SATELLITE MEETING ON

Taking a systems approach: defining the agenda for ecological forecasting

Wednesday 20 – Thursday 21 April 2011

The Kavli Royal Society International Centre, Chicheley Hall, Buckinghamshire

Organised by Professor Matthew Evans, Professor Tim Benton and Professor Ken Norris

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Taking a systems approach: defining the agenda for ecological forecasting
Wednesday 20 – Thursday 21 April 2011
The Kavli Royal Society Centre, Chicheley Hall, Buckinghamshire
Organised by Professor Matthew Evans, Professor Tim Benton and Professor Ken Norris

Day 1 – Wednesday 20 April 2011

09.00  Welcome by Professor Matthew Evans, Organiser

SESSION 1
Chair – Professor Georgina Mace, Imperial College London, UK

09.05  The need for ecological predictions to inform policy decisions
Professor Robert Watson, DEFRA, UK

09.35  Discussion

10.30  Coffee

11.00  Predicting the consequences of policy and technology change
Mr Paul Leonard, BASF SE, Belgium

11.30  Discussion

12.30  Lunch

SESSION 2
Chair – Dr Justin Travis, University of Aberdeen, UK

13.30  Conservation management for an uncertain future
Dr Mike Morecroft, Natural England, UK

14.00  Discussion

15.00  Tea

15.30  Can recurrent patterns of plant specialisation help summarizing ecosystem properties?
Professor Sandra Diaz, National University of Córdoba, Argentina

16.00  Discussion

17.00  End of day 1

18.30  Dinner
Day 2 – Thursday 21 April 2011

SESSION