeds University, the University of Guayaquil, Ecuador, and the Galapagos Islands found evidence that *C. quinquefasciatus* continues to be regularly introduced from mainland Ecuador to the Galapagos archipelago. In addition to finding stow-away mosquitoes on planes, they found that Galapagos mosquitoes on islands with airports were more closely related to mainland Ecuador than the Galapagos archipelago. Evidence for regular ongoing introductions of mosquito disease vectors into the Galapagos Islands is strong evidence that this region is still in the early stages of introduction and spread, raising a unique conservation challenge as it is here that the study documented recent mass-mortality events in this ecologically-sensitive high altitude area.

This study is embedded within the European programme RACE (Risk Assessment of Crytridiomycosis to European Amphibian Biodiversity) that is enabling research on the emergence of Bd more widely across Europe. Key to combating the pathogen is an understanding of how Bd is being introduced into Europe, and what are the key vectors within regions. The work by Walker *et al.* (2010) provides key evidence that we are still at a relatively early stage of the emergence of Bd and that there are many as yet uninfected, but at-risk, regions. Understanding how we can prevent the further spread of the pathogen, and can perhaps mitigate the effects of infection in the wild, is now a conservation imperative.


**Sampling Alytes tadpoles for Batrachochytrium dendrobatidis infection.**

Historical presence of *Batrachochytrium dendrobatidis* in African pipid frogs

Amphibian chytridiomycosis is associated with global amphibian population declines and species extinctions. The disease is now pandemic but its origin is unknown. One hypothesis, for which there is some evidence, states that it originated from *Xenopus spp.* (family Pipidae) in South Africa and was spread globally with the international trade of these frogs, which began in the mid-20th century. In order to test this hypothesis further, iOZ scientists teamed up with the Natural History Museum, London, to examine their large collection of pipid frogs for evidence of early infection with *B. dendrobatidis*. A total of 665 specimens of 20 species of African and South American pipid frogs collected between 1844 and 1994 were examined using a novel technique developed by the team which enabled samples to be taken without harming the valuable specimens. Six of the animals examined were infected with *B. dendrobatidis*: two specimens of *Xenopus gilli* collected from South Africa in 1982, one *X. laevis* laevis tadpole collected from Malawi in 1969, two *X. l. bunyoniensis* collected from Uganda in 1934 and one *X. fraseri* collected in Cameroon in 1933. None of the South American pipids was positive, although only 45 of these were available for examination, so a low prevalence of infection could have been missed. These results suggest that *B. dendrobatidis* infection was present in *Xenopus spp.* across sub-Saharan Africa by the 1930s, providing additional support for the ‘out of Africa’ hypothesis.


**Research Themes**
Our understanding of reproductive biology comes largely from a small number of intensely studied model species, but nature presents a bewildering array of adaptations with almost every new species we examine. In the Reproductive Biology Research Theme we aim both to explore and understand some of this diversity and to use some of this knowledge for the development of technologies that may have practical applications. In addition, we aim to find out whether and how environmental change may affect reproductive and developmental processes.

### Why aren’t sperm tails all the same length?

Sperm competition and sexual selection outcomes are often reported as depending on superior sperm velocity and flagellar length, suggesting that sperm shape may be optimised for maximum efficiency. This has led to some widely held views that spermatozoa with longer tails should possess a fertilisation advantage, especially under conditions involving sperm competition. Nevertheless, this is a largely inferred and unexamined assumption regarding sperm performance. We have examined this idea using a ‘swim-up’ selection technique as a proxy for sperm transport within the female tract. This technique involves selecting the motile sperm population that is capable of swimming across a fluid boundary, leaving their original suspension and moving upwards into an overlying fluid layer. The procedure allowed us to test the hypothesis that the selected sperm population should be enriched for sperm with long tails. We examined the effects of the swim-up sperm selection technique on sperm flagellar lengths in brown hares, domestic pigs and domestic bulls. All three species showed small but significant ($P<0.001$) increases in mean sperm flagellar length after swim-up. Applying the swim-up technique to boar spermatozoa additionally revealed that the selected population was enriched for progressive cells. We also conducted a small in vivo insemination experiment in pigs and showed that all sperm size categories were able to traverse the utero-tubal junction, enter the oviduct and form the sperm reservoir bound to oviductal epithelial cells. These results support the view that sperm selection in vitro produces a marginal bias towards longer and faster spermatozoa, although, because sperm selection was not associated with a reduced variance in sperm length, it was clear that there was evidence for the exclusion of short-tailed spermatozoa. While the processes involved in sperm transport do not seem to prevent the short-tailed spermatozoa from reaching the vicinity of the oocytes, there is probably sufficient skewing in the overall population measurement to ensure that when mating systems involve a great deal of sperm competition there is likely to be a gradual shift towards the production of longer sperm tails.

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**Summary box- whisker plots showing the effects of swim-up treatment on flagellar length in brown hare, boar and bull spermatozoa.**

Small squares represent the median values; boxes indicate 25th and 87th percentiles, and whiskers represent the nonoutlier range. Filled circles represent outliers.
Echidna sperm development and DNA

The short-beaked echidna (Tachyglossus aculeatus: Monotremata) belongs to the group of mammals known as monotremes. An unusual reproductive characteristic of echidnas is that the males produce long and filamentous spermatozoa, which group together and swim in bundles of around 100 cells instead of the more usual tendency to swim individually. This type of sperm aggregation is thought to promote faster swimming, which should theoretically be an advantage in situations involving mating of single females by more than one male.

Another unusual aspect of echidna spermatozoa is that the sperm heads (nuclei) adopt a helical configuration. Previous studies of echidna spermatozoa (Watson et al. 1996) have indicated that the chromosomes are precisely aligned against each other, as in some insects such as grasshoppers (Cerna et al. 2008). We therefore predicted that the chromosomes in the sperm head adopt this spiral configuration because they are structurally forced to follow the tertiary structure of the DNA-protein scaffold.

