**Institute of Zoology mission:**
To identify, undertake, and communicate high-quality research to benefit the conservation of animal species and their habitats.

**IoZ Activities**

**IoZ objective 1**
To undertake relevant, high-quality basic research and research training.

- **NECS funded programmes**
  - We undertake research and research training. Current themes are: (published with CUP)
    - Conservation biology book series
    - Journal of Zoology and Animal Conservation
    - Annual programme of evening scientific meetings
    - Biannual international symposia
    - Annual programme of evening scientific meetings
    - Conservation Science and Practice book series published with Blackwell

**IoZ objective 2**
To anticipate and respond to the research needs identified by conservation organisations.

- **with ZSL**
  - We respond to research questions and contribute to ZSL's Conservation Programmes (published with CUP)
    - Population and community ecology
    - Animal health and welfare research
    - Reproductive monitoring

- **with Cambridge University**
  - We maintain and develop research links with Zoology and other relevant departments.
  - Our research is influenced by ongoing conservation in the Cambridge Zoological Society and English Nature.

- **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 (published with CUP)

- **with other organisations**
  - Collaboration with most relevant outside bodies for our core research interests (published with CUP)
  - Research questions are influenced by our formal links with the Wildlife Conservation Society and English Nature.

- **with IoZ**
  - We run a programme of meetings and publications (published with CUP)
    - Conservation biology book series
    - Annual programme of evening scientific meetings
    - Biannual international symposia
    - Annual programme of evening scientific meetings
    - Conservation Science and Practice book series published with Blackwell

**IoZ objective 3**
To communicate outcomes and results to scientists, conservation practitioners and the wider community.

- **with IoZ**
  - We respond to research questions and contribute to ZSL's Conservation Programmes (published with CUP)
    - Population and community ecology
    - Animal health and welfare research
    - Reproductive monitoring

- **with Cambridge University**
  - We contribute to the Tropical Biology Association programme and Cambridge Student Conference.

- **with institutions in London**
  - Our meetings facilities and programme of talks communicate science and conservation.

- **with other organisations**
  - Collaboration with most relevant outside bodies for our core research interests (published with CUP)
  - Research questions are influenced by our formal links with the Wildlife Conservation Society and English Nature.

- **with IoZ**
  - We run a programme of meetings and publications (published with CUP)
    - Conservation biology book series
    - Annual programme of evening scientific meetings
    - Biannual international symposia
    - Annual programme of evening scientific meetings
    - Conservation Science and Practice book series published with Blackwell

**PhD Theses**

**MSc Theses**
- (Wild Animal Biology) Awarded by University of London, UK.
  - Penney, S. (2005) An evaluation of the effects of captive feline viruses (Feline panleukopenia/FeLV) and of feline calicivirus (FCoV) in captive felids. University of Cambridge, UK.

- (Wild Animal Health) Awarded by University of London, UK.
  - Penney, S. (2005) An evaluation of the effects of captive feline viruses (Feline panleukopenia/FeLV) and of feline calicivirus (FCoV) in captive felids. University of Cambridge, UK.

- (Wild Animal Health) Awarded by University of London, UK.

- (Wild Animal Health) Awarded by University of London, UK.
I am pleased to introduce this year's annual report from the Institute of Zoology, ZSL, and to commend its comprehensive coverage of an eventful year to all our readers and supporters.

The relationship between the University of Cambridge and ZSL for the HEFCE grant that supports the IoZ is proceeding smoothly and productively. This year we were pleased to see and approve the new science plan (2005–2010) which underpins the agreement. The plan identifies two major areas on which research will focus, and these are presented in this report: 'Biodiversity patterns and processes', and 'People and the environment in a changing world'. These topics are of high value to both science and policy and, importantly, include topics on which both University and IoZ researchers are working.

Scientific highlights from IoZ this year include topical issues such as amphibian declines, UK marine mammal strandings, and biodiversity hotspots. In a year when the full extent of global amphibian declines became better known, though far from understood, it is good to see work here that contributes towards our understanding of the emerging diseases that seem to be the cause of the more enigmatic declines. IoZ’s work in wildlife epidemiology includes a range of studies from very fundamental knowledge on the epidemiology of emerging diseases, through to practical involvement in UK native species conservation and recovery programmes. This year, the latter included the attempted rescue of the Thames whale, something that for a brief 24 hours captured major news coverage nationally and internationally.

IoZ researchers have also been heavily involved in some large collaborative projects analysing newly emerging global data sets on the distribution and conservation status of the world’s mammals and birds. These data allow assumptions in conservation plans to be critically evaluated for the first time, and have therefore also attracted much interest.

The programme of meetings organised by the IoZ continued to attract both excellent speakers and good audiences this year. The highlight was Professor Sir John Lawton’s Stamford Raffles lecture on climate change and biodiversity, delivered to a packed theatre on an appropriately warm evening in June.

**Professor Sir Brian Heap**
Chair, ZSL/University of Cambridge Joint Committee.
One of the most important achievements this year was the production of a new science plan for the IoZ. The formal agreement that underpins our relationship with Cambridge University requires an indication of the focus of our work over the next 5 years. Although we have previously considered the disciplinary areas in which we work, leading to the research themes whose outputs are highlighted in pages 10–21, we have never before attempted to prioritise specific areas on which we as an institution will focus. Both the new funding agreement with Cambridge University, and the increasing pressures from donors to clarify the scientific priorities of organisations in which they are investing, suggested that this would be a good thing to do. The process to develop the science plan began in the summer of 2005 with discussions among staff. These discussions fed into an internal workshop in September at which a great deal was achieved in terms of highlighting scientific topics of relevance and therefore opportunities for IoZ. During the autumn we consulted with colleagues in Cambridge, and with others in ZSL, and the final plan was approved by the end of the year. The plan actually has two elements – a set of general principles about how we think research in the IoZ should be focused, and two science topics on which we plan to prioritise our efforts over the period 2005–2010.

The development of the plan was an interesting and enjoyable experience for all of us; and was especially timely given the arrival of a number of new research staff who had the opportunity to participate and put their ideas into the discussions. We are still working on how to track progress and to monitor developments in the science questions, as well as to link this work with colleagues in Cambridge and other collaborating institutions.

Georgina Mace
Director of Science

Science Plan: The major topics

(a) Biodiversity patterns and processes
How can we explain and model biological diversity at a range of spatial, temporal and biological scales?

(b) People and the environment in a changing world
How can we manage wild species and habitats sustainably alongside human population growth and development?

Each of these two themes comprises a number of more specific questions. These will be reviewed annually.

General principles
1. All our research will be underpinned by excellent scientific practice, and our results published in the peer-reviewed literature.
2. We will maintain the flexibility in staff and skills to undertake fundamental science across the areas in which we work. This will allow us to track and to inform changing priorities as well as to attract the best scientists.
3. We will deliver high-quality postgraduate research training across the areas in which we work, especially through PhD and MSc programmes.
4. We are a small and specialised research institute. We must collaborate widely with relevant institutions in order to be able to successfully address broader issues of significance. Hence we regard our collaborators as important and will treat them with due care and respect.
5. We will maintain core skills, capabilities and our reputation in the areas that work best in our funding and institutional environment. These include:
   a. working at the interface between fundamental science and practical conservation;
   b. working internationally and globally, as well as within the UK;
   c. exploiting links to veterinary science, ZSL’s Conservation Programmes and zoos;
   d. exploiting the convening power of ZSL;
   e. developing and maintaining unique/distinctive resources of national/international significance, e.g. wild species genetic resource banks, pathology reference archives, key species-related datasets;
   f. continuing to develop innovative tools and techniques for conservation, recognising that we expect to pass them on for implementation, e.g. reproductive assays and interventions, disease screening, species extinction risk assessments, survey techniques.
In any research institution, the arrival and departure of research staff mark turning points in research directions, as leaders in particular areas of study come and go. This year has been important for the Institute of Zoology, as staff changes will undoubtedly mark changes in our research focus.

Andrew Bourke joined the University of East Anglia as a Chair in Evolutionary Biology. Andrew had been at the IoZ since 1992, and had become a key member of the senior academic staff. As well as leading his own areas of science in behavioural ecology, he contributed greatly to the smooth running of research. His appointment to UEA is appropriate recognition of his success as a scientist, and a well-deserved recognition of his academic leadership. John Bridle left IoZ after 6 years to take up a lectureship at the University of Bristol. We wish both of them well. At the same time, we were delighted to welcome Alex Rogers to our senior staff. Alex is a marine biologist, previously at the British Antarctic Survey. His interests are in oceanic biodiversity, focusing on the discovery and understanding of poorly known systems in hydrothermal vents and seamounts. Alex's work brings a whole new ecosystem to the IoZ, and links well to other parts of ZSL, especially to the new aquarium project (Biota! – see http://www.zsl.org/biota/), and to work in the Marine and Freshwater Conservation programme.

Nick Isaac and Sam Turvey were successful in winning NERC Fellowships. Both previously held fellowships at IoZ, but have now won funding to take forward their plans. Nick will be working on a macroecological approach to population dynamics, and Sam is taking his work on assessing the scale and focus of pre-historical extinctions through to the present. We are delighted to have this new work here.

We were awarded three further fellowships under the RCUK scheme, and several large Research Council and government-funded grants. In addition, we have renewed contracts with English Nature for the species recovery project, and with DEFRA for the cetacean strandings project.
The stranding of a northern bottlenose whale in the Thames in central London caused a completely unexpected interruption to routine work on the cetacean project. Paul Jepson, our veterinary pathologist on the project, was one of the first vets on the scene, called in by the British Divers Marine Life Rescue organisation (which takes the lead on occasions such as this). However, our proximity to the site, and the expertise available in the IoZ team, soon led to its playing a major role in the attempt to rescue the stranded animal. Sadly, but perhaps inevitably, the rescue was unsuccessful and the whale died. The team quickly moved into its more usual role of undertaking the post-mortem analysis. The results were released 4 days later to a packed press conference, and included a full account of the circumstances leading to the animal’s stranding and death. It was an extremely hectic few days for Paul Jepson, Becki Lawson, Matt Perkins and Rob Deaville but the entire process was professionally managed and much useful experience was gained.

