Institution: Institute of Zoology

Unit of Assessment: B7

a. Overview

The Institute of Zoology (IOZ) is a unique organisation worldwide. It is the scientific research department of the Zoological Society of London (ZSL), an independent charity and conservation NGO that houses living collections at two zoos, runs field conservation projects in more than 50 countries worldwide, and that engages with conservation policy makers around the world. It is also a HEFCE-funded research institute affiliated to University College London (UCL), pursuing pure and applied scientific projects in lab, field and theory as part of a holistic approach to animal conservation. IOZ scientists use the results from their research to develop evidenced-based conservation policy advice at all scales, from local to international, and work with conservation managers to apply conservation science in the field. A high proportion of IOZ's work is therefore interdisciplinary, fusing basic science to applied environmental, economic and social questions.

Clear evidence of our success was provided by a recent major HEFCE review of IOZ research, carried out in 2010 by an Advisory Group of independent scientists chaired by Professor. Charles Godfray. The Advisory Group "*acknowledged the uniqueness of the Institute, both within the UK and globally",* and concluded that "*Although other zoological institutes exist in other countries, none has the Institute's holistic approach to animal conservation, which runs from pure science to field research, policy advice and public engagement",* the "*Institute is both leading and distinctive, and its activities are very coherent",* and that "*"Its contribution to the economy and society is strong, impressive and appropriately focused*." IOZ enters the REF process voluntarily to ensure that its quality is maintained and benchmarked against international standards.

IOZ research activity is concentrated in five areas that are fundamental to conservation science in the 21st century, and that are core to IOZ's Science Plan. These are defined by five Research Themes, all of which are covered by the REF2014 submission:

Behavioural & Population Ecology (BPE) Understanding the evolutionary and ecological basis of an animal's behaviour provides invaluable insights into our ability to predict, and manage, its response to human impacts. This is especially true when we scale-up individual behaviour to population dynamics and extinction processes. These areas are fundamental to the design of effective conservation policy and practice. The aims of the BPE Theme are therefore (1) to test fundamental hypotheses in behavioural and population ecology, and (2) to use the knowledge of wild species thereby gained to inform conservation policy and management.

Biodiversity & Macroecology (BME) The main threats facing organisms and their environments are manifested at global spatial scales and impact a vast array of species. An understanding of processes at such scales can thus make a critical contribution to effective conservation action. The aims of the BME Theme are therefore (1) to describe patterns of diversity in the biology, ecology and distribution of animal species and their habitats at regional and global scales, (2) to test hypotheses about the evolutionary and ecological processes that may explain the origin and maintenance of this diversity, and (3) to work with practitioners to apply this knowledge in setting priorities for conservation action. BME also incorporates the **Indicators & Assessments Unit**, the purpose of which is to produce scientifically robust biodiversity indicators to track progress on the conservation goals of the Convention on Biological Diversity, define the status and trends of global biodiversity, and to measure human impact on the planet.

Evolution & Molecular Ecology (EME) To understand what needs to be done for biodiversity conservation, it is often essential to understand the mechanisms underlying the evolutionary process that gave rise to and continue to generate the species and populations we so value. DNA, RNA and other molecular technology, and the bioinformatics that allows this trove of data to be interpreted, have developed exponentially, and we aim to stay at the forefront of research in these areas. The aims of the EME Theme are therefore (1) to improve our knowledge of the evolutionary processes that shape biodiversity, across systems and at all scales, and (2) to use this knowledge to inform conservation practice and policy, and to add to our basic understanding of evolution.

People, Wildlife & Ecosystems (PWE) Effective management of natural resources increasingly depends on a sound understanding of the interactions between people, wildlife and ecosystems. Humans are a component of natural systems, and need to be understood in this context to develop solutions to mitigate these pressures. This understanding can be used to help develop policy and management solutions that best conserve biodiversity while ensuring sustainable benefits to local communities and society. The aims of the PWE Theme are therefore

(1) to understand humans as a component of ecosystems, and (2) to use this understanding to develop solutions ensuring sustainable coexistence in the face of environmental change.