If this unusual sperm head morphology is really attributable to the coiling and supercoiling of the DNA-protein complexes, the DNA helix would have to be bent and stretched in ways that can only happen if the DNA strands are systematically broken, and forced to realign in unusual configurations, so they can accommodate the unusual shapes. Using a technique to detect DNA strand breaks we were able to show that echidna spermatozoa do indeed contain strand breaks, and that these were not randomly distributed along the sperm head, but apparently positioned with some precision. Interestingly the strand breaks were not positioned in the same way in all spermatozoa, and we could arrange sets of spermatozoa in ways that appeared to show that there was repair of DNA strand breaks as the spermatozoa became more mature (Johnston et al. 2009).


The Indicators and Assessments (IAU) unit was formed in 2006 to consolidate work at ZSL on defining the status and trends of biodiversity. The unit is a joint Institute of Zoology and Conservation Programmes initiative, and comprises around 20 staff, students and interns. The main projects are designed to develop and produce scientifically robust global biodiversity indicators for global targets such as the Convention on Biological Diversity (CBD) and the United Nations Millennium Development goals. This year, work has expanded to develop novel analytical approaches to understanding the distribution of biodiversity and species threat. The projects are providing science to inform global biodiversity policy in 2010, the International Year of Biodiversity, and reporting year for the CBD 2010 target.

Rapid decline in wildlife populations
Trends in wildlife population abundance can provide the metric for powerful and sensitive indicators of biodiversity change. Two regional examples published this year provide worrying but compelling evidence of extensive biodiversity loss. The first, a PhD project with the University of Cambridge and UNEP-WCMC, examined wildlife trends in Protected Areas (PAs). Despite being the cornerstone of global conservation efforts, PA performance in maintaining populations of their key species remains poorly documented. We addressed this gap using population abundance time series for 69 species of large mammals in 78 African PAs. The multi-species index of change in population abundance revealed on average a 59% decline in population abundance between 1970 and 2005. Indices for different parts of Africa demonstrate large regional differences, with southern African PAs typically maintaining their populations and western African PAs suffering the most severe declines. These results indicate that African PAs have generally failed to mitigate human-induced threats to African large mammal populations, but they also show some successes.

In a joint initiative with the Circumpolar Biodiversity Monitoring Program, we used the same methods to track change in Arctic species trends. The contribution of Arctic wildlife to global biodiversity is substantial. The region supports globally significant populations of birds, mammals and fish. For example, over half of the world’s shorebirds and 80% of the global goose population breed in Arctic and sub-Arctic regions. Dramatic changes in the Arctic’s ecosystems such as sea-ice...
Global biodiversity change

Aggregated indices of (A) the state of biodiversity, (B) pressures on biodiversity and (C) responses for biodiversity.

Values in 1970 set to 1; shading shows 95% confidence intervals derived from 1,000 bootstraps. Significant positive/upward (open circles) and negative/downward (filled circles) inflections are indicated.

loss are predicted to occur over the next century. Arctic species that have adapted to these extreme environments are expected to be displaced by the encroachment of more southerly (sub-Arctic) species and ecosystems, and indeed, our results supported contrasting trends in abundance between high, low and sub-Arctic populations. Continued, rapid change in the Arctic ecosystems will have global repercussions affecting the planet’s biodiversity as a whole. Understanding how the Arctic’s living resources, including its vertebrate species, are responding to these changes is essential in order to develop effective conservation and adaptation strategies.

Informed global biodiversity policy

This year, all signatory nations are reporting to the Convention on Biological Diversity (CBD) on their progress towards the 2010 goal of reducing the rate of biodiversity loss. Biodiversity indicators have been developed to assess whether or not this target has been met and to demonstrate the changing state of nature over time. In a joint project with the 2010 Biodiversity Indicators Partnership, we analysed 31 indicators to assess whether the 2010 target had been met. Most indicators of the state of biodiversity (covering species’ population trends, extinction risk, habitat extent and condition, and community composition) showed declines, with no significant recent reductions in rate, whereas indicators of pressures on biodiversity (including resource consumption, invasive alien species, nitrogen pollution, overexploitation, and climate change impacts) showed increases. Despite some local successes and increasingly positive trend in responses (including extent and biodiversity coverage of protected areas, sustainable forest management, policy responses to invasive alien species, and biodiversity-related aid), the rate of biodiversity loss does not appear to be slowing.


When is a species really extinct?

The severity of the extinction crisis is often expressed in terms of counts of extinct species, with lengthening lists representing continuing loss of biodiversity, whereas the lack of addition to such lists could be seen as an indicator of conservation success. Superficially, determining whether a species is extinct might seem a simple task, whereby we either find a species to be extant or it is extinct. However, scientists are reluctant to state with certainty if a species is extinct, so as not to facilitate the Romeo effect (giving up on a species too early) or the Lazarus effect (bringing a species back from being named extinct).

We tested a technique called optimal linear estimation to analyse the sightings record of mammal and bird species of varying ecology, life history and population demography. Uncertainties in categorising species as extinct must be made more transparent to ensure threatened and extinct species lists are buffered against changes in knowledge. New developments for the Extinct category of the IUCN Red List will evolve from this work and others like it, in a working group, which should result in more defensible applications of the criteria. Such techniques can also be used to infer detail about extinction events, such as patterns of range decline in the recently declared extinct Yangtze River dolphin.


A training programme for young scientists

As an integral part of the IAU project portfolio, the IAU internship programme has been running since the formation of the unit in 2006. During the subsequent 4 years, more than 50 young scientists have undertaken 6 month positions as a stepping stone to future careers in science. Of these individuals, 19 have gone on to further postgraduate training, including 13 to PhD studentships (University of Cambridge, Imperial College London, Trinity College Dublin, University of York, University of New South Wales, Queen’s University Canada, and University of British Columbia), 12 have gone on to work for NGO/IOGs, three have taken up positions in UK government environment agencies and departments and nine have undertaken field research projects ranging from the UK to Papua New Guinea, Namibia, Kenya and Tanzania.