Jonathan Baillie’s work on developing biodiversity indicators has made much progress during the year. Apart from the existing collaboration with IUCN for the Red List Programme, we have now formed a new partnership with WWF to work on the development of the Living Planet Index, and we welcomed Jonathan Loh from WWF to the IoZ for this project. This is an established project in WWF but the index is now adopted as one of the headline biodiversity indicators, and we are collaborating to improve its coverage and application. The work done by Jonathan’s group has strong links into our Conservation Programmes and Zoos, and so it has been established as a new cross-cutting unit within ZSL – The Biodiversity Assessments and Indicators Unit.

Congratulations are due to various award winners this year. Georgina Mace was the 2005 recipient of the Ulysses Seal Award for Conservation Innovation, Karina Acedecho-Whitehouse won an award for Excellence in Science Communication from the Society for Marine Mammalogy for her presentation Unravelling the genetic basis of heterozygosity – fitness correlations in diseases in California sealions. PhD students Andy King and Nana Satake won prizes for their posters at postgraduate student events at University College and the Royal Veterinary College, respectively.
ZSL recognises outstanding achievements in the field of conservation and zoological research through its annual presentation of awards and prizes. In 2005 the following awards were presented.

The Frink Medal for British Zoologists
Awarded to: **Professor Geoff Parker FRS**, Liverpool University, for research into evolutionary processes ranging from the origin of sex to individual behaviour and speciation.

The Scientific Medal
Awarded to: **Dr Daniel Haydon**, University of Glasgow, for his use of mathematical models to clarify our understanding of population biology, spatial coupling and disease spread in wild and domesticated animal populations, and **Professor Andy Purvis**, Imperial College London, for his major contributions to the fields of macroecology, conservation biology and phylogeny estimation.

The BIOSIS Award for Communicating Zoology
Awarded to: **Charles Clover**, Environment Editor of *The Daily Telegraph*, for his book *The End of the Line: How overfishing is changing the world and what we eat*.

The Silver Medal
Awarded to: **Alastair Fothergill**, BBC Natural History Unit, for *Deep Blue*, a feature-length selection of the highlights of the BBC’s highly successful documentary series *The Blue Planet*.

The Stamford Raffles Award
Given annually for distinguished contributions to zoology by amateur zoologists.
Awarded to: **Dr Peter Grubb** for his remarkable body of research on mammalian systematics.

The Marsh Award for Conservation Biology
Awarded to: **Professor Bill Sutherland**, University of East Anglia, for his extensive contributions to conservation biology.

The Marsh Award for Freshwater and Marine Conservation
Awarded to: **Professor Ian Boyd**, Sea Mammal Research Unit, University of St Andrews, for research that has guided best practice in the management of marine ecosystems.

The Thomas Henry Huxley Award
Presented for the best doctoral thesis in the UK.
Awarded to: **Dr Andy Gardner**, University of Edinburgh, for his thesis *Developments in the theory of social evolution*.

The Prince Philip Prize
Given for the best zoological project by an A-level student or equivalent.
Awarded to: **Ailsa Bradbury** of Wallington High School for Girls, for her project *Investigation into the sensory responses of Calliphora larvae*.

Honorary Fellowships
Awarded to: **Professor Sir Brian Heap**, University of Cambridge, **Professor Sir John Krebs**, University of Oxford, and **Dr Katherine Ralls**, Smithsonian National Zoological Park, Washington, DC.
Publications

Animal Conservation
Our quarterly journal provides a forum for rapid publication of novel, peer-reviewed research into conservation of animal species and their habitats. The focus is on rigorous quantitative studies of an empirical or theoretical nature, which may relate to populations, species or communities and their conservation. Subjects covered by the journal include population biology, epidemiology, evolutionary ecology, population genetics, biodiversity and biogeography and conservation economics.

Journal of Zoology
Our pre-eminent international journal dedicated to academic zoology continues to attract an increasing number of high-quality research papers and reviews. The Journal, published monthly, promotes hypothesis-driven studies that are of interest to all readers of zoology, and provides comprehensive coverage of the latest research.

Conservation Biology book series
This book series includes titles which reflect our research interests and provide an extensive review of a particular topic. *Top Predators in Marine Ecosystems*, edited by Ian Boyd, Sarah Wanless and C.J. Camphuysen, and *Large Herbivore Ecology, Ecosystem Dynamics and Conservation*, edited by Kjell Danell, Roger Bergström, Patrick Duncan and John Pastor, were published during the year.

International Zoo Yearbook
This year Volume 40 was published. The special section focuses on the conservation, reproduction and management of elephants and rhinoceros, *in situ* and *ex situ*. Overviews of the conservation status of rhinoceros in Africa and Asia are given and long-term conservation initiatives are discussed, with a description of an integrated management strategy in Kenya and a review of co-operative population management in captivity. Articles in Section 2 *The Developing Zoo World* include descriptions of captive breeding in the Kihansi spray toad, Bali starling, dillbler and the giant river otter. The volume also contains essential reference material, including the list of *Zoos and Aquariums of the World* and the list of *International Studbooks*. An online version of the *International Zoo Yearbook* is now available: www.blackwell-synergy.com/loi/IZY.

In January we entered a new partnership with Blackwell Publishing in order to fully exploit the potential for electronic publishing. This follows eight successful years with Cambridge University Press.
Meetings

Scientific Meetings
These were held monthly throughout the academic year and covered a range of subjects, including *Wild Animal Disease Surveillance in the UK, Conservation of Large Carnivores Outside of Protected Areas*, *Captive Breeding and Reintroduction of Native Species* and *Madagascar: The Island Continent*.

Symposia
In January ZSL and the Wildlife Conservation Society held an international symposium on *Wild Rangelands: Conservation in the World’s Grazing Ecosystems*, organised by Richard Kock, James Deutsch and Monica Wrobel. This two-day conference explored a variety of strategies for conserving grazing ecosystems. Rangeland resources, health at the human-livestock-wildlife nexus, policy and planning and human–wildlife conflicts were discussed, along with an examination of the effects of expanding markets, globalisation and new methods for monitoring and assessing rangeland habitats.

Science and 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 wide range of subjects were covered during the year, including: *Context-dependent virulence in host-parasite systems* and *Evolutionary biology of stalk-eyed flies*.

Stamford Raffles Lecture
The 2006 lecture was given by Professor Sir John Lawton CBE FRS, Chair of the Royal Commission on Environmental Pollution and former Chief Executive of the Natural Environment Research Council. The Lecture, *Biodiversity, Climate Change and Unsustainable Development*, explored the mechanisms conservation biologists have put in place or plan to develop in order to slow down the loss of biodiversity by 2010, and gave a stark account of the unsustainability of the human enterprise in its present form.
As usual, we received our annual core income from HEFCE via the University of Cambridge; however, this year 49% of our income came from other sources, especially the Research Councils and government departments. A total of 58 new grants was received during the year.

Major new grants included two NERC fellowships. Sam Turvey was awarded a fellowship (for £215,823) for his project ‘How useful is the subfossil record for interpreting pre-human ecosystems and current extinctions’, and Nick Isaac was also successful with his application (for £202,379.20) for his project ‘Revealing the effects of spatial scale on population abundance and dynamics’. In addition, we were pleased to hear that Jinliang Wang had been awarded £177,127.66 from BBSRC for his project ‘Inference of genealogical relationships among individuals from genetic markers’ and that Andrew Bourke and Bill Jordan were awarded £321,177 from NERC for their project ‘Conflict resolution and direct benefits of kin-selected conflicts in social groups’.

Two of our applications for funding biodiversity research through DEFRA’s Darwin Initiative scheme were successful this year. Richard Pettifor was awarded £239,577 for the project ‘Integrating crane conservation with sustainable habitat utilisation’ and Kate Jones was awarded £179,029 for the project ‘Use of roadside bat biodiversity as indicators of sustainable development in eastern Europe’.

A new project was funded by WWF for the development and implementation of the Living Planet Index 2006–2010. This is a new partnership for us, but WWF have established the LPI as one of the leading indicators of the state of the world’s biodiversity. This project will be undertaken in the newly established Indicators and Assessments Unit, under Jonathan Baillie’s leadership, alongside continuing work on the Sampled Red List Index in partnership with IUCN. Continued funding for this work has been contributed by the Rufford Maurice Laing Foundation.

### Institute of Zoology Income
#### 12 months, 1 August 2005–31 July 2006

**Total Income** £3,797,355

<table>
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<th>Source</th>
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<td>Core Grant</td>
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**Funding organisations**

Association for the Study of Animal Behaviour (ASAB)
Bat Conservation Trust
Biotechnology and Biological Sciences Research Council (BBSRC)
Birdcare Standards Association
Born Free Foundation
British Andrology Society
British Association for the Advancement of Science
British Ecological Society
British Veterinary Association: Animal Welfare Foundation
Centre for Population Biology (Imperial College London)
CJ WildBird Foods Ltd
Commonwealth Commission
Conservation Agency
Conservation International
Craneswick Pet Products
Darwin Initiative (DEFRA)
Department for Environment, Food and Rural Affairs
Engineering and Physical Sciences Research Council
English Nature
Gardman Ltd
Higher Education Funding Council for England (HEFCE)
International Seabed Authority
IUCN
Morris Animal Foundation
National Endowment for Science, Technology and the Arts
Natural Environment Research Council
North of England Zoological Society
Ocean Park Conservation Foundation
People’s Trust for Endangered Species
Primate Society of Great Britain
Project Tiger (Indian Ministry of Forests and Environment)
Rio Tinto plc
Royal Society
Royal Society for the Protection of Birds
Royal Veterinary College
Rufford Maurice Laing Foundation
Saint Louis Zoological Park
Society for Reproduction and Fertility
UNEP World Conservation Monitoring Centre
United Nations
Universities Federation for Animal Welfare (UFAW)
University of Cardiff
University of Girona
University of London Central Research Fund
University of Oxford
University of Padova
Wildlife Conservation Society
World Wildlife Fund International
Diversification patterns in bats

Patterns of species diversification of bats were investigated in a recent collaboration between the IoZ, Jena University, Germany, and the University of Virginia, USA. Using a new methodology to assign dates of divergence to the bat phylogeny, it was shown for the first time that diversification rates have not been constant and are more uneven than in any other mammalian group. This means that bats are made up of either very speciose families (vesper bats, horseshoe bats, fruit bats, New World leaf-nosed bats) or families that consist of only a few species (bumblebee bats, disc wing bats, funnel-eared bats). The study also found evidence that diversification rate shifts were greatest around 30–50 million years ago and suggested that this may have been caused by an increase in the diversification of fruit and flowering plants around that time. This would have allowed the diversification of fruit- and flower-eating bats (a major group of which are the New World leaf-nosed bats) and perhaps insect-eating bats (e.g. vesper bats, horseshoe bats) owing to an increase in insect pollinators.