Wildlife Epidemiology (WLE) Diseases are increasingly being recognised as key threats to wildlife populations and species. Wildlife are also a source of pathogens of significance for humanity, leading to pressures to control or eliminate reservoir hosts, and highlighting the need for research to understand and mitigate the drivers of disease emergence. The aims of the WLE Theme are therefore (1) to identify where disease is a threat to wildlife, either as a primary cause of declines or as a threat to remnant populations, (2) to investigate the mechanisms leading to the emergence of disease as a conservation threat, and (3) to develop an understanding of the consequences of changes in wildlife disease epidemiology, both to wildlife conservation and welfare and to human health and welfare, particularly where changes have anthropogenic drivers. WLE also maintains the most comprehensive sample archive for wildlife disease studies in Europe.

b. Research strategy

ZSL's Mission is to promote and achieve the worldwide conservation of animals and their habitats. In support of this, IOZ's Mission is to undertake and promote relevant high quality scientific research predominantly relevant to conservation biology, to inform and influence conservation practice and policy in the UK and internationally, for the benefit of the natural world and the people who depend on it. The strategy by which this Mission is pursued is set out in the IOZ Research Plan, which is updated every 5 years. Most of the REF2014 period has been influenced by the IOZ Research Plan that ran from 2006 – 2011, and which aimed to take a holistic, coordinated and unique approach to conservation science. The success of this Research Plan is indicated by the conclusions of the HEFCE review of IOZ research in 2010 mentioned above, notably that IOZ's "*activities are very coherent*", and "*it is focusing on the right areas of activity.*" These conclusions were a strong vindication of IOZ's continuing excellence, and showed that it was achieving its strategic aims in respect of promoting research for the benefit of conservation. They also helped inform the current IOZ Research Plan, which runs from 2012 – 2016.

The aim of the new plan is to ensure that the IOZ research program over the next 5 years continues to be driven by cutting edge issues in conservation science, while taking advantage of significant relevant funding opportunities. As a result, our new Plan is still based around the consideration of priority topics for scientific research, but differs from the previous one in a changed set of priorities. Notably, in recent years we have developed a substantial number of projects that explicitly address the interface between humans and natural systems. This research reflects the increasing importance of ecosystem services to human health and welfare. We have therefore instigated a new Research Theme, PWE, to support and coordinate such studies, and to catalyse future work in this area. We have also refocused genetic research at IOZ by forming the EME Theme, to stimulate work using molecular genetic and genomic techniques, experimental ecology, modeling, long-term population studies, behaviour and the development of theory, to explore the evolutionary processes that shape biodiversity at a broad range of spatial and temporal scales. These changes to research priorities led to the research structure and research aims described in the **Overview**.

A high proportion of IOZ's work is interdisciplinary, and our research structure is specifically designed to facilitate this. Each staff member usually runs several research projects, and these may be registered across more than one research theme depending on the project focus. Theme leaders meet with the Director, Director of ZSL Conservation Programmes, IOZ Administrator, PhD Student Tutor and MSc Course Director once a month to report on recent progress in projects and to share information on ideas and opportunities. This structure promotes collaboration: e.g., while IOZ was already a leading centre for research in macroecology and wildlife disease, interactions between members of these themes facilitated novel research mapping the global distribution of emerging infectious diseases, allowing the underlying drivers of disease hotspots to be identified (*Nature* **451**:990, 2008). Given the importance of collaborations, we see flexibility in working practices as a key need. For example, in 2009 we seconded Dr N Pettorelli to work with the Climate Change and Biodiversity Programme of UNEP-WCMC, where her work included investigating the role of ecosystems in climate change mitigation policies, covering issues related to Monitoring, Reporting and Verification and carbon mapping; and investigating the possible links between biodiversity, ecosystem services and climate change mitigation. This flexibility may also explain the high proportion of female staff at all levels of the organisation (see **Section c i**).

The new IOZ Research Plan identifies a set of key research programmes that we aim to pursue

relevant to priority topics. For example, there are 5 such programmes overseen by the WLE Theme: (i) Infectious diseases of wildlife: threats to biodiversity, livestock and human health; (ii) Understanding the emergence of infectious diseases of wildlife; (iii) Ecological and evolutionary aspects of host-parasite interactions; (iv) Investigating wildlife health at individual, population and ecosystem level; and (v) Investigating drivers of wildlife population decline due to infectious or non-infectious diseases. The primary aims of the Themes are to guide and structure these research programmes, but each staff member usually runs projects across more than one Theme. The new Plan aims to increase opportunities for collaboration by the development of special-interest groups that bring together relevant parties across the whole of ZSL: we have already instigated groups on Amphibians, Climate Change, and Carnivores, while a further group on Captive Breeding and Reintroduction is in the planning stage. The new Plan also identifies priority areas for staff recruitment, infrastructure investment, and education, which we are in the process of developing.