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 over 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.

New Conservation Tools and Discoveries

Rediscovering the Horton Plains slender loris
As part of the ongoing red slender loris project in Sri Lanka, the research team have rediscovered the virtually unknown Horton Plains slender loris. Originally documented in 1937, there have only been four known encounters in the past 72 years. The Horton Plains slender loris is evidently extremely rare and was only found after more than 200 hours of nocturnal transect surveys. The rarity of this loris resulted in it previously being listed as one of the world’s 25 most endangered primates and it is now being incorporated into ZSL’s conservation strategy for the region.

A potential new species of elephant shrew
When a ZSL EDGE Fellow began to study the golden-rumped elephant shrew, she had no idea that she would discover a mysterious mammal that is potentially new to science. In the poorly-known Boni and Dodori forests of Kenya, brief glimpses of an animal suggested it was not a golden-rumped elephant shrew, but rather an entirely new species. These suspicions were later backed up by a joint expedition of ZSL and the Kenya Wildlife Service (KWS). Scientists on the expedition were able to observe the new elephant shrew first hand, and documented a number of distinguishing features.

National Red List Website
National Red Lists enable nations to readily determine the conservation status of species, identify those under threat, raise awareness, and develop effective conservation policies and action plans. The National Red List website (www.nationalredlist.org) is the first central source of national level biodiversity data and features an online forum, library, educational tools and over 67,000 species accounts from 44 countries and regions. It provides a focal point to share information, with the aim of increasing the effectiveness of conservation planning. It also functions as a proactive means of identifying taxonomic and geographic data gaps and highlighting regions in need of national level assessments.

Safeguarding Species and Ecosystems

Greater one-horned rhino in Bardia National Park
With support from the Darwin Initiative, ZSL has developed an integrated rhino conservation programme in Nepal. Our approach was simple: scientifically trained technical staff to monitor and report on each rhino individually. Local press coined it as providing ‘body guards’, and the result was a subtle form of deterrence that provided valuable information to anti-poaching efforts. The project also combined habitat management and community engagement; dealt with
invasive plant species and human wildlife conflict; and provided support to education and livelihood programmes. No further rhino in Bardia have been poached since and ZSL is working to replicate that success in other parks.

Creation of the Chagos Marine Protected Area

ZSL played a key role in creating the world’s largest marine protected area (MPA), which doubled the amount of ocean currently under protection. The Chagos Archipelago represents some of the world’s most pristine and diverse ocean habitats and is an important scientific reference site. In 2008, the UK Foreign Office opened a public consultation and ZSL engaged with this consultation as part of the Chagos Environment Network (CEN). The CEN adopted a strong position to encourage the creation of a no-take MPA encompassing the entire 210,000 square mile area and on 1 April 2010, it was announced that a full no-take MPA had been designated.

Chinese giant salamander conservation

One of ZSL’s top priority species for EDGE amphibians is the Chinese giant salamander, the world’s largest living amphibian and one of the most evolutionarily distinct species on the planet. To combat a steep decline in the wild population, EDGE recently coordinated the International Conservation Workshop for the Chinese Giant Salamander, which generated key action plan recommendations and set crucial directions for conserving the species across its range. Through a holistic approach, it is hoped that a secure future can be built for this extraordinary species, transforming the Chinese giant salamander into a symbol of freshwater ecosystem conservation in China.

Linking Biodiversity Conservation and Development

The Salakpra Elephant Ecosystem Conservation Alliance

Working with the Elephant Conservation Network (ECN), ZSL’s Asian elephant project tackles the key issues associated with elephant conservation in and around Salakpra Wildlife Sanctuary in Thailand.

With support from the USFWS Asian Elephant Fund, we have a growing network of local groups – most of whom depend on the forest for income – developing alternative livelihoods under the Salakpra Elephant Ecosystem Conservation Alliance (SEECA). Team members are acknowledged leaders in involving villagers, many of whom are women, in self-help conservation development projects to such an extent that universities, NGOs and communities around Thailand and abroad send groups to learn the methods adopted.

Project Seahorse

ZSL and the University of British Columbia direct Project Seahorse, an organisation committed to conservation and sustainable use of coastal marine ecosystems. Further support from the BBC Wildlife Fund enabled Project Seahorse to launch a rapid assessment of seahorse species, distributions and habitats across the Danajon Bank in the Philippines using the knowledge and skills of local fishers. We developed a broad-scale habitat map of the region, which determined known locations of seahorse populations. The team also worked with top Filipino scientists to develop a position statement and guidelines for the proposed seaweed farm that could cover over 24,000 hectares of the Danajon Bank coral reef.

Advising Industry and Policy

Roundtable on Sustainable Palm Oil

The spread of oil palm plantations in Southeast Asia is closely linked to forest loss and the consequent impacts on biodiversity. ZSL recognises that demand for palm oil and the need for poverty alleviation mean that further expansion is inevitable; we are therefore working with the palm oil industry to mitigate its effects on biodiversity. With a grant from the Biodiversity and Agricultural Commodities Programme and matched funding from Wilmar International, we are engaging with the multi-stakeholder Round Table on Sustainable Palm Oil (RSPO) to strengthen their ‘Principles and Criteria’ that relate to the identification and management of biodiversity on and around oil palm concessions.

GLOBE

ZSL acts as the scientific advisory body to the Global Legislators Organisation for a Balanced Environment (GLOBE). ZSL staff attended several high-profile meetings of international parliamentarians organised through the GLOBE process, where they presented information to the assembled legislators on the current status, trends and projects for tropical forests, marine fisheries and coral reefs, including discussion of policy responses that could reduce human impacts on these ecosystems. ZSL will continue this work at the next meeting of the Convention on Biological Diversity (CBD) in Nagoya, Japan in October 2010, where they will be closely involved with the GLOBE ‘Parliamentarians and Biodiversity’ Forum.
A major part of IoZ’s work is facilitating the communication of science between researchers, professional zoologists and the public. We achieve this through a varied programme of meetings and the publication of scientific journals and books.