The estimates of divergence times calculated have also been used to estimate the evolutionary distinctiveness of each species, which is currently guiding global conservation plans. Furthermore, the techniques developed in this study form the basis of the protocols for the phylogeny of all mammals which is currently in preparation.

Extinction dynamics in the world’s mammals

Through a long-standing collaboration with Imperial College and the University of Virginia, USA, we have now completed a large database from which to test various ideas about what drives the distribution of threatened species among the world’s mammals. Our initial interest was to understand the extent to which threat is a function of the biological traits of species, or of the environments and pressures that they face, or an interaction between these. Interestingly we found surprising amounts of variability in threat being simply due to the biological traits of species, although, especially among certain groups, extinction risk was further exacerbated by their association with high and growing human populations. This analysis allowed us to identify species that are not currently threatened with extinction, but which possess the traits that are likely to make them become so. Some of these species are found in areas with currently low human population density, but not all. The resulting map of latent extinction risk is one of the first attempts to map areas of importance for future conservation actions, one important means to allow us to get ahead of the extinction curve.

A second important approach is to establish the right kinds of conservation actions for the circumstances – different species facing different actions in different areas require different solutions. Our analysis of the same data set revealed some interesting distinctions between relatively large- and small-bodied mammals, and this suggests some general rules that can benefit efficient conservation planning. In particular, large-bodied mammals face disproportionately increasing rates of threat as body size increases. Thus, the largest mammals really do face multiple jeopardies as their extended habitat requirements, lower productivity and slower reproductive rates all conspire
to make them progressively more vulnerable to pressures from habitat loss and exploitation. On the other hand, small-bodied mammalian species rarely exhibit biological vulnerabilities, and their extinction risk can be more or less explained by human pressures on their environments alone. We conclude that while large-bodied species will often need species-specific recovery plans and extensive habitat outside protected areas, small-bodied species may be effectively conserved by a well-planned protected area network.


Global patterns of deforestation

Global deforestation is widely recognised as one of the world’s leading environmental problems and presents a serious threat to global biodiversity. Consequently, it is important to recognise the causes that underlie deforestation at very large scales. Two global patterns have been identified: (1) rates of deforestation are higher in poor nations while wealthy nations tend to have low deforestation, or even afforestation and (2) nations with small amounts of forest cover tend to be afforesting rather than deforesting.

However, an analysis of rates of change in forest cover from 103 nations suggests that these relationships are far from straightforward. Wealthy nations show the expected trend, because wealthy nations with little forest cover tend to be undergoing rapid afforestation. However, poor nations show the exact opposite trend; poor countries that have few forest resources remaining are destroying that resource at progressively faster rates. This indicates there is an important feedback mechanism between economic development and forest cover. High levels of economic development allow afforestation to proceed, typically through investment in plantation forestry. In contrast, poor nations may be relying heavily on income from their natural forests to spur economic growth, but remain too poor to replace them. The end result is a net decrease in the amount of forest cover, and a downward spiral of diminishing environmental quality and an ongoing reduction in the likelihood of attaining sustainable economic development.


**Biodiversity hotspots**

The conservation of biodiversity hotspots has been widely proposed as a ‘silver bullet’ solution for directing scarce resources. These species-rich areas, it has been argued, should be the focus of conservation effort because they capture large amounts of diversity. A consortium of research organizations, including IoZ, tested this assumption by pooling their expertise and databases in a project funded by the Natural Environment Research Council. A new global database on the breeding distribution of all known extant bird species was developed to test for congruence (spatial overlap) across three types of hotspot. Results suggest that hotspots of total species richness, threatened species richness and endemic species richness do not show the same geographical distribution. Only 2.5% of hotspot areas are common to all three aspects of diversity, with over 80% of hotspots being idiosyncratic. More generally, there is a surprisingly low overall congruence of biodiversity indices, with any one index explaining less than 24% of variation in the other indices. These results suggest that, even within a single taxonomic class, different mechanisms are responsible for the origin and maintenance of different aspects of diversity. Consequently, the different types of hotspots also vary greatly in their utility as conservation tools.

The aim of the Population and Community Ecology Research Theme is to undertake research that will enhance our understanding of the dynamics of animal populations and communities, and their interactions with the environment. These environmental interactions often involve human impacts, such as habitat conversion and hunting. Most conservation management takes place at the population level, so knowledge about population ecology is fundamental to effective species conservation.

Bushmeat and consumer demand
People have always hunted wild animals for meat (bushmeat), and in the past, this hunting has often been sustainable. As human populations in the tropics grow, hunting is increasingly turning from a subsistence activity to commercial trade, and the increased hunting pressure that results now represents one of the most pressing threats to many animal species in the tropics.

The human population is not only growing, but also becoming increasingly urban. Most consumers now live in cities, and we therefore need to look there if we wish to understand the factors driving demand for bushmeat. This study surveyed patterns of meat and fish consumption in Bata, the second city of Equatorial Guinea, a country on the west coast of central Africa which recently discovered large deposits of offshore oil and is currently undergoing a period of strong economic and population growth. Unexpectedly, the vast majority of dietary protein eaten came from imported frozen products, but not by choice – fresh foods, whether fish, livestock or bushmeat, were overwhelmingly preferred, and correspondingly more expensive. As might be expected, consumer wealth had a strong effect on the relative amounts of alternatives consumed. Richer households consumed more fresh meat and fish, but less frozen food.

On one hand, this is bad news for the prospects of controlling demand. As the population of Bata becomes larger and wealthier, total demand for bushmeat will undoubtedly increase, driving unsustainable hunting in and around nearby protected areas. On the other hand, bushmeat is no more expensive than fresh fish or livestock meat, suggesting that it is the freshness that is most important, rather than the particular bushmeat species involved. This holds hope for meeting the dietary protein requirements of the urban population without overexploiting forest animals, through a combination of improved livestock production, controlled exploitation of robust bushmeat species, and effective protection of vulnerable species.

Armed conflict and the bushmeat trade

Political instability and armed conflict are commonplace in many areas of the world that are rich in biodiversity. However, our understanding of the effects of war on the natural world is surprisingly limited, due to the difficulty of evaluating its impacts. In this study, we studied the bushmeat trade before, during and after a period of armed conflict around Garamba National Park in the Democratic Republic of Congo. Our investigation focused on the sale of protected and unprotected species in urban and rural markets, and the bushmeat commodity chains that supplied these markets.

We found that, during peacetime, protected species from the park (predominantly elephant and buffalo) rarely appeared in the rural markets, but comprised over half of all bushmeat sales in the urban markets. This marked pattern reflected fundamental differences in the commodity chains that supplied the rural and urban trade. Specifically, automatic weapons were required to hunt large protected species, and these were supplied to hunters by the military officers who controlled the lucrative urban markets. Further, the use of such weapons was discouraged by the traditional chiefs who administered the village markets.

Most importantly, during wartime, the sales of protected species in the urban markets increased fivefold. This was because the military officers fled, leaving behind an open-access system that led to a massive increase in the exploitation of protected species by the soldiers who remained behind. In contrast, the rural markets remained relatively stable: a reflection of the continued and effective authority of the village chiefs.

Our results show that armed conflict can have a major impact on biodiversity, but that the severity of this impact can be strongly influenced by the nature of local sociopolitical structures. An improved understanding of these structures is therefore likely to benefit the development of effective conservation policies. In addition, our findings suggest that traditional authorities may be potentially valuable partners for bushmeat management in the future.

Defusing conservation conflict in Scotland

Every winter, about half a million wild geese of five species migrate to Scotland from their arctic breeding grounds. In terms of conservation, these flocks are of international importance, as well as providing one of Britain’s greatest wildlife spectacles. Unfortunately, the geese feed in large numbers on agricultural land, causing substantial localised damage to pasture and crops, and hence loss of revenue to farmers. This is a classic human–wildlife conflict, similar to that experienced in many other parts of the world. Diverse solutions to such conflicts have been suggested. In the case of geese and agriculture, culling, scaring, compensation or the establishment of refuges are among the commonly advocated solutions; however, the first of these is not viable, either politically or practically, while none of the others would be effective in isolation.

Since the early 1990s, Scotland has pioneered a more subtle management response that has greatly reduced the intensity of the conflict. The approach is based on local management schemes in areas of intense conflict. While the details vary from scheme to scheme, most involve the zoning of land into refuges and unprotected areas. Government funds are used to provide financial incentives for farmers to manage the refuges for geese and leave them undisturbed, while farmers are free to exclude geese from the unprotected areas.

The key to the success of these schemes lies in their stakeholder-driven approach. Local schemes are initiated at the request of local communities, and the details are decided by groups in which farming, conservation and hunting interests are all represented at both local and national levels. Thus, while national government provides the organisational structure and funding, the local groups ensure that the details of each scheme are tailored to local needs. This has helped greatly to ensure the peaceful co-existence of geese and agriculture in Scotland.
The broad focus of the Behavioural and Evolutionary Ecology Research Theme is to obtain a better understanding of how an animal’s behaviour has evolved to help it survive and reproduce. The survival and reproduction of individual animals is fundamental to species conservation, and knowledge about the evolutionary forces that determine these processes can play an important role in the development of effective conservation policy and management.