A further significant change to the IOZ strategy since RAE2008 has been to our university affiliation. In 2011, with HEFCE approval, the Council of ZSL elected to change the partnership from the University of Cambridge to UCL. The rationale for affiliation with UCL was that this university offered significantly greater benefits to IOZ (and even better value for money to HEFCE) through complementarity of research, geographical proximity, and the potential for cost savings through greater opportunities to share resources, facilities, and student support and training. We have put in place several new initiatives to grow this relationship, including joint staff appointments, a new M.Res. in Biodiversity, Evolution and Conservation, partnering (with several other London HEIs) in a NERC Doctoral Training Programme (DTP) proposal, and joint Awaydays for senior staff. The M.Res. and DTP initiatives were identified as priority areas for education development in the Research Plan. Management of IOZ is overseen by a joint ZSL/UCL Committee, including independent members from other research organisations.

c. People, including:

i. Staffing strategy and staff development

In 2013, IOZ staff comprised 29 postdoctoral research staff, 11 research support staff (technicians and research assistants), 6 administrative and support staff, 48 directly supported and 10 affiliated PhD students, and 4 staff dedicated to producing ZSL's scientific journals (including *Journal of Zoology*) and running ZSL's public scientific meetings and international scientific symposia. We recognise that, as an independent research institute, our reputation depends on the quality of our research staff, and quality is the primary criterion for recruitment to academic posts at all levels. This quality is reflected in the fact that we will return 100% of eligible staff to REF2014.

IOZ staffing policy recognises a general need to reward good performance and to provide salary and promotion terms to attract and maintain the best scientists, while at the same time providing flexibility in response to fluctuations in external funding. Our current strategy is thus to have up to 12 long-term employed senior staff, and a large number of core- and externally-funded junior post-docs and Research Fellows, the bulk of whom will move on to high quality academic positions elsewhere as a result of the career development we provide. We believe that this scheme and our associated policies provide the best strategy to retain senior staff, generate a continual turnover of new ideas and approaches, allow the very best to be promoted upwards (at IOZ or elsewhere), give the best possible grounding for career progression for scientists mentored here, and support the principles of the Concordat to Support the Career Development of Researchers. Evidence of the effectiveness of our policies is given below in respect of internal promotions, and the destinations of former IOZ research staff at all levels.

Senior staff are employed on 5 year reviewable contracts, assessed by internal and external peer review, with a joint ZSL/UCL Committee providing guidance on performance and promotion. Staff are graded according to criteria based on their research potential, research performance and contribution to the running of IOZ. Below the Director of IOZ are three broad categories of research staff: Readers, Senior Research Fellows (SRFs) and Postdoctoral Research Fellows. Readers are equivalent to Readers in major universities, and SRFs to Senior Lecturers. IOZ staffing policy includes a formal process for promotion to Reader and SRF. Applicants are evaluated by a promotions sub-committee of the joint ZSL/UCL Committee on the basis of clearly defined criteria for progress, including evidence of an extensive body of original research and high quality publications, a strong reputation within the candidate's own field, and effective contribution to activities other than research (including conservation outputs/impact, teaching, management and administration). Readers and SRFs may use the title of Professor if conferred Honorary or Visiting

Status by an accredited UK HEI, and 3 of the current 10 senior staff have this distinction.

To promote the careers of promising early-career scientists, IOZ funds research development posts (four years with a possible two-year extension) that allow junior scientists to develop a body of their own work, gain experience in research management, and apply for external funding, including research council grants. These posts are known as Institute Research Fellows (IRFs). Current IRFs are Drs Bielby, Brekke, Harrison, Lawson, and Rowland. It is expected that IRFs will subsequently be attractive to research employers for more senior and permanent positions at universities or other research organisations, or within IOZ. Indeed, former IRFs who have left IOZ in the current assessment are Dr N. Raihani (now Royal Society URF, UCL), Dr J. Bro-Jørgensen (now RCUK Research Fellow, Liverpool University), and Dr K. Acevedo-Whitehouse (Principal Investigator, School of Natural Sciences, UAQ, Mexico), while Dr N. Pettorelli received an internal promotion. In light of these successes, our strategy is to increase the number of IRF positions, and the five current IRFs is an increase from two at the start of the REF2014 assessment period.