**PUBLICATIONS**

**Animal Conservation**
Animal Conservation provides a forum for rapid publication of novel, peer-reviewed research into the conservation of animal species and their habitats. The journal focuses on quantitative studies detailing important new ideas and findings that have general implications for the scientific basis of conservation. Subjects include biodiversity, population biology, epidemiology, evolutionary ecology, population genetics, biogeography, palaeobiology and conservation economics. An editorial, special Feature Paper and commentaries appear in each issue.

**Journal of Zoology**
The Journal of Zoology, our pre-eminent journal dedicated to academic zoology, continues to attract an increasing number of high-quality research papers. Published monthly, the Journal includes hypothesis-driven studies that advance our knowledge of animals and their systems. In June we introduced the Thomas Henry Huxley Review: the first in the series is How stupid not to have thought of that: post-copulatory sexual selection by Tim Birkhead. In July the digitised back volumes of Proceedings and Transactions of the Zoological Society of London were made available online via the journal homepage. The Journal of Zoology podcast can be heard at www.wiley.com/bw/podcast/jzo.asp

**International Zoo Yearbook**
The International Zoo Yearbook is an international forum for the exchange of information on the role of zoos in the conservation of biodiversity, species and habitats. Volume 44 focuses on ex situ husbandry and management of bears and canids. By bringing together the very best of current practice and welfare, the Volume is intended to provoke discussion from different points of view, identify deficiencies in our current knowledge, and encourage increased investment of imagination, effort and resources to establish dynamic ex situ programmes that complement effective in situ conservation.

**Conservation Science and Practice book series**

**MEETINGS**

**Communicating Science and Wildlife Conservation events**
ZSL’s popular Communicating Science and Wildlife Conservation 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 featured a range of topics, including Conservation and the world in 2050, South Asian vultures: catastrophic declines and environmental impact, The human animal: biological basis of mate choice and Conservation with shifting goalposts: polar conservation and climate change.

Please see www.zsl.org/science/scientific-meetings for details of forthcoming Science and Conservation events.
Stamford Raffles Lecture

The 2010 Stamford Raffles Lecture was given by Professor Linda Partridge, Director of the UCL Institute of Healthy Ageing. The New Biology of Ageing described how research into ageing has been rejuvenated by the discovery of mutations in single genes that extend the lifespan of laboratory animals. Some of the signalling pathways involved, particularly the insulin/Igf-like pathway, have effects on lifespan that are conserved over the large evolutionary distances between nematode worms, fruit flies and mice. An environmental intervention, dietary restriction, also prolongs life in diverse organisms. In all cases there is a prolongation of healthy lifespan, with a broad-spectrum improvement in function during middle and old age, together with delay or amelioration of a range of ageing-related diseases. These findings have led to an intensive wave of research directed at understanding the mechanisms at work.

Symposia

International symposia bring together teams of experts to discuss important topics in conservation science. Three were held during the year:

Impacts of environmental change on reproduction and development in wildlife

The October symposium examined the ways in which environmental changes, such as global warming, increased radiation and exposure to endocrine disrupting chemicals, influence not only short-term reproductive success and development but also long-term survival and fitness. Speakers included experts in ecology, nutrition, reproductive physiology, developmental biology and molecular biology.

Foundations of Biodiversity: saving the world’s non-vertebrates

The focus of the February symposium was the importance of non-vertebrate biodiversity from ecological, social and economic perspectives. An overview of the conservation status of selected non-vertebrate taxa was used to highlight the issue of promoting invertebrate, fungus, plant and ecosystem conservation without the need to focus on charismatic megafauna.

Linking Biodiversity Conservation and Poverty Reduction: what, why and how?

The April symposium discussed the links between biodiversity conservation and poverty reduction. Despite apparent consensus at the international policy level, there is considerable divergence of opinion at the practical level as to the nature and scale of biodiversity-poverty links and the role and responsibilities of different interest groups in addressing them. Speakers described key research areas and practical needs to maximise the synergies between these two challenging international policy objectives.

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 Phylogeography and conservation genetics of wild Asian elephant in Thailand, Biosonar and behaviour in the abyss – How tag and telemetry devices are providing insights into the hidden lives of beaked whales and What’s really going bump in the night? Hi-tech for conservation of difficult beasts.
ZSL recognises outstanding achievements in conservation and zoological research through its annual presentation of awards and prizes. In 2009 the following awards were presented:

**Frink Medal**
Presented to a professional scientist for substantial and original contributions to zoology. Awarded to:
*Charles Godfray FRS*, University of Oxford, for outstanding contributions to our knowledge of population and community ecology, and evolutionary biology. In particular, for research on ecological speciation and the evolution of specialisation, the coevolution of host resistance and natural enemy counter-resistance, the role and dynamics of bacterial symbionts, and the importance of indirect population dynamic effects mediated by predators, parasitoids and pathogens.

**Scientific Medal**
Presented to research scientists with no more than 15 years postdoctoral experience for distinguished work in zoology. Awarded to:
*Greg Hurst*, University of Liverpool, for research on the effect of parasites on the design and population biology of their hosts. In particular, for his work on the influence of parasites on the design of animal reproductive systems, and on the functioning of invertebrate immune systems.
*Oliver Pybus*, University of Oxford, for improving our understanding of the evolutionary dynamics of pathogens, particularly viral infections of humans, including HIV/AIDS, the hepatitis C virus, and influenza.