Colony genetic structure in a eusocial hover wasp

The degree of genetic heterogeneity among the individuals in an animal society is dependent on the genetic structure of that society. Genetic heterogeneity, in turn, means that group members will differ in their reproductive objectives and conflicts over reproduction may arise. The resolution of these conflicts may be reflected in the way that reproduction is partitioned between potential reproductives. We used five microsatellite loci to investigate genetic structure and reproductive skew in 17 nests of the Malaysian hover wasp, *Parischnogaster alternata*. The colonies of this species are small, with only between one and 10 females, and all adult colony members are capable of mating and producing offspring. Our results indicate that colonies tend to consist of closely related individuals and that at any one time the production of both female and male offspring was nearly always monopolised by a single dominant female, despite considerable variation between nests in parameters predicted to affect skew. Subordinate females that remained in their natal colonies gained indirect fitness benefits by helping to raise offspring to which they were related. Subordinate females also appeared to be positioned within an age-based queue for inheritance of the dominant egg-laying position. We suggest that the high skew in *P. alternata* may result from strong ecological constraints on solitary nesting, high relatedness, and a relatively high probability that subordinates will eventually inherit the position of dominance.


Hunting decisions in cheetah

IoZ’s long-term research project on cheetah in the Serengeti National Park, Tanzania, continues to illuminate our knowledge of large carnivore communities. This year the project made use of analysis techniques from the field of economics to take a new look at hunting decisions in cheetah. The techniques allowed IoZ researchers to examine predation decisions within the context of the immediate environment and the reproductive and hunger status of individuals. Data came from observations of cheetah together with detailed data on the immediate environment, enabling researchers to identify the environment in which an individual made the decision to hunt, as well as its choice of prey. The analysis revealed that cheetah hunting decisions were influenced by the abundance of their main prey, the reproductive status of the cheetah and presence of competitors and predators but, interestingly, not by the hunger level of the cheetah. Once a cheetah decides to hunt, its choice of prey was then driven by the period of the year, the sex of the
predator, the abundance of the prey and the presence of competitors. This study provides one of the first examinations of the factors influencing the decision of a large carnivore to hunt, as well as providing a simultaneous assessment of an entire suite of environmental factors influencing hunting decisions. It thus provides a new step forward in our ability to understand the decisions animals make in their natural environment.


Predicting behaviour and its consequences in social foragers
At any moment in time, an animal could conduct any one of a potentially huge number of behaviours: it could forage for a particular sort of food, keep a look out for predators, travel to another place, or even find somewhere sheltered to rest. The behaviour that the animal conducts will ultimately be related to how this behaviour affects its long-term survival and likelihood of reproducing. We can quantify these effects using experimental and mathematical modelling techniques, and so predict which behaviours the animal should conduct.

In baboons and other group-living animals, the predictions we make are complicated by the fact that other members of the group will also have an effect upon the behaviour of an individual. For socially foraging animals, one group member can keep an eye out for predators, whilst another may be lucky enough to find food that everybody can share. As well as these benefits of working together as a group, there may be costs: if there are lots of mouths, there may be less food to go round, whilst a large group may be more prone to predator attack than a small one.

The Tsaobis Baboon Project has been working towards understanding these complex phenomena using a combination of theoretical predictions with natural and experimental observations. In our most recent modelling work, which builds on our general theoretical framework for interacting foragers in a spatially explicit environment, we explored the role of the dominance hierarchy. On the basis of a simple assumption, that dominant animals reduce the feeding success of subordinates, we found a variety of effects. Most importantly, we found that subordinate animals should spend more time moving than dominants, while dominant animals should develop larger food reserves than subordinates. These findings provide us with new insights into dominance relationships and their consequences for baboons and other social foragers.

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.

Population structure of Atlantic salmon in the British Isles

The Atlantic salmon is an important species for commercial and recreational fisheries but is in decline over large areas of its range, including the British Isles. The homing behaviour of Atlantic salmon makes its population structure complex, but a knowledge of the population structure, and any adaptive significance it may have, is necessary to inform effective management decisions in relation to harvesting, reintroduction and supplementation.

As part of a large collaborative project, data on geographical variation in allele frequencies at enzyme coding loci in Atlantic salmon from the British Isles were collated from published and unpublished sources.

Statistically significant differences in allele frequencies were found among samples both within and among river systems, suggesting that the Atlantic salmon in the British Isles is not a single, randomly mating population, and that even within major river systems it cannot be treated as a single genetic stock for fisheries management purposes. Although there was some evidence of regional differences in the frequency of some rare alleles, most single-locus variation did not show strong geographic patterns, with the exception of the AAT-4* locus at which allele frequencies had a significant latitudinal cline. There was some evidence for the existence of genetically-distinct celtic and boreal races of Atlantic salmon in the British Isles as previously has been suggested. Multiple regression analyses revealed associations between genetic variation and local environmental conditions (i.e. between variation at MEP-2* and both temperature and local river gradient), providing additional evidence for adaptive population divergence in the species.


Alternative male mating tactics in zebrafish

The advent of genetic parentage analysis has had a substantial impact on our understanding of animal mating systems. Many socially monogamous species have proven to be genetically polygamous, while territorial or harem-holding males have frequently been shown to be cuckolded. Moreover, due to the operation of sperm competition and cryptic female choice, mating success is not equivalent to reproductive success. It is now recognised that genetic analyses are crucial for measuring parentage, and thereby in understanding mating system evolution and the strength of sexual selection.

We used behavioural and genetic data to investigate the effects of density on male reproductive success in the zebrafish, Danio rerio. Male zebrafish exhibit two distinct mating tactics: territoriality and active pursuit of females. Based on previous measurements of aggression and courtship behaviour by territorial males, we predicted that they would sire more offspring than non-territorial males. Microsatellite analysis of paternity showed that at low densities territorial males had higher reproductive success than non-territorial males. However, at
high density territorial males were no more successful than non-territorial males. Such density dependence in male reproductive success has important implications for the genetically effective population size of the species: in small, low-density populations high reproductive skew towards small numbers of territorial males will render the effective size much less than the census size.


Detecting purging of inbreeding depression in captive populations
Animal and plant breeders have known for centuries that the mating of close relatives results in offspring which are less healthy than their outbred counterparts, an effect known as inbreeding depression. Inbreeding depression is therefore a major concern in the captive breeding of threatened species. Consequently, zoo populations are carefully managed in order to minimise inbreeding. However, even with international co-operation, the small size of some populations means that inbreeding is unavoidable. It is known from laboratory studies that deliberate inbreeding can sometimes ‘purge’ a population of its deleterious genes, resulting in an increase in the population’s fitness and it has been speculated that such a phenomenon may be occurring within zoo populations. In 1997, this hypothesis was investigated by Jon Ballou using pedigree and fitness data from 25 mammalian species but his results were tantalisingly inconclusive; although he detected significant purging in just one individual population (the Sumatran tiger), he found a highly significant trend of purging across species.

In order to further our understanding of purging, we used computer simulations to test the power of the model that Ballou used in his study. For populations with similar parameters to zoo populations, the model detected purging in less than 10% of instances. Our result suggests that purging may have been occurring in the populations that Ballou analysed but that the model was not powerful enough to detect it. We developed an alternative model which was slightly more powerful; however, any regression model will be lacking in power when used on typical zoo data due to the small population sizes and low generation numbers. This means that pedigree-based studies of inbreeding depression and purging must be carefully interpreted. The fact that inbreeding depression and/or purging have not been detected in a population does not mean that they are not present.

Disease and extinctions in amphibians
Cutaneous chytridiomycosis is a fungal disease of amphibians which has caused severe population declines and local extinctions in many amphibians and the total extinction of a growing number of species. Some species, such as the North American bullfrog (\textit{Rana catesbeiana}) and African clawed frogs (\textit{Xenopus} spp.), however, appear to be unaffected by \textit{Batrachochytrium dendrobatidis} infection and these species might act as transport hosts, introducing the infection to new areas and to new host species and populations.

To investigate the distribution of \textit{B. dendrobatidis} in Europe, we screened archived samples from wild-caught European amphibians available from various European laboratories that study amphibians for other purposes. We detected \textit{B. dendrobatidis} infection in wild amphibians from Spain, Portugal, Italy and Switzerland. Prevalence levels were high at locations in Spain where amphibian mortalities and declines are occurring, but high infection prevalences were detected also in Switzerland at sites where, anecdotally, no declines are occurring. These results support previous findings that some amphibian species may act as “asymptomatic” carriers of the disease.

While our survey does not accurately describe the actual distribution of chytrid in Europe and European amphibians due to the lack of systematic sampling, it is clear the pathogen has the ability to infect numerous European taxa and is widely and patchily distributed on the continent. Our findings suggest that \textit{B. dendrobatidis} is extending its range within Europe and that there is an urgent need to further understand the means by which the pathogen is introduced and maintained within host populations.

We also detected \textit{B. dendrobatidis} infection in introduced North American bullfrogs at their primary site of establishment in Britain: the first time that \textit{B. dendrobatidis} infection has been found in wild amphibians in Britain. Worryingly, the site provides good habitat for native British amphibians, including \textit{Rana temporaria}, \textit{Bufo bufo}, \textit{Triturus vulgaris} and \textit{T. cristatus}. Considering the pattern of widespread mortality and catastrophic declines of amphibians due to chytridiomycosis repeated in Australia, Central America and Spain, the introduction of \textit{B. dendrobatidis} to Britain could present a major threat to native amphibian populations. Work, funded by English Nature, is now underway to determine if \textit{B. dendrobatidis} infection has spread to any native amphibian species and, if so, to assess any immediate effects (e.g. mortality) this infection might have on these species.


Emerging infectious diseases and public health
Recently, the emergence of significant threats to public health from previously-unknown pathogens hosted by wildlife has catapulted the phenomenon of “emerging infectious diseases” up medical and political agendas. Diseases with high case fatality rates in humans, such as AIDS and severe acute respiratory syndrome (SARS), have highlighted the importance of wildlife as reservoirs or vectors for disease. A topical example is avian influenza, which can cause human pandemics after genetic mutation or reassortment between influenza viruses of wild and domestic birds, other animals, and humans. The prospect of a global pandemic of H5N1 is very real, at least for wild birds and mammals, and possibly also for humans.