IOZ recognises that managing performance is an important and continuous aspect of the effective development of research and technical staff, and promotes this through individual Performance & Development Reviews (PDRs). The core of this system is an annual meeting between the staff member and their manager to assess and acknowledge past performance, and to plan action to achieve agreed future performance. Every member of staff with a contract of more than one year has a PDR. Once they have carried out PDR reviews for all their staff, managers pool the information to agree a final plan for developing and supporting staff in their section. This helps IOZ identify which training programmes and courses are of highest priority to develop staff experience and strengthen our institutional capabilities. This system was introduced in IOZ, but its demonstrated benefits have led it to be adopted across ZSL.

ZSL has an Equality Employment Policy that sets out its commitment to equality of opportunity. In line with this policy, the process for recruiting and promoting staff at IOZ considers only the quality of applicant and their alignment to the IOZ Mission. Discrimination, associative discrimination, perceptive discrimination, indirect discrimination or harassment, on the grounds of age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex or sexual orientation, are viewed as disciplinary offences, and serious cases may result in summary dismissal. ZSL works with employees and with the recognised trade unions to monitor the effectiveness and working of the policy and to encourage appropriate practices and attitudes to achieve its objectives. As an indicator of success, 50% of IOZ staff are female, including 45% (14/31) of research staff, and 59% (10/17) of technical/administrative staff. Sixty percent of IOZ PhD students are also female. Our commitment to gender equality is also demonstrated by Soapbox Science (soapboxscience.org), founded and run by IOZ scientists. This started as a general mechanism for public engagement in science, but has developed into a community of researchers united in raising the profile, and challenging the public's view, of women and science; over the past few years, the organisers have produced a number of documents and articles pinpointing issues faced by women in STEM and highlighting ways forward. In 2013, Soapbox Science gathered support from renowned institutions including the British Ecological Society, Society of General Microbiology, Francis Crick Institute and the British Society for Antimicrobial Chemotherapy, demonstrating that it is gaining gravitas as a vehicle for change.

Working at the interface between science and conservation means that a high proportion of our work is interdisciplinary. Our staff tend to have a broader range of interests and expertise as a result, and so are attractive to future employers. This quality is illustrated by staff successful in obtaining excellent positions elsewhere during the assessment period: Dr S. Sumner to Senior Lecturer at Bristol University; Dr J. Baillie to Director of Conservation Programmes at ZSL, with an Honorary Professorship at Oxford University; Dr A. Rogers to a Chair in Conservation Biology at Oxford University; Dr K. Jones to a Chair in Biodiversity and Conservation at UCL. The success of our staffing strategy is also indicated in other ways: (i) Internal promotions include appointments to Professor for Cunningham, Reader for Jepson, SRF for Garner and Turvey, and RF for Pettorelli; (ii) personal research fellowships awarded to staff in the assessment period include Royal Society URFs to Turvey and Raihani, a Marie Curie Fellowship to Murphy, L'Oreal Women in Science Fellowships to Sumner and Pettorelli, AXA Post-doctoral Research Fellowships to Brekke and King, a Wolfson Research Merit Award to Cunningham; and a Philip Leverhulme Prize to Jones.

ii. Research students

Postgraduate research students are highly valued by IOZ, as it is recognised that an active and

successful postgraduate student body is an indicator of a thriving research community, and is crucial to the IOZ's future. IOZ currently has PhD students with a range of backgrounds, project areas, practical approaches and funding sources. IOZ cannot award degrees, and so postgraduate students are registered on a full or part time basis at an accredited UK HEI; we therefore have the freedom to select the HEI that best serves the needs of the student The majority of our students have been registered with Imperial College, UCL and the University of Cambridge; however, over the 2008-2013 period, we have had PhD students registered with 21 HEIs in total. We also co-supervise a significant number of affiliated PhD students, who are registered at universities abroad but collaborating with IOZ projects over the course of their research; examples include students at Auckland and Massey (New Zealand), Aveiro (Portugal), Accra (Ghana), and Santiago (Chile).