**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:
*David Macdonald*, University of Oxford, for outstanding contributions to zoology and wildlife conservation through popular and scientific books, research papers, films and other output. In addition, his establishment in 1986 and subsequent directorship of the Wildlife Conservation Research Unit located at Tubney, near Oxford, have furthered our understanding of conservation biology and influenced policy and practice.

**Marsh Award for Conservation Biology**
For contributions of fundamental science and its application to the conservation of animal species and habitats. Awarded to:
*Ana Rodrigues*, Centre National de la Recherche Scientifique, for research on the implications of biodiversity patterns for conservation. In particular, for her work on the development of methods for the selection of priority areas for conservation, and research on how the spatial distribution of conservation efforts and threatening activities affects biodiversity.

**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:
*Peter Mumby*, University of Queensland, for empirical ecological studies to improve our understanding of reef processes and for developing ecosystem models from which the effectiveness of conservation measures in mitigating disturbance on reefs, including climate change, can be tested.
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:
Grace O’Donovan, The King’s School, Canterbury, for her project Do certain soil types predominate in areas with high incidence of bovine tuberculosis?

ZSL Award for Outstanding Contributions to the Zoo Community
Awarded to:
Leobert de Boer

The Stamford Raffles Award
Presented for distinguished contributions by amateur zoologists. Awarded to:
Robert Swann, for outstanding contributions to ornithology.

Thomson Reuters Zoological Record Award
Presented for the public communication of zoology. Awarded to:

Thomas Henry Huxley Prize and Marsh Award
Presented for the best zoological doctoral thesis produced in the UK. Awarded to:
Tom Fayle, University of Cambridge, for his thesis Ant community structure in a rainforest microcosm.

Charles Darwin Award and Marsh Prize
Presented for the best zoological project by an undergraduate student attending a university in the UK. Awarded to:
Haihan Tan, University of Cambridge, for his project Novel roles of nuclear receptors in cell fate decisions of neural stem cells and differentiated progeny in Drosophila.

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:
Grace O’Donovan, The King’s School, Canterbury, for her project Do certain soil types predominate in areas with high incidence of bovine tuberculosis?

ZSL Award for Outstanding Contributions to the Zoo Community
Awarded to:
Leobert de Boer

The Zoological Society of London thanks the Marsh Christian Trust and Thomson Reuters for their continued support of the awards.
ZSL’s new Library Management System and online catalogue went live on 20 October 2009. The catalogue can be accessed at http://library.zsl.org and contains details of books, journals, online resources, ZSL archives and artworks, enabling visitors to search all these resources through one database. The online catalogue now includes the display of many book covers which can help readers find material on the shelf, as well as improved help, including in the form of Frequently asked questions. Additional resources include A list of studbooks in ZSL Library and as RSS feeds for Recently received journal issues and Newly acquired books. There are 1,268 URL links within the catalogue, many to open access publications.

A Retrospective Book Cataloguing project is underway to add all books in the Library for which there is no existing electronic record, thus increasing their availability and accessibility. This project will help ZSL to deliver the strategic aim of facilitating access to zoological and conservation knowledge. This project is funded with thanks to a bequest from Connie Nutkins, a former member of staff who left a generous gift in her will to the Library.

Wireless internet access went ‘live’ in the Library during May, allowing Library visitors to use their laptops to access the internet whilst in the Reading Room.

Our Darwin 200 celebrations continued in November with a special tour for Fellows, who had the opportunity to see some of the publications of Charles Darwin as well as a selection of the publications which influenced him. The November Artefact of the month was the first edition of On the origin of species to celebrate the 150th anniversary of its publication. Three editions of Origin of species were exhibited in the Reading Room, and the ZSL Reception featured paintings lent to the Fitzwilliam Museum for their Darwin 200 exhibition, as well as a display about Charles Darwin’s connections to ZSL.

The Library contributed text and pictures to a display about Darwin and ZSL, produced as part of the Charles Darwin: A Genius in the Heart of London project, which was coordinated by the Linnean Society of London and Westminster Archives and funded by the Heritage Lottery Fund.

Interest in ZSL’s archives has continued to increase with a variety of researchers visiting the Library, mainly to consult the London Zoo and Whipsnade Zoo Daily Occurrence books, 19th century Minutes of Council, Minutes of Scientific Meetings, the correspondence collection and zoo guides, and other historical and genealogical archives.

Items from the archives were featured in the exhibition Zoo Stories – Wild Animals for Europe, a zoo history exhibition held at the Westphalian Horse Museum located in the Allwetterzoo Münster. The exhibition then toured a number of museums in Germany. Visitors to the ZSL Nepal Conference in November visited the Library to view the Hodgson manuscripts.

‘Meet the archives’ events were held for Fellows and for visiting American students. These events generate much enthusiasm and interest and will continue to be held in the future.

Artefact of the month on the ZSL website has featured Kenneth Martin’s Screw mobile, which has been restored and rehung in the ZSL Meeting Rooms through generous support from the Calouste Gulbenkian Foundation and Camden Arts Centre; a celebration of the bicentenary of Philip Henry Gosse, with beautiful illustrations from two of his books The aquarium, an unveiling of the wonders of the deep sea (1854 and 1856) and Actinologia Britannica: a history of the British sea-anemones and corals, with coloured figures of the species and principal varieties (1860); the model of Obaysch made from Nile mud to celebrate the arrival of Obaysch the hippopotamus on 25 May 1850; a celebration of 100 years of ZSL Offices including the Library at Regent’s Park and a letter from ZSL Founder Sir Thomas Stamford Raffles to Sir Everard Home.

Wireless internet access went ‘live’ in the Library during May, allowing Library visitors to use their laptops to access the internet whilst in the Reading Room.

Our Darwin 200 celebrations continued in November with a special tour for Fellows, who had the opportunity to see some of the publications of Charles Darwin as well as a selection of the publications which influenced him. The November Artefact of the month was the first edition of On the origin of species to celebrate the 150th anniversary of its publication. Three editions of Origin of species were exhibited in the Reading Room, and the ZSL Reception featured paintings lent to the Fitzwilliam Museum for their Darwin 200 exhibition, as well as a display about Charles Darwin’s connections to ZSL.