Seventy-five per cent of new or emerging infectious diseases in humans...
originates from wildlife and, as only about a fifth to a 50th of animal species have been documented, it is likely that wildlife will continue to be a reservoir of unfamiliar microorganisms from which previously unknown pathogens will continue to emerge. But why are we now seeing an apparently rapid increase in the emergence of new zoonoses from wildlife?

One of the major drivers of the emergence of infectious disease is closer human contact with wildlife, primarily caused by human encroachment into, and modification of, wildlife habitat. As the human population continues to grow, our needs for space and resources result in further encroachment into a diminishing natural world. At the same time, the exponential rise in volume and speed of trade and travel has transformed the epidemiology of emerging infectious diseases, giving the outcomes of emergence events global rather than local importance. The international trade in wildlife is now huge, with hundreds of millions of wild animals and their products being traded globally each year. Also, travellers can be in the middle of a tropical jungle one day and commuting to their desk in London the next. This globalisation of people and products is difficult to control and is largely related to increasing air transportation. Therefore, the problem of emerging infectious diseases is set to continue to grow.

Emerging infectious diseases are not only a problem for human health but are a major threat to animal welfare and to species conservation. Through emerging infectious diseases, therefore, the medical, veterinary, and wildlife conservation professions share a common agenda. The problem is not small, and tackling it will not be easy, but recognising a common problem is, at least, a start.


Impacts of PCBs on mortality patterns in porpoises

For decades there has been growing concern about the accumulation and toxic effects of persistent environmental pollutants in the marine environment, including their possible role in severe declines of numerous marine mammal populations in heavily industrialised oceanic regions. The first of two studies published in 2006 tested for statistical associations between nematode worm burdens and polychlorinated biphenyl (PCB) levels in UK-stranded harbour porpoises (Phocoena phocoena). Post-mortem examinations of harbour porpoises regularly reveal heavy parasitic worm burdens. This study confirmed that a significant, positive association between PCB levels and nematode burdens was found, but was confounded by the sex, age and cause of death of the porpoises. It was also apparent that individuals with the heaviest infestations of nematodes did not necessarily have the highest PCB level. Therefore, while PCBs are important, they are clearly not the sole determinants of nematode burdens in wild populations of the harbour porpoise around the UK.

The second study, conducted in collaboration with the Sea Mammal Research Unit, was the first rigorous case-control study design in free-living cetaceans to determine how the risk of mortality from infectious disease in UK-stranded harbour porpoises increased with increasing blubber PCB concentrations. The study found that, for each 1 mg/kg increase in blubber PCBs, the average increase in risk of infectious disease mortality was 2%. A doubling of risk occurred at approximately 45 mg/kg lipid. To avoid selection bias, controls that died of physical trauma were used as representative of the exposure prevalence in the population that gave rise to the cases. The effect of variation in energetic status among the cases and controls was also controlled for. These investigations should enable future population level quantification of the risk posed by PCBs (and other pollutants) in porpoise populations of known size and PCB exposure.


Reproductive biology

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.

Semen cryopreservation in kangaroos and wallabies

The application of assisted reproductive procedures to Australian marsupials is severely limited by two major factors. Firstly, the basic biology of many of these species is poorly understood and secondly, until the late 1980s and 1990s very little attention had been paid to the development of semen cryopreservation methods for any of these species. As a number of macropods (kangaroos and wallabies), including nineteen species and subspecies of rock wallabies, are considered vulnerable or endangered at the present time there is nevertheless considerable interest in developing protocols for the cryopreservation of semen and the establishment of artificial insemination methods for these species.

To date macropod semen has almost completely resisted attempts to develop suitable cryopreservation protocols. Our previous work revealed that kangaroo and wallaby spermatozoa would only survive the freezing process if treated with unusually high concentrations (15–20%) of the cryoprotectant, glycerol (by contrast, human or bovine sperm are routinely frozen using 6–8% glycerol). Unfortunately, this high glycerol concentration also means that rewarming the spermatozoa back to body temperature causes cell membrane destabilisation and cell death. Why should kangaroo and wallaby spermatozoa differ so markedly from the sperm of eutherian mammals and some other marsupials? As macropod spermatozoa exhibit unusual and highly complex cytoskeletal structures immediately beneath the plasma membrane, we wondered whether these confer an exceptional degree of membrane stability that prevents the sperm from responding appropriately to the extensive water fluxes induced when water initially leaves the cell during freezing, but then re-enters the cell during the thawing process. It is known that if cells are unable to adjust their cytoplasmic volume in response to water fluxes they inevitably undergo membrane damage; in a sense, the cells burst like balloons. To investigate this hypothesis, we compared the survival of mature cauda epididymal spermatozoa (which possess the complex submembranous cytoskeleton) with immature spermatozoa from the caput epididymidis; these lack the membrane complexity and may therefore be better able to survive the freeze-thaw process.

Experiments on eastern grey kangaroo and red-necked wallaby spermatozoa, undertaken in a collaboration with the University of Queensland, Australia, clearly supported this hypothesis. The practical implications of this work are that it may be feasible to rescue and store spermatozoa post-mortem from genetically valuable animals, by focusing on those that have yet to undergo the physiological maturation process. Scientifically, this work shows that the structure and cell biology of macropod...
spermatozoa differ fundamentally from those of eutherian mammals, and even from some other marsupials in which semen cryopreservation is relatively successful, such as wombats.


Sperm transport in mammals; what is the role of the oviduct?

Sperm storage in the female reproductive tract has been extensively documented in a range of vertebrates that includes sharks, salamanders, snakes and turtles, as well as many birds and mammals. Some of these species store spermatozoa for several months or even years. The evolutionary development of this remarkable ability provides an interesting parallel to the aims and intentions of biotechnologists who wish to extend the lifespan of spermatozoa, either in a tube prior to artificial insemination, or within the female reproductive tract after insemination. In both instances the motivation is to uncouple the synchrony between insemination and ovulation. If afforded this capability, it would be possible for biotechnologists to inseminate females without worrying about the accuracy of ovulation prediction, or at the very least they would be able to relax the synchrony by several hours without compromising fertility. In a collaboration with the Royal Veterinary College, London, the University of Sheffield and Genus Breeding Ltd, Ruthin, we investigated the role of oviductal plasma membrane proteins in maintaining sperm viability, using cattle and pigs as model species. Although millions of spermatozoa are inseminated in mammals, the female reproductive tract imposes stringent selection criteria, only allowing a few thousand to form a sperm reservoir in the oviduct where they are nurtured and protected for 1 or 2 days, depending on species. Although formation of the sperm reservoir involves a physical interaction between spermatozoa and the oviductal epithelium, we have shown that if the oviductal membrane proteins are isolated and solubilised, they still retain the ability to prolong the life of spermatozoa during in vitro incubation in the laboratory. Do these proteins have any special properties? We have recently shown that when pig spermatozoa interact with these proteins their movement becomes slower and more linear; this is because the proteins are actually signalling to the spermatozoa and modulating their flagellar activity. It also appears that the proteins help prepare the spermatozoa for fertilisation by, amongst other things, enhancing the pre-fertilisation rise in intracellular pH. Our work also suggests that the proteins may not be species-specific; this may be important in helping to improve the success of artificial insemination techniques for the captive breeding of wild species, especially if the spermatozoa need to be transported from one place to another. In addition to publishing the data from this project, the three collaborating academic groups have jointly been granted a patent by the US Patent Office.


Deserts and Rangelands

Antelope conservation in Kenya (a)
Rapid growth in human populations increasingly confines wild animals in Africa to protected areas. Because ranging patterns of large mammal populations do not necessarily coincide with park boundaries, there is an urgent need to clarify the consequences of human encroachment for wildlife in boundary zones. Since 1998, the ZSL Antelope Research Project in Masai Mara National Reserve has collected data on ranging patterns and reproductive strategies of selected antelope species in order to inform reserve management. Most work so far has concentrated on topi but a new focus is the ecology and behaviour of the world’s largest antelope, the eland, which ranges widely outside the park at certain times of year. Animals are individually recognised which allows behavioural changes in areas with human contact to be identified. DNA extracted from faecal pellets is analysed to determine the consequences of alternative reproductive strategies for effective population size and population viability.

Carnivores and People

Black-backed jackal ecology and wildlife disease (b)
In Southern Africa the black-backed jackal is a notorious but poorly understood species. This highly adaptive canid has successfully exploited a variety of niches, from urban areas where they come into contact with people and domestic wildlife, such as dogs and livestock, to remote reserves where they are sympatric with endangered wild carnivores, such as lion, wild dog and cheetah. Wildlife diseases pose a real threat to carnivore conservation infecting a variety of endangered carnivores worldwide. Jackals are susceptible to rabies, canine distemper virus (CDV) and canine parvovirus (CPV), diseases which have been implicated in the decline of endangered carnivores including the Ethiopian wolf and African wild dog. The jackals’ ecological plasticity and susceptibility to disease make it a likely vector for disease transmission between species. However, little is known about the key determinants of jackal spatial and social organisation, both of which are crucial to our understanding of disease transmission. Our project, based on the Skeleton Coast in Namibia, uses a multidisciplinary approach to investigate the consequences of the jackals’ ecological flexibility for sociality and space-use and the implications this has for disease transmission.