The value of these students to our mission has stimulated initiatives significantly to grow our student body, for example a programme of CASE partnerships with conservation practitioners through ZSL. The result has been a continuous increase in postgraduate student numbers from 20.5 FTE in 2007 to 46 FTE in 2013. While 24 IOZ students were awarded doctoral degrees in the RAE2008 assessment period, the number has increased to 43 in the REF2014 assessment period.

We have developed a policy-driven Code of Practice to provide an effective framework for scientific and career development for these students under our graduate programme. This programme is designed to function with the Registration and Policy and Procedures requirements maintained by the HEI where the student is registered. It reflects our students' varying needs, opportunities and expectations, recognising that while approximately 50% of our student body is made up of Research Council funded students, we also support studentships under alternative funding schemes (NGO-funded; CoMPLEX; IMPACT). The Code of Practice recognises two important aspects to the supervision of PhD students: (1) to select suitable projects, to stimulate and enthuse students and to provide a steady stream of ideas and guidance, and (2) to establish a framework for ensuring the student makes good, steady progress and completes a thesis, including guidance by the supervisor on how to present scientific work.

Each PhD project is individually registered with IOZ and formally assessed in terms of safety, welfare, ethical considerations and progress. Each IOZ student has at least one (usually two) IOZ supervisors, a Principal and Sub-Supervisor, as well as one or more supervisors from the relevant HEI(s). Both IOZ supervisors are academic members of staff and at least one must be a senior member of staff at the level of Senior Research Fellow or higher. The panel of supervisors oversees the student's progress and provides academic advice. Pastoral care is provided by a Graduate Tutor, aided by the formal Student Log. The formal requirements of each IOZ supervisor and Graduate Tutor in respect of our graduate research students are explicitly laid out in the Code of Practice. IOZ provides dedicated office and laboratory space, IT equipment, research training, funds for transferable skills, administrative support for students, and access to the ZSL library.

All PhD students are expected to give an internal seminar about their research progress to the research staff and other students at the IOZ in each of their three years of study, in order to gain confidence in presenting data and ideas to academic peers and colleagues. We hold an annual Student Conference where students give presentations on their work to a mixed audience of staff and students. We award prizes for the best talks, and provide detailed feedback on their presentations. We hold weekly research seminars and monthly meetings in each Research Theme where staff and students present aspects of their work in an informal atmosphere.

In order to maximise our chances of obtaining the best students, IOZ policy is to advertise studentships as early as possible in the annual funding cycle, and before other HEIs. This involves estimating the number of grants that will be awarded to us on the basis of likely quotas and previous outcomes, instigating an internal competition for projects assessed on scientific merit, advertising for students for the winning proposals, and then ranking the proposals for funding on the basis of the quality of the students that apply for them. In this way we attract exceptional students to advertised PhD places. Additional motivation for high quality students is provided by the collaborative and often interdisciplinary nature of our projects, which require a wide range of skills and make significant contributions to pure science and applied conservation. Approximately 75% of our PhD students have fieldwork as a major component of their projects, just over half have a significant lab component, and >1/3 of these combine lab and field components in their work. Many involve field research in some of the most biodiversity rich regions of the world, with over 50% of these based outside of Europe in Africa, Australasia and South America. The quality of our students is reflected in their success at obtaining funding and awards for their research. These

include funds from AXA, a Russell Train Fellowship, Parliamentary Office of Science and Technology, CONACyT (National Council of Science and Technology - Mexico), the International Society of Behavioral Ecology, Cambridge Philosophical Society, The Leakey Foundation, Animal Behaviour Society, International Primatological Society, Ocean Park Conservation Foundation Hong Kong, and Panthera-Kaplan Graduate Award. IOZ PhD students have an outstanding completion rate (97% in the past ten years) and employment record. Of the students completing over the past five years, approximately 70% are employed (25% are recent graduates), approximately 50% of these are Lecturers, Fellows, PDRAs or Researchers; 20% work for NGOs. Three of 5 recently appointed IRFs were IOZ PhD students. In addition, our PhD students have published in top international journals including, *Science* (2013, **339**: 271-73), *PNAS* (2009, **106**, 10230-5; 2011, **108**: 18732-6) and *Current Biology* (2008, **18**: R853-R854) during their doctorates.