The Library contributed text and pictures to a display about Darwin and ZSL, produced as part of the Charles Darwin: A Genius in the Heart of London project, which was coordinated by the Linnean Society of London and Westminster Archives and funded by the Heritage Lottery Fund.

Interest in ZSL’s archives has continued to increase with a variety of researchers visiting the Library, mainly to consult the London Zoo and Whipsnade Zoo Daily Occurrence books, 19th century Minutes of Council, Minutes of Scientific Meetings, the correspondence collection and zoo guides, and other historical and genealogical archives.

Items from the archives were featured in the exhibition Zoo Stories – Wild Animals for Europe, a zoo history exhibition held at the Westphalian Horse Museum located in the Allwetterzoo Münster. The exhibition then toured a number of museums in Germany. Visitors to the ZSL Nepal Conference in November visited the Library to view the Hodgson manuscripts.

‘Meet the archives’ events were held for Fellows and for visiting American students. These events generate much enthusiasm and interest and will continue to be held in the future.

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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, and by donating books, archives, zoo ephemera and funds for the conservation of items in our collections.
In September ten students graduated from our MSc course in Wild Animal Health and fifteen students graduated from our MSc in Wild Animal Biology. Two MSc WAB students received distinctions. Saoirse Leonard was awarded the prize for the student with the highest aggregate of marks and Emmelianna Bujak received the best project prize for her study on the reproductive cycle of captive female Eurasian otters (Lutra lutra). Emmelianna has continued to win awards, and was successful in the Vodafone World of Difference International competition. She will continue her work with otters in south-east Asia as a Conservation Biologist for ZSL.

Sreejith Radhakrishnan, who was awarded the prize for student with the highest aggregate of marks in the MSc WAH course, was the first student from a developing country to be awarded the prize for ten years, and so this represented a special achievement. The MSc WAH project prize was shared between Violaine Colon for research on the pathology of common buzzards (Buteo buteo) in the UK and Angels Baig for her work on the possible transmission of ranavirus between wood frog (Rana sylvaticus) and blue spotted salamander (Ambystoma laterale).

Femke Broekhuis, an MSc WAB graduate from 2006/2007, has recently been awarded the Kaplan Prize Scholarship for a four year doctorate at the University of Oxford, working with WildCRU and the Panthera Foundation.

The Wild Animal Biology MSc course now includes an option for students to gain experience in field conservation projects with rotations in Wild Animal Conservation and Management. Through collaboration with the London Wildlife Trust, the Wildfowl and Wetlands Trust and the People’s Trust for Endangered Species we are able to offer rotations in habitat analysis for bats, bird surveys using transects, moth trapping and identification, aquatic invertebrate surveys, shoveler and gadwall distribution and feeding activity surveys, and bat roost mapping. To meet similar objectives, a new unit of the MSc Wild Animal Biology course, Capture and Handling of Free-Living Wild Animals, has been introduced allowing students to experience reptile field techniques and avian capture and handling.

The MSc course in Conservation Science continues to provide a growing number of students with the skills required for success in the field of international conservation. Run in partnership with Imperial College, the Royal Botanic Gardens Kew, IoZ and the Durrell Wildlife Conservation Trust, the course focuses on interactive learning, and includes training in both practical skills, such as project planning, management and stakeholder engagement, and quantitative methods, such as decision theory, socio-economic surveys, and population modelling. Graduates are well placed to become future leaders in science-based conservation.
clear, the social organisation of foraging must have arisen independently in the two groups, because their common ancestor was solitary. Indeed, honey wasp and the honeybee have very different social systems: whilst honeybee colonies contain one active queen, honey wasps have up to 1,500, and workers are not permanently sterile, though they do not reproduce. This project will provide the first evaluation of foraging organisation in the honey wasp and address a fundamental question in evolutionary biology: whether apparently convergent traits reflect co-option of the same genetic raw material. Elli will investigate whether the same genetic and physiological mechanisms underlie task specialism in honeybees and honey wasps. Such traits illuminate genetic ‘toolkits’ that selection has acted on repeatedly, which both facilitate and constrain evolutionary change.

Tim Blackburn was awarded £32,250 from the Leverhulme Trust for the project ‘A global map of bird invasions’. The aim of this project is to produce the first comprehensive picture of the worldwide distribution of all the invasive species in a taxon – birds. The data will be an important resource for scientists interested in understanding the invasion process, and will be the basis for future research on invasion biology at IoZ. The data will also help conservation bodies and policy makers to understand where and why invasions are continuing to occur, and so ultimately help to stem the process and ameliorate its impacts.

Kate Jones has been awarded a sub-contract from The Wildlife Trust in New York worth approximately $80,000 per year for the next 5 years for predicting the emergence of new human infectious diseases from wildlife. This work forms an important part of a larger, recently launched programme from the US Agency for International Development (USAID) aimed at detecting and predicting diseases (zoonoses) that move between wildlife and people. The global early warning system, named PREDICT, will be developed with incremental funding of up to
$55 million over 5 years and is one of five new USAID initiatives, known in combination as the Emerging Pandemic Threats Program. USAID is developing these initiatives to help prepare the world for infectious diseases like H1N1 flu, avian flu, SARS and Ebola. Kate will be collaborating with The Wildlife Trust along with UC Davis, the Wildlife Conservation Society, Smithsonian Institution and Global Viral Forecasting Inc. to implement USAID’S PREDICT programme. The work at IoZ will involve building better online data portals for disease reporting and collating and analysing large global biodiversity datasets to improve predictive models of which emerging infectious disease is the most likely to strike next.