Marine and Freshwater

Deep-ocean ecosystems (c)
The deep oceans are on average 3,800m deep and cover 71% of the Earth’s surface. They are therefore the largest ecosystem on Earth and harbour a huge diversity of species, certainly more than 1 million and maybe more than 10 million. It may seem improbable that such vast ecosystems could be influenced by man but advances in technology have extended the exploitation of biological and mineral resources to depths in excess of 2,000m. Deep-sea fishing has been shown to rapidly deplete species and to destroy delicate organisms associated with habitats such as cold-water coral reefs and seamounts. Climate change may alter the patterns of circulation and productivity and the chemistry of the oceans, potentially leading to huge shifts in species distributions and major extinctions. The Deep-Ocean Ecosystems programme is a new research initiative aimed at exploring the deep ocean, understanding how species diversity is distributed in it and how this is vulnerable to human impacts. We aim to communicate this information to policy makers.
makers both nationally and internationally with partners such as IUCN, UNEP and the Census of Marine Life programme. Our work this year has led to a better understanding of how diversity is distributed on seamounts and what environmental factors are important to the habitat forming corals that live on them. We have also used DNA-sequencing to reveal previously undiscovered diversity in small animals inhabiting the sediments of the abyssal plains. Additional funding from NERC will allow us to explore deep-sea hydrothermal vents in the Southern Ocean, an area critical to our understanding of the biogeography of these habitats.

**Bushmeat and Forests**

**Surveying wildlife in Southeast Asia (d)**
The tropical forests of Sumatra in Indonesia are home to many of the world’s endangered mammal species, including tiger, tapir and sun bear. However these forest habitats are rapidly being cleared to make way for agribusiness operations such as logging and oil palm plantations. The resulting deforestation has been identified by conservation organisations as critical to biodiversity throughout Southeast Asia. ZSL in collaboration with oil palm plantation, PT Asiatic Persada, and the Indonesian forestry department have joined forces to find out how the existing wildlife is currently using the habitat mosaic of plantation, scrub and secondary forest. The aim of this project is to better understand how habitat change affects the distribution of species and to develop improved management practices to minimise the impact on wildlife. Ultimately, we intend to assess the degree to which these altered landscapes (with improved management) can provide corridors for movement of wildlife between protected areas.

To establish if large mammals are currently using these habitats, ZSL is using camera-traps (cameras that record animals on game trails), track surveys and radio-telemetry, including the first radio tracked Sumatran tiger. We are also looking at ways to minimise the economic impact of crop raiding oil palm through improved management practices in order to increase the potential for these areas to sustain wildlife.

**UK Native Species**

**Garden Bird Health Initiative (e)**
The Garden Bird Health Initiative is a highly collaborative 3-year project launched in spring 2005. A surveillance system will be created to record and investigate causes of garden bird mortality and disease across Great Britain. Through opportunistic and systematic monitoring of garden bird mortality, achieved with assistance from the general public and by volunteers from the BTO/CJ Garden BirdWatch scheme, we aim to learn more about ecological and anthropogenic factors associated with increased risk of infectious disease at garden feeding stations. Results will be used to evaluate supplementary feeding practices, recommend methods to mitigate identified risk factors and to inform the development of best practice guidelines for feeding garden birds.

**Island Ecosystems**

**Taxonomy of oceanic seabirds (f)**
The recognition and management of biotic diversity invariably focuses on species. Species are the currency of conservation, whether in selection of biodiversity hotspots, compiling lists of endangered organisms or providing protective legislation. However, in many groups of animals unambiguous species boundaries remain elusive. The gadfly petrels (genus *Pterodroma*) are a group of pelagic seabirds that breed on remote oceanic islands worldwide. These birds have both a historically confused taxonomy and an urgent need for conservation – threats from introduced mammalian predators and long-line fishing mean that many populations are critically endangered. Using molecular genetic techniques we hope to solve some of the more intractable problems of petrel classification. In particular we are looking at a recently discovered population on Round Island, north of Mauritius in the Indian Ocean. Round Island petrels may represent a second population of the rare Trindade petrel, known only from a single island in the South Atlantic. However, they also share similarities with two more widespread Pacific species. Identifying the taxonomic position of Round Island birds relative to these established groups has important implications for their conservation status and subsequent management. Through a combination of field studies and laboratory work we are now beginning to fill in the most important gaps in our understanding of these birds.
The Michael Marks Trust generously awarded ZSL a grant to fund the cataloguing of our artworks including paintings, sculpture and artefacts. Cataloguing began in November and the emerging catalogue can be searched online using the “switch database” option to “Art” in the Library catalogue.

The journal holdings information of ZSL Library has been uploaded to SUNCAT and can now be seen on their online catalogue http://edina.ac.uk/suncat/. As a major collection which is not part of a research or university library we were invited to contribute to the second stage of this project. This will raise the profile of the Library’s collection and facilitate access to our holdings information for other libraries, members of the academic community and the public.

SUNCAT is the pilot Serials Union Catalogue for the UK. The pilot service includes records from 22 of the largest UK research libraries and the databases of the CONSER programme and the ISSN International network. Further libraries will be added continuously over the next two years. A full service will be launched in Autumn 2006. SUNCAT can be used to locate serials in contributing libraries. SUNCAT will also provide links to the web pages of contributing libraries so that users of this service can find the library addresses, phone numbers, opening hours and lending services.

Professor Geoff Moore of the University of London Marine Biological Station in Millport on the Isle of Cumbrae continued to be a Library Visiting Scholar. A further two Visiting Scholars have been appointed. Rita Owen is researching and conserving a volume of Mark Catesby’s The natural history of Carolina, Florida and the Bahama Islands, containing the figures of birds, beasts, fishes, serpents, insects and plants... together with their descriptions in English and French..., London: printed at the expense of the author, 1731–43. Edward Dickinson is comparing ZSL’s collection of Brian Houghton Hodgson bird drawings to the copies kept at the Natural History Museum.

Archives Libraries Museums London funded a photographic preservation audit visit by a specialist conservator in December 2005.

The Library lent items to external exhibitions, allowing increased public access and awareness of items in our collections. An album of photographs by Frederick York (1823–1903) together with two Gambier Bolton prints were lent to Museum Folkwang in Essen (Germany) for display in their exhibition Useful, cute, collected. The York album dates from 1872 and it is one of only three known copies. It contains some fascinating images including photographs of many animals now extinct or very rare including the quagga, Sumatran rhinoceros and Burchell’s zebra.

The Library continued to provide reference use of the Library to Friends of ZSL and members of the public. Regular introductory Library tours are held for ZSL staff to enable them to make effective use of the Library’s resources. Special library tours have also been given to staff of Antwerp Zoo, Library staff from the Natural History Museum and Fellows of ZSL.

ZSL library staff participate in the wider world of libraries and archives by attending meetings and conferences of ASLIB Biosciences, Charity Archivists and Record Managers (CHARM), GLAS User Group, Animal Health Information Specialists (UK & Ireland) and the London Learned Society and Professional Librarians’ Group.

We are extremely grateful for the continued help of our dedicated team of volunteers and the many Fellows and Friends of ZSL who continue to support the Library with their time, by donating books, archives, zoo ephemera, and funds for the conservation of items in our collection.
Education and training are central to IoZ’s activities and we have a strong commitment to hosting research projects, particularly those leading to a PhD degree.

Our PhD students are co-registered at a university department but most spend the majority of their time at IoZ. During the year PhDs were awarded to Ben Collen (Imperial College London) for his research into the effects of bias and scale in mammalian diversity patterns; Lizzie Boakes (University of Cambridge), for her investigation into inbreeding depression and purging in captive populations; Julie Anderson (University College London), for her analysis of metapopulation dynamics of Angolan black-and-white colobus monkeys in Kenya; and Fredi Devas (University of Cambridge), for his research on social relationships and foraging success in baboons.

During the year we had our largest ever number of students on the Masters Course in Wild Animal Health. This course, and the closely aligned Masters Course in Wild Animal Biology are both run jointly with the Royal Veterinary College. Our first Masters Student Conference gave all students the opportunity to convey their research findings to colleagues and staff. Prizes were given to the student who received the highest marks on each course (Dan Horton for Wild Animal Health and Katy Morgan for Wild Animal Biology).

Prizes for the best project in Wild Animal Health were awarded to Nic Masters and Chandani Ganga Wijesinghe. Katy Morgan was awarded the best project on the Wild Animal Biology course.

The IoZ annual Student Conference was held in January. The conference offers an opportunity for students to present their work in a relatively informal atmosphere and for staff and university supervisors to learn about the diverse research undertaken by students at IoZ. This year’s Daisy Balogh Prize for the best talk was awarded to Nicky Jenner, for her talk on ‘Reproduction and resources of the black-backed jackal’.

Chandani Ganga Wijesinghe carrying out ophthalmological examination of the eyes of a skink during a teaching practical.

Mario Baldi Salas and Jason Chuei, Masters students assisting Taina Strike, Veterinary Officer at London Zoo, examining a red panda.

The 2004/5 Wild Animal Health MSc students at Regent’s Park.
The Zoological Society of London

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Peter Bennett DPhil, Theme Leader, Biodiversity and Macroecology
Andrew Bourke PhD, Theme Leader, Behavioural and Evolutionary Ecology
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William Holt PhD, Theme Leader, Reproductive Biology
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Postdoctoral Research Staff and Lecturers
Karina Acevedo-Whitehouse PhD
Jonathan Baillie PhD
Elizabeth Boakes PhD
Jon Bridle PhD
James Bull PhD
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Postgraduate Research Assistants
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Administrative, Support and Technical Staff
Christina Herterich LLM ACIS (Institute Administrator)
Phil Cottingham BTEC (CED) MIScT
(Assistant Institute Administrator)
Amrit Dehal BSc (Assistant Institute Administrator – Information Systems)
Breda Farrell (General Technician)
Jenny Fulford (Editorial Assistant)
David Hitchcock (Senior Workshop Technician)
Joanne Keogh (PA to Director of Science and Senior Staff)
Julie Phillips BA PGCE (Administrative Assistant)

Research Technicians
Dada Gottelli BSc (Chief Technician)
Daphne Green HNC AIScT (Senior Technician)
Robert Deaville BSc (Senior Technician)
Dominique Fiedler (Research Technician) •
Sedef Gavaz BSc (Research Technician) •
Shinta John MLT (Microbiology Technician)
Shaheed Macgregor Htec MSc FIBMS (Veterinary Microbiologist)
Matthew Perkins BSc (Pathology Technician)
James Sainsbury PhD (Research Technician) •