The IOZ is a full partner in NERC DTP bids led by UCL and Imperial College which set out a roadmap for a London-wide PhD student network, including the Natural History Museum, RBG Kew and several London Colleges. This will provide new opportunities for multidisciplinary and cross-institutional PhD projects over the period 2014-19. A central element of these programs will be to foster a training base across NERC disciplines for students in the first 2 terms of their PhDs. The DTPs will also provide a catalyst for new collaborations across partners in these networks.

d. Income, infrastructure and facilities

IOZ recognises the importance of external funding and maintaining a broad portfolio of income sources to protect against the vagaries of the funding environment, to limit our reliance on funds from any single source, and to provide significant added value to the funding we receive from HEFCE. Consequently, IOZ works to a Business Plan set up to manage growth in external income, through research grant income won competitively from RCUK, charity and private sources. Thus, while our annual HEFCE grant increased by 7% over the total period of the REF2014, from £2.076 million in 2007/8 to £2.219 million in 2012/13, our total annual income (including non-grant income) grew by 18.5%, from £4.157 million to £4,929 million in the same period. External (non-HEFCE) grant income awarded increased every year from 2007/8 to 2011/12, peaking at £4,431K. We have been able to access external (non-HEFCE) funds totalling c. £12.2 million within the REF2014 period, which in the context of our discipline is a significant achievement. The wide range of sources included, in 2012/13, £386K from UK Research Councils, £244K from UK charities, £1,288K from UK government (not including HEFCE), and £473K from other sources.

IOZ is housed in two purpose-built buildings (the Nuffield and Wellcome) at ZSL's Regent's Park site on the edge of central London, where it is provided with fit-for-purpose research facilities, including pathology and microbiology laboratories, constant temperature animal housing rooms, genetic sequencing facilities, and extensive storage capacity for a range of frozen and fixed-tissue archives, such as those of the Garden Bird Health Initiative, Disease Risk Analysis and Health Surveillance, and Cetacean Strandings Investigation Projects, the most comprehensive archive for wildlife disease studies in Europe. ZSL houses one of the major zoological libraries in the world (founded in 1826). Support for computing facilities for research and teaching, and the IOZ website, is provided by ZSL's ICT department, while access to other computing facilities, including large computer clusters and electronic library resources, is a condition of IOZ's affiliation to UCL.

Suitable infrastructure is clearly vital to the continued operation of IOZ. Hence, it operates a plan for rolling refurbishment of laboratory and office space in both its buildings, as well as for significant improvements to the fabric of the buildings. Costs of these improvements are supported by capital funds from ZSL's annual surplus. Notable recent upgrades include the conversion of surplus animal rooms into offices; the addition of an informal meeting area to the Wellcome building; the provision of modern storage facilities for liquid nitrogen; and the provision of refurbished and dedicated office and laboratory space for the increasing numbers of IOZ PhD students. ZSL has also just completed a refurbishment of the 2nd floor of the Nuffield building, investing £450k in five new environmentally controlled laboratories to enable IOZ to be at the cutting edge of research on advanced genetics and genomics. In addition to the improvements to buildings, IOZ has invested substantially in new equipment over the current assessment period to ensure the best possible facilities. Significant equipment purchases include: an Illumina MiSeq, an Agilent 2200 TapeStation and a NextEngine 3D laser scanner. In total, £1188K has been invested in infrastructure support and development and equipment over the REF2014 assessment period.

IOZ scientists have also helped to fund and develop infrastructure in a range of foreign countries, to increase both IOZ and local research capacity. Examples include a molecular

diagnostics laboratory and a captive breeding facility for the Critically Endangered mountain chicken frog in Dominica, laboratories to assist avian disease diagnostics and vulture conservation breeding in India, and laboratories to investigate disease threats to Galapagos fauna.

e. Collaboration and contribution to the discipline or research base

IOZ pursues a holistic approach to animal conservation that uses the results from our high-quality science to develop evidenced-based conservation practice and policy advice at all scales, from local to international. These ambitious goals make it particularly important for us to engage and retain a network of collaborators in similar areas of scientific research and policy development.