In March 2010, ZSL received a one year extension to the existing period of funding of the collaborative UK Cetacean Strandings Investigation Programme (CSIP). The CSIP has been conducting research on strandings around the UK coastline since 1990 and is funded by Defra and the Devolved Administrations (Scottish Government and Welsh Assembly Government). The main remit of the CSIP is to provide a systematic and coordinated approach to the surveillance of all strandings of cetaceans (whales, dolphins and porpoises), marine turtles and basking sharks around the coast of the UK and to investigate causes of death. The funding will facilitate the toxicological investigation of a number of UK stranded harbour porpoises (*Phocoena phocoena*), a UK-wide leaflet campaign publicising the CSIP and a symposium to be held at ZSL in 2010 to mark 20 years of research on strandings in the UK by the CSIP. The CSIP is currently managed and coordinated by IoZ – other partner organisations are the Scottish Agricultural College, Inverness, the Natural History Museum and Marine Environmental Monitoring.

Marcus Rowcliffe has been awarded £52,608 from NERC/ESRC for the project ‘Biodiversity, ecosystem services, social sustainability and tipping points in African drylands’. The award is part of a larger grant in collaboration with University College London, the International Livestock Research Institute and the African Technology Policy Studies Network. African drylands are undergoing rapid transformation in response to changing land management policies. On one hand, formerly communally owned land is being privatised, while on the other hand, management of government land is being devolved from the centre to local communities. These changes are causing households to abandon traditional livelihood practices, leading to large-scale changes in land use. A frequent outcome is the enclosure of previously open rangeland, which restricts wild and domestic grazer mobility, and so reduces biodiversity value, degrades ecosystem services and further impoverishes poorer sectors of the community. The goal of this project is to understand these processes in more detail, modelling household decisions among the Boran of northern Kenya/southern Ethiopia, and the Maasai of southern Kenya/northern Tanzania in response to large-scale policy shifts. The outputs will be used to predict tipping points between alternative land use states, and so influence national policy debates.

The Indicators and Assessments Unit project ‘Development and implementation of the Living Planet Index (LPI)’ was awarded £45,000 by WWF International. The project is a collaboration between IoZ and WWF, which has been running since 2006. The aim of the collaboration was to improve and enhance the LPI as a global biodiversity indicator and to develop new LPI-related measures of biodiversity change. This partnership has already led to a number of peer-reviewed journal articles, wildlife trend reports (e.g. migratory species, Arctic species, and estuarine species), production of the *Living Planet Report* in 2006 and 2008, and has informed the Convention on Biological Diversity on progress towards the 2010 target, in publications such as the *United Nations Global Biodiversity Outlook*. In the coming year, the project will produce the *Living Planet Report 2010*, and an online database making population trend data a widely available resource.

### Funding

Amphibian Ark  
BBiSR  
Big Cat Productions Ltd (Disney)  
British Ecological Society  
British Wildlife Health Association  
Centre for Ecology and Hydrology (CEH)  
Cold Spring Harbor Laboratory, USA  
Darwin Initiative  
Defra  
Durrell Wildlife Conservation Trust  
Environmental Planning Department, Falkland Isles Government  
Esme Fairbairn Foundation  
Foundation for Science and Technology (Portugal)  
Galapagos Conservation Trust  
IUCN  
King Faisal University, Saudi Arabia  
L’Oreal UK  
Leverhulme Trust  
Lizard Island Research Station (Australian Museum)  
Medical Research Council (MRC)  
Mohamed bin Zayed Species Conservation Fund  
MRAG Ltd  
Natural England  
NERC/ESRC  
New Zealand Department of Conservation  
North of England Zoological Society  
Panthera Kaplan Graduate Award Program  
Penguin Books  
People’s Trust for Endangered Species (PTES)  
Profile Productions  
Research Councils UK  
River Otter Alliance  
Roger Vere Foundation  
Royal College of Veterinary Surgeons Trust  
Royal Society  
RSPB  
Rufford Maurice Laing Foundation  
SeaWorld and Busch Gardens Conservation Fund  
UNEP World Conservation Monitoring Centre  
Universities Federation for Animal Welfare (UFAW)  
University of Cambridge  
Veterinary Laboratories Agency  
Wildlife Conservation Society  
Wildlife Trust, USA  
World Association of Zoos and Aquariums (WAZA)  
WWF International  
WWF Netherlands
The Zoological Society of London

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Ian Meyrick BA FCIPD (Human Resources Director)
Michael Russell FCMA (Financial Director)
Rich Storton MA (Marketing Director)
Jackie Tanner BSc (Development Director)

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Cambridge nominees
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Professor Malcolm Burrows FRS, University of Cambridge
Dr Andrea Manica PhD, University of Cambridge
Professor William Sutherland PhD, University of Cambridge

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Professor Paul Harvey BA MA DPhil DSc FRS, University of Oxford
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Professor Ian Owens PhD, Imperial College London

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Michael Russell FCMA (Financial Director)
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Christina Herterich LLM ACIS, Institute Administrator (Committee Secretary)

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Ruth Jones MSc (Assistant Librarian)
Emma Milnes MA (Retrospective Book Cataloguer)

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Abdul Altaher
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Ellie Dyer (Research Technician)
Christopher Durrant (Research Technician)
Dada Gottelli (Chief Technician)
Daphne Green HNC (Senior Veterinary Technician)
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Malcolm Bennett, University of Liverpool
Tom Coulson, Imperial College London
Peter Dazak, Consortium for Conservation Medicine, USA
Matthew Fisher, Imperial College London
John Gittelman, University of Virginia, USA
Katherine Homewood, University College London
E.J. Milner-Gulland, Imperial College London
Katherine Forsythe

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Jon Bridle
Jakob Bro-Jørgensen
Boris Dzyuba
Simon Goodman
Nick Isaac
Marcela Kelly
Jonathan Loh
Valerie Olson

Kamran Safi
Derek Tittensor

Governance, staff and students 31
Scientists at Speakers’ Corner 2010

Scientists at Speakers’ Corner in Hyde Park, London on 14 June 2010, see page 3.
Professional Affiliations

Agencia Nacional de Evaluación y Prospectiva (ANEPI), Spain
Karina Acevedo-Whitehouse (Reviewer)

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Rhiannon Lloyd (Biobanking Officer)

Animal Health Information Specialists (UK and Ireland)
Ann Sylph (Member)

Bat Conservation Trust, UK
Kate Jones (Trustee)

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Centre for Excellence in Invasion Biology, South Africa
Tim Blackburn (International Science Advisor)

Centro Interdisciplinario de Ciencias Marinas, Mexico
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Conservation Commons
Ben Collen (Member, Steering Committee)

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Andrew Cunningham (Member, TB Advisory Group; Member, Amphibian Health Advisory Committee; Reviewer, Statutory and Exotic Diseases Research Programme); Trent Garner (Member, Amphibian Health Advisory Committee)

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Frozen Ark
William Holt (Member, Steering Group); Rhiannon Lloyd (Member, Steering Group)

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Ben Collen (Task Chair)

Global Biodiversity Information Facility
Ben Collen (Task Co-Chair)

Global Invasive Species Programme
Tim Blackburn (Member, Expert Working Group on Invasive Alien Species Indicators)

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
Seirian Sumner (Member, Secretary for British Section)

IUCN SSC
Ben Collen (Committee Member, Red List; Co-Chair, National Red List Working Group; Member, Red List Technical Working Group); Andrew Cunningham (Member, Veterinary 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, Veterinary Specialist Group)

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London Learned and Professional Societies
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Mexican National Science Academy
Karina Acevedo-Whitehouse (Member)

Mexican Society of Marine Mammalogy
Karina Acevedo-Whitehouse (President Elect; European Delegate; Committee Member, Veterinary Specialist Group)

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Sarah Durant (Trustee)

New Zealand Department of Conservation
John Ewen (Member, Hiti Recovery Group)

Office International des Epizooties
Andrew Cunningham (Member, Ad hoc Group on Amphibian Diseases)

Sheep Trust
William Holt (Trustee)

Societas Europaea Herpetologica
Trent Garner (Member, Conservation Committee)

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Guy Cowlishaw (Member, Conference Advisory Committee)

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University of Liverpool
Andrew Cunningham (Honorary Senior Research Fellow)

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World Congress of Herpetology
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William Holt (Member, Editorial Board)

Biological Reviews
Guy Cowlishaw (Member, Editorial Board)

Cryobiology
William Holt (Member, Editorial Board)

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Andrew Cunningham (Editor)

EcoHealth
Jon Biebl (Review Editor); Andrew Cunningham (Member, Editorial Board)

Emu: Austral Ornithology
John Ewen (Associate Editor)

Endangered Species Research
Andrew Cunningham (Editor); Marcus Rowcliffe (Editor)

Global Ecology and Biogeography
Tim Blackburn (Editor); Kate Jones (Editor)

Journal of Applied Ecology
Nathalie Pettorelli (Associate Editor)

Journal of Zoology
Trent Garner (Member, Editorial Board); Nichola Ralhan (Member, Editorial Board)

Latin American Journal of Aquatic Mammals
Karina Acevedo-Whitehouse (Editor)

Proceedings of the Royal Society B: Biological Sciences
Guy Cowlishaw (Member, Editorial Board)

Tropical Conservation Science
Ben Collen (Associate Editor)

Wildlife Research
Andrew Cunningham (Associate Editor)


PhD Theses

MSc Theses – Wild Animal Health Awarded by University of London
Baig, A. F. (2009) The possible transmission of ranavirus between wood frog (Rana sylvatica) and blue spotted salamander (Ambystoma laterale)
Colon, V. (2009) Pathological findings in common buzzards (Buteo buteo) in the UK.
Perry, L. (2009) Measuring day range in mammals: does sample frequency affect our estimates?
Sicre, J. (2009) Serum cortisol and pox virus infection in hospitalised California sea lions (Zalophus californianus).

MSc Theses – Conservation Science Awarded by Imperial College London
Boon, L. (2009) The value of volunteer labour to conservation activities at ZSL.
French, J. (2009) Can gorilla tourism become a viable tool for conservation in Gabon?
Robertson, G. (2009) Examination of attitudes towards taking birds from the wild for falconry purposes in the UK.
Saffery, J. (2009) Predicting the effect of climate change on rhinos.
Wright, R. (2009) Can forest certification schemes contribute to the conservation and sustainable management of biodiversity?

MSc Theses – Wild Animal Biology Awarded by University of London
Balen, R. (2009) Investigation to determine the extent of skin movement (skin motion artifact) over the hip and shoulder joints of Asian elephants (Elephas maximus) during walking and running.
Brooks-Marchant, L. (2009) Use of archival dive recording techniques to examine the behaviour of breeding macaroni penguins (Eudyptes chrysolophus) foraging in the waters north of South Georgia.
Chave, A. (2009) Disease risk analysis for the reintroduction of the short-haired bumble bee (Bombus subterraneus).
Leonard, S. (2009) Cryptic Irish refugia: could brown bear populations (Ursus arctos) have persisted in situ through the last glacial maximum?
Peray, L. (2009) Measuring day range in mammals: does sample frequency affect our estimates?
Sicre, J. (2009) Serum cortisol and pox virus infection in hospitalised California sea lions (Zalophus californianus).

MSc Theses – Conservation Science Awarded by Imperial College London
Boon, L. (2009) The value of volunteer labour to conservation activities at ZSL.
French, J. (2009) Can gorilla tourism become a viable tool for conservation in Gabon?
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Saffery, J. (2009) Predicting the effect of climate change on rhinos.
Wright, R. (2009) Can forest certification schemes contribute to the conservation and sustainable management of biodiversity?