Honorary Research Fellows
Dr Andrew Balmford, University of Cambridge
Professor Malcolm Bennett, University of Liverpool
Professor Michael Bruford, University of Cardiff
Professor Roger Butlin, University of Sheffield
Dr Peter Daszak, Consortium for Conservation Medicine, USA
Dr Matthew Fisher, Imperial College London
Professor John Gittleman, University of Virginia, USA
Dr Rhys Green, University of Cambridge
Dr Rufus Johnstone, University of Cambridge
Professor Ian Owens, Imperial College London
Dr Debbie Pain, Royal Society for the Protection of Birds
Dr Andy Purvis, Imperial College London
Dr Robert Simmons, Percy Fitzpatrick Institute of African Ornithology, South Africa
Professor Rene Stet, University of Aberdeen
Dr Simon Thirgood, Macaulay Institute
Professor Charles Tyler, University of Exeter
Professor Paul Watson, Royal Veterinary College

Honorary Research Associates
Teresa Abaigar PhD
Jakob Bro-Jorgenson PhD
Boris Dayuba PhD
Simon Goodman PhD
Marcella Kelly PhD
Heather Koldeway PhD
Jonathan Loh PhD
Nancy Ockenden PhD
Giovanni Pastorino MSc
Nilendran Prathalingham PhD
Sebastien Regnault PhD

Scientific Publications and Meetings

Scientific Books
Fiona Fisken BSc (Editor)

Journals and Meetings
Linda DaVolls BA (Head of Scientific Publications and Meetings)
Patricia Manly (Senior Editorial Assistant)
Deborah Body MSc (Scientific Meetings and Awards Co-ordinator) •
Joy Miller BSc (Scientific Meetings and Awards Co-ordinator)

Editors Journal of Zoology
Ian Boyd PhD DSc
Juliet Clutton-Brock PhD DSc
Robert Ewwood PhD
John Gittleman PhD
Tim Halliday MA DPhil
Philip Rainbow PhD DSc

Editors Animal Conservation
Guy Cowlishaw PhD
Keith Crandall PhD
John Gittleman PhD
E J Milner-Gulland PhD

Library
Ann Sylph MSc MCLIP (Librarian)
Michael Palmer MA (Archivist)
Marie Monaghan BA MCLIP (Assistant Librarian)
Claire Thatcher BA (Library Assistant)

Others working at the Institute, including volunteers working on projects in the field
Mark Ambrus, Carin Andersson, Tzo Tze Ang, Sayako Arai, Elena Badia, Martyn Baker, Jessie Barker, Katy Barton, Carmen Bessa-Gomes, Amandine Bouchard, Joe Bourne, David Bowden, Brenna Boyle, Carlos Bricio, Annaliese Brightwell, George Busby, Nicolas Camara, Claudia Carraro, Bernadette Carroll, Sally Cheung, Fay Clark, Melissa Cuke, Penelope Curtiss, Melissa de Graaff, Anneloes de Raad, Emily Dolan, Nathalie Doswald, Caitlin Douglas, Chris Elvidge, Daniele Fanelli, Juliet Field, Rose Fleming, Kryzysta Golaber, Agnes Rocha Gosselin, William Goulding, Jocelyn Hacker, Alex Hall, Kate Harris, Hiliary Hiscock, Sarah Holbrook, Kelly Houston, James Howard, Marianne James, Hanna Javed, Caitlin Joseph, Carlos Filipe Justo Moura, Janien Kamps, Hans Kelstrup, Vitaliy Khododin, Laura Krisop, Melissa Kyriakos, Susana La Falci, Mike Lawes, Ana Longo, Carlos Lopez-Vaamonde, Shelah G Macmillan, Rachel Marno, Clare Marsden, Harry Marshall, Louise McRae, Miriam Mesa, Caroline Millins, Geoff Moore, Philippa Morrison, Lenka Nealova, Christopher Nwaizu, Rob Pickles, Monica Puig MacLean, Mohammad Rezaaur Rahman, Malu Ram, Anna Randall, Emilio Rendon-Franco, Carolyn Riddell, Amber Rosenthal, Leigh Scantlebury, Lisa Schoegei, Rachel Shore, Mirmam Smith, Enrico Sorato, Rowena Spence, Andrew Temple, Emily Thomas, Valarie Thomas, Aidan Weatherill, Ann Weddle, Jan Whalley, Susan Wilson, Marc Yeste Oliveras

departures
Collaborations

Applied Biomathematics (USA)  IUCN Sampled Red List Index
Bat Conservation Trust Monitoring bat biodiversity: Indicators of sustainable development in Eastern Europe
Bird Conservation Nepal Conservation of Gyps spp. vultures in India
Birdlife International Global biodiversity hotspots: IUCN Sampled Red List Index
Bengal National History Society (India) Conservation of Gyps spp. vultures in India: Assessing the impact of vulture declines on public health in India
British Embassy in Quito (Ecuador) Building capacity and determining disease threats to endemic Galapagos taxa
British Trust for Ornithology Garden Bird Health Initiative
Bulgarian National Museum of Natural History Monitoring bat biodiversity: Indicators of sustainable development in Eastern Europe
Canterbury Museum (New Zealand) Extinct birds and bird extinctions in the South Pacific
Care for the Wild International Comparative demography of elephants in European zoos and range states
Central Science Laboratory Garden Bird Health Initiative
Centre for Ecology and Hydrology, Monika Wood Restoration and management of bumble bee habitat in agricultural landscapes; Effects of spatial scale on population abundance and dynamics
Centre for Environment, Fisheries and Aquaculture Science (CEFAS) Environmental monitoring and training
Charles Darwin Research Station Ecology, adaptation and evolution in invasive ants
Chester Zoological Gardens Chrytidiomycosis emergence in Dominica
Conservation International (USA) IUCN Sampled Red List Index; Global Mammal Assessment; Global biodiversity hotspots; Evaluating incentives for the sustainable hunting of bushmeat; Spatial patterns of hunting sustainability in Equatorial Guinea; Evaluating dependence on wild foods among the rural poor in Central Africa
CSIRO Australian Animal Health Laboratory (Australia) Anthropic change and emerging zoonotic paramyxovirus; Conservation of Gyps spp. vultures in India; Ecology and evolution of infectious diseases in mammalian mating and social systems
Department of Fisheries and Wildlife Habitat use of tiger in altered landscapes and monitoring of cryptic mammals
Desert Research Foundation of Namibia (Namibia) Functional response mechanisms in social foragers; Individual optimisation and social constraints in group-living vertebrates; Coordination of social foragers in patrolling assessments; MHC, parasite loads, and mate choice in desert baboons
Downstream Research Group (USA) Conservation of the Yangtze River dolphin
English Nature Assessing the impact of Batrachochytrium dendrobatioides emergence in Britain; Health surveillance for habitat in agricultural landscapes
Estacion Experimental de Zonas Aridas (Spain) Reproductive studies in gazelles
European Zoological Association (EAZA) Genetic analyses and management of captive-breeding populations
Farmed Environment Company Ltd Restoration and management of bumble bee habitat in agricultural landscapes
Fauna and Flora International Chrytidiomycosis emergence in Dominica; Habitat use of tigers in altered landscapes and monitoring of cryptic mammals
Forestry and Wildlife Division, Commonwealth of Dominica Chrytidiomycosis emergence in Dominica
Frankfurt Zoological Society (Germany) Long-term demography of the Serengeti cheetah population
Galapagos Conservation Trust Building capacity and determining disease threats to endemic Galapagos taxa
Galapagos National Parks Service Building capacity and determining disease threats to endemic Galapagos taxa
Genes-ABS Ltd Enhancement of sperm cell survival by epididymal and oviduct epithelial cells
Globabab Training and Research Centre (Namibia) Spatial organisation and sex transmission in black backed jackal; Coordination of social foragers in patrolling environments; MHC, parasite loads, and mate choice in desert baboons
Harvard Medical School (USA) Anthropic change and emerging zoonotic paramyxoviruses
Inax (Brazil) Hierarchical socio-economic models of Amazonian deforestation
IMV Enhancement of sperm cell survival by epididymal and oviduct epithelial cells
Inovis Ltd Enhancement of sperm cell survival by epididymal and oviduct epithelial cells
Institut Congolais pour la Conservation de la Nature (Democratic Republic of Congo) Development of a monitoring and training unit for the World Heritage Sites of Democratic Republic of Congo
Institut National Agronomique Paris-Grignon (France) Dynamics of species extinctions
Institute of Ecology Anthropic change and emerging zoonotic paramyxovirus
Institute of Hydrobiology Conservation of the Yangtze River dolphin
Instituto Nacional de Pesquisas da Amazônia (Brazil) Hierarchical socio-economic models of Amazonian deforestation
Interdisciplinary Centre for Marine Sciences (CIDMAR) (Mexico) Zoonotic potential of whale watching; Determining age structure of cetacean populations using telemeters as a biological clock
IUCN (Switzerland) Global Mammal Assessment; Conservation of the Yangtze River dolphin; IUCN Sampled Red List Index; Range-wide conservation planning for cheetah and wild dogs
Leeds Institute of Genetics, Health and Therapeutics DNA damage and cancer in wildlife; a biomolecular approach to understanding urogenital carcinoma in California sea lions
Leuser Development Programme (Indonesia) Habitat use of tigers in altered landscapes and monitoring of cryptic mammals
Marine Environmental Monitoring Cetacean strandings investigation
Marine Mammal Center (USA) DNA damage and cancer in wildlife: a biomolecular approach to understanding urogenital carcinoma in California sea lions; Phylogeographic patterns of disease occurrence in California sea lions
Massey University (New Zealand) Sexual selection and the hii Mountian Wildlife Foundation Conservation and molecular ecology of habitat in altered landscapes
Ministry of Lands and Resettlement, Government of the Republic of Namibia Coordination of social foragers in patchy environments; MHC, parasite loads, and mate choice in desert baboons
National Bird of Prey Trust Conservation of Gyps spp. vultures in India
Natural History Museum Cetacean strandings investigation
New South Wales Wildlife Zoos in Kio Muni, Equatorial Guinea; Evaluating dependence on wild foods among the rural poor in Central Africa
Paignton Zoo and Environmental Park Health surveillance for species recovery programmes
Palaecol Research Ltd Extinct birds and bird extinctions in the South Pacific
Peoples Trust for Endangered Species Health surveillance for species recovery programmes
Poultry Diagnostic and Research Centre Conservation of Gyps spp. vultures in India
Queensland Department of Environment and Heritage (Australia) Monitoring bat biodiversity: Indicators of sustainable development in Eastern Europe
Romanian Bat Protection Organisation Monitoring bat biodiversity: Indicators of sustainable development in Eastern Europe
Rothschild Research Restoration and management of bumble bee habitat in agricultural landscapes
Royal Society for the Protection of Birds Conservation of critically endangered Gyps spp. vultures in India; Garden Bird Health Initiative; Investigating the impact of catastrophic vulture declines on public health in India; Ecology and conservation of the great yellow bumble bee; Health surveillance for species recovery programmes
Royal Veterinary College Epidemiology of poxviruses in squirrels; Maximising semen performance by improving sperm assessment and survival during and after cryopreservation; Cetacean strandings investigation; Enhancement of sperm cell survival by epididymal and oviduct epithelial cells
Salmonella Reference Unit, Health Protection Agency Garden Bird Health Initiative
Scottish Agricultural College Cetacean strandings investigation; Garden Bird Health Initiative
Scottish Salmonella Reference Laboratory Garden Bird Health Initiative
Sea Mammal Research Unit Cetacean strandings investigation
Smithsonian Tropical Research Institute (USA) Genetics of cancer determination in polistine wasps; Hierarchical socio-economic models of Amazonian deforestation
Sumatran Tiger Project Habitat use of tigers in altered landscapes and monitoring of cryptic mammals
Swedish Natural History Museum Sexual selection and the hii
Tanzania National Parks Long-term demography of the Serengeti cheetah population; Developing a National Conservation Action Plan for the mammals of Tanzania
Tanzania Wildlife Research Institute (Tanzania) Long-term demography of the Serengeti cheetah population; Development of a National Conservation Action Plan for the mammals of Tanzania
Tarangire Elephant Project (Tanzania) Development of a National Conservation Action Plan for the mammals of Tanzania
Tiger Tops Habitat use of tigers in altered landscapes and monitoring of cryptic mammals
Tsavo Republic National Park (Namibia) Coordination of social foragers in patchy environments; Individual optimisation and social constraints in group-living vertebrates; MHC, parasite loads, and mate-choice in desert baboons; Functional response mechanisms in social foragers
UNESCO ‘Conservation in Crisis’ Programme Monitoring and training for the World Heritage Sites of Democratic Republic of Congo