Within the UK, IOZ collaborates on a range of projects with scientists, conservationists and policymakers from a broad range of organisations, including (in 2012/13) CEH, CEFAS, the Sea Mammal Research Unit, RSPB, BTO, Natural England, Defra and 39 UK universities. These links are strengthened by the requirement for university partners to co-supervise IOZ PhD students. Our status as founder member of the Centre for Ecology and Evolution (CEE), a centre of excellence based at UCL, is also significant in this regard. CEE is an active network of London-based scientists fostering research through talks, workshops, collaborative project funding, and training opportunities. The scientific rigour and impartiality with which IOZ addresses conservation problems makes it an invaluable source of independent and authoritative advice to NGOs. IOZ scientists collaborated with more than 90 UK and international NGOs in 2012/13 alone.

IOZ has always had strong international linkages as a consequence of its work. Participation in significant activities in conservation science requires international collaboration both at a general level and as necessitated by specific projects. In 2012/13 alone, IOZ scientists worked with more than 300 overseas organisations. Our linkages include strong collaborations with national governments (e.g. in Botswana, the Commonwealth of Dominica, Ecuador, Ghana, India, Indonesia, Kenya, and Tanzania), local NGOs (e.g. Bombay Natural History Society, Sociedad Ornitologica de la Hispaniola, New Zealand's Forest & Bird), IGOs (e.g. CBD, OIE, UNEP-WCMC, CMS, CITES) and commercial concerns (e.g. Timbmet, Disneynature). In 2012/13, IOZ scientists collaborated on research with colleagues in more than 250 overseas HEIs and research institutes. As one example, IOZ works with collaborators in the Galapagos National Park service, University of Leeds and local NGO Concepto Azul, to identify and mitigate disease threats to the endemic fauna. IOZ research identified the anthropogenic transport of mosquitoes to the islands as an important threat to the archipelago's biodiversity (*Proc. R. Soc. B* **276:**3769, 2009), leading to significant changes in Park management and national regulations, such as prohibiting direct flights from other countries to Galapagos and mandatory disinsection of aircraft flying to the islands.

The complexity and scale of some conservation problems requires a concerted programme of research that involves multiple projects, often of an interdisciplinary nature. For example, the Bushmeat Research Programme (PWE Theme) has conducted 10 field projects in 6 different countries over the REF2014 reporting period. It is helping to elucidate the complex connections between poverty, livelihoods, and the bushmeat trade in Africa, and to identify the conditions that might lead to a sustainable trade reconciling conservation and development needs. The Programme is a source of advice to government and industry, helping to guide the development of a tropical timber-certification scheme in collaboration with Timbmet, the UK's largest timber importer, providing advice to The Cabinet Office and the Food Standards Agency on microbiological hazards associated with illegal importation of bushmeat, to the Foreign and Commonwealth Office in Ghana on the importance of the bushmeat trade to livelihoods and conservation, and to the Customs Analytical Team and the Criminal Investigation Service on the smuggling, identification, and financial value of bushmeat species. Dr Kemp runs a project on community responses to trawling impact in association with the Marine Stewardship Council, to investigate and quantify variation in the biodiversity and composition of the seafloor community of the west Greenland shelf, and the potential association of this variation with fishing activity. Results from this project are issued directly to government and industry bodies to inform marine management policy on the west Greenland shelf, and are of direct importance to reducing the environmental impact of an industry that generates 60% of Greenland's total export revenue.

We formally recognise the importance of key collaborators by making them Honorary Research Fellows. These fellowships are normally awarded to senior scientists in other organizations with whom we hold significant grants, or with whom we have collaborated successfully over an extended period, and expect to continue to do so. We also recognise the contribution of other scientists collaborating on research and teaching, and of visiting researchers, by designating them

as Honorary Research Associates. We currently have 11 HRFs and 3 HRAs.

Our on-going collaborations with research users inform both research activities and strategy: our Research Plan recognises that "our network of organisational links is fundamental to the effective implementation of the strategy." For example, IOZ supports and houses the Indicators and Assessments Unit (IAU), a collaboration between IOZ, ZSL Conservation Programmes, WWF and IUCN to research global indicators of the state of the natural world. It provides the science and much of the data underlying the IUCN Red List of Threatened Species, the IUCN Sampled Red List Index, and the WWF Living Planet Report, and hence informs key headline indicators for the Convention on Biological Diversity (CBD). It also provides the raw material for high impact scientific publications (e.g. *Science* **328**: 1164-1168). IAU was for many years entirely funded by external grants from research charities. However, the importance and success of this collaboration led to biodiversity indicators becoming a prime focus of IOZ research, and hence the core appointment of Dr Freeman to head IAU and apply his expertise in software engineering and hardware development to next generation indicators of biodiversity change.

IOZ staff are at the forefront of the conservation science community, as reflected by their leadership roles in relevant academic and professional bodies. For example, one third of IOZ research staff are members of IUCN committees and specialist groups, including the SSC Specialist Groups for Invasive Species (Blackburn), Conservation Breeding (Cunningham) Cetaceans (Jepson, Turvey), Wildlife Health (Cunningham, Jepson, Sainsbury), Reintroduction (Ewen), Small Mammals (Turvey: conservation co-ordinator), Asian Wild Cattle Saola Working Group (Turvey), Amphibians (Cunningham, Garner) and Mangroves (Pettorelli). As leaders of the Range Wide Conservation Program for Cheetah and Wild Dogs Durant and Woodroffe developed 3 IUCN/SSC regional conservation strategies (as well as 13 National conservation action plans). IOZ scientists were instrumental in the founding of the Wildlife Population Health subspecialty of the European College of Zoological Medicine, the first internationally recognised further qualification in this field. Cunningham is one of the founding Diplomates and the current Chair of the subspecialty; Jepson, Lawson, and Sainsbury have obtained de facto Diplomate status, and so IOZ currently has the largest number of WPH Veterinary Specialists of any organisation in Europe. Other professional bodies on which IOZ scientists have or currently serve include: the Council of the British Ecological Society (Blackburn); British Veterinary Zoological Society (Lawson); International Council for Exploration of the Sea (ICES) Groups on Marine Mammal Ecology (Jepson), Effects of Sound in the Marine Environment (Jepson), Marine Mammal Ecology (Murphy: Chair), and Advice Drafting Groups on Marine Mammals and Protected Species and Mammals (Murphy); New Zealand Department of Conservation Hihi Recovery Group (Ewen: Chair); Societas Europaea Herpetologica Conservation Committee (Garner); World Congress of Herpetology Executive (Garner); Scientific Advisory Committee for the International Foundation for Science (Rowcliffe); National Geographic's Big Cats Initiative committee (Durant); Committee on Earth Observation Systems (CEOS) steering committee member (Pettorelli); Expert Committee of the Board of Studies (Wildlife) of Kerala Veterinary Animal Science University (Sainsbury); Council of the British Veterinary Zoological Society (Lawson); Council of the European Wildlife Disease Association (Lawson); and Board of the South African DST-NRF Centre of Excellence in Invasion Biology (Blackburn). IOZ scientists were editors for 17 peer-reviewed journals in the REF2014 period (*Anim. Conserv., Biol. Rev., Comp. Math. Methods Med., Dis. Aquat. Organ., EcoHealth, Ecol. Appl. Emu, Endang. Sp. Res., Eur. J. Wildl. Res., Global Ecol. Biogeogr., Heredity, Int. J. Parasit., J. evol. Biol., J. Zool., NeoBiota, Proc. R. Soc. Lond. B., Sci. Rep., Wildl. Res).*

Other indicators of leadership for current staff include Honorary Professorships for Blackburn (Oxford, Birmingham, UCL), Cunningham (RVC, UCL, Universidad Andres Bello) and Woodroffe (Imperial); Adjunct Professorship at Laurentian University (Garner); Royal Society (Turvey), Marie Curie (Murphy), L'Oreal Women in Science (Pettorelli), and AXA (Brekke) Research Fellowships; Wolfson Research Merit Award (Cunningham), Honorary Senior Lecturership at the RVC (Sainsbury); Distinguished Scientist Research Fellowship at King Saud University (Blackburn); Honorary Research Associateship at the Centre of Excellence in Invasion Biology (Blackburn); Honorary Research Fellowship at Imperial College (Garner); ISI Highly Cited Scientist (Blackburn); judging panel for the 2012 Royal Society Winton Prize for Science Books (Turvey); advisor to the Darwin 200 evolution exhibition at Down House (Turvey); UK delegate member to the Scientific Committee of the International Whaling Commission (Murphy); OIE ad hoc Group on Amphibian Diseases (Cunningham); and UK Amphibian Health Advisory Committee (Cunningham, Garner).