Universities Federation for Animal Welfare Garden Bird Health Initiative; Cetacean strandings investigation

University of Bath Conservation management and ecological genetics of the black bog ant

University of Birmingham Global biodiversity hotspots; Sexual selection and the ladybird

University of California (USA) DNA damage and cancer in wildlife: a biomolecular approach to understanding urogenital carcinoma in California sea lions; Range-wide conservation planning for cheetah and wild dogs

University of Cambridge MHC, parasite loads, and mate choice in desert baboons; Genetic analyses and management of captive-breeding populations; Ecology and conservation of the great yellow bumble bee; Patterns of genetic variation in UK butterflies: understanding neutral and functional genetic influences on pathogen resistance; Predicting the susceptibilities of species to human disturbances

University of Cape Town (South Africa) Regional differences in avian life-history traits

University of Castilla-La Mancha (Spain) Wildlife immunogenetics: understanding neutral and functional genetic influences on pathogen resistance

University of Cork (Ireland) Cetacean strandings investigation

University of East Anglia Conservation management and ecological genetics of the black bog ant and commerce in Sumatra; Ecology and conservation of the great yellow bumble bee; Restoration and management of bumble bee habitats in agricultural landscapes; Understanding neutral and functional genetic influences on pathogen resistance; Predicting the susceptibilities of species to human disturbances

University of Edinburgh Implications of dog-wildlife co-existence for conservation and public health

University of Florida (USA) Habitat use of tigers in altered landscapes and monitoring cryptic mammals

University of Girona (Spain) Individual optimisation and social constraints in group-mate choice in desert baboons

University of Guelph (Canada) Comparative demography of elephants in Europe 2005 and range states

University of Kent Spatial organisation and disease transmission in black-backed jackal

University of Kiel (Germany) Post-mortem research feasibility study on cetacean ears

University of Kwazulu Natal (South Africa) MHC, parasite loads and mate choice in desert baboons

University of Las Palmas (Spain) Pathological investigations into gas and digestive tract disorders in horses

University of Laval (Canada) Comparative demography of elephants in Europe 2005 and range states

University of Lincoln Population genetics and phylogeography of the European bitterling

University of Liverpool Garden Bird Health Initiative; Cetacean strandings investigation

University of Maley (Malaysia) Anthropogenic change and emerging zoonotic paramyxoviruses

University of Montpellier (France) MHC, parasite loads and mate choice in desert baboons

University of Murcia (Spain) Enhancement of sperm cell survival by epididymal and oviduct epithelial cells

University of Natal (South Africa) Dynamics of species extinctions

University of New Mexico (USA) Energetic constraints on animal ecology

University of Newcastle Epidemiology of poxviruses in squirrels

University of Oxford Regional differences in avian life-history traits; Habitat use of tigers in altered landscapes and monitoring of cryptic mammals; Camera trapping as a census tool

University of Padova (Italy) Institute of Zoology hormone assay service

University of Princeton (USA) Anthropogenic change and emerging zoonotic paramyxoviruses

University of Reading Patterns of genetic variability during population decline in Iberian Atlantic salmon

University of San Diego (USA) Energetic constraints on animal ecology

University of Saskatchewan (Canada) Cetacean strandings investigation

University of Sheffield A postgenomic approach to the role of odour and gustatory receptors in Droopophilid speciation; Enhancement of sperm cell survival by epididymal and oviduct epithelial cells; Global biodiversity hotspots; Human-driven changes in species’ geographic ranges and the risk of extinction

University of St Andrews A postgenomic approach to the role of odour and gustatory receptors in Droopophilid speciation; Patterns of genetic variability during population decline in Iberian Atlantic salmon

University of Strirling Comparative demography of elephants in Europe 2005 and range states

University of Sussex Communication networks in African elephants

University of Sussex Patterns of genetic variability during population decline in Iberian Atlantic salmon

University of Victoria (Canada) Historical and current determinants of pathogen distribution and prevalence in a multihost and island system

University of Virginia (USA) Energetic constraints on animal ecology; Ecology and evolution of infectious diseases in mammalian mating and social systems; The effects of spatial scale on population abundance and dynamics

University of Washington (USA) Long-term demography of the Serengeti cheetah population

Veterinary Laboratories Agency Cetacean strandings investigation; Developing a National Conservation Action Plan for the mammals of Tanzania; Range-wide conservation planning for cheetah and wild dogs; Investigating human–large carnivore conflict in Tanzania; Human impacts on carnivore biodiversity inside and outside protected areas in Tanzania

Veterinary Services Division, Commonwealth of Dominica (Dominica) Chytridiomycosis emergence in Dominica

Waikato Institute of Technology (New Zealand) The Hope River Forest Fragmentation Project

Wildlodge and Wetlands Trust Revised population viability analysis of Scottish geese

Wildlife Conservation Society (USA) Long-term demography of the Serengeti cheetah population; Developing a National Conservation Action Plan for the mammals of Tanzania; Range-wide conservation planning for cheetah and wild dogs; Investigating human–large carnivore conflict in Tanzania; Human impacts on carnivore biodiversity inside and outside protected areas in Tanzania

Wildlife Veterinary Investigation Centre Garden Bird Health Initiative

Working Dogs for Conservation (USA) Long-term demography of the Serengeti cheetah population

World Pest Association Human-driven changes in species’ geographic ranges and the risk of extinction

World Wildlife Fund Development and implementation of the Living Planet Index; IUCN Sapped Red List Index

Wurzburg University (Germany) The evolution of nest-snipping by workers of the tropical paper wasp


Institute of Zoology mission:
To identify, undertake, and communicate high-quality research to benefit the conservation of animal species and their habitats.

**IoZ Activities**

**IoZ objective 1**
To undertake relevant, high-quality research and research training.

**IoZ objective 2**
To anticipate and respond to emerging research and management issues identified by conservation organizations.

**IoZ objective 3**
To communicate outcomes and results to scientists, conservation practitioners and the wider community.

**IoZ Research Strategy**

**IoZ focussed programmes**
- Conservation biology
- Animal husbandry
- Animal health and welfare
- Comparative ethology
- Conservation genetics

**Research strategy**
This table summarises the main aspects of our research strategy, and the way in which it is to be implemented with our partners and collaborators. A full version of the strategy is available on request.

**With ZSL**
We respond to research questions and contribute to ZSL's Conservation Programmes (see page 26)
- Bushmeat and forests
- Carnivores and peacocks
- Deserts and rangelands
- Marine and fresh water
- UK native species
- Island ecosystems

**With Cambridge University**
We maintain and develop research links with Cambridge and other relevant departments.

**With institutions in London**
We maintain and develop research links with academic bodies, especially the Centre for Ecology and Evolution.

**With other organisations**
Collaboration with most relevant outside bodies for our core research interests (see page 42)

**Research questions**
Research questions are influenced by our formal links with the Wildlife Conservation Society and English Nature.

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

**With institutions in London**
Our meetings facility and programme of talks communicate science to scientists, conservation practitioners and the wider community. (see page 37)

**Oral presentations**
Our meetings facilities and programme of talks communicate science to scientists, conservation practitioners and the wider community. (see page 37)

**Writing**
- IoZ book series published with Blackwell
- Technical publications to support best practice in zoos (Conservation Reports)
- Series published with CUP
- Zoo Yearbook
- Music by chytridiomycosis to the mountain chicken

**Research publications**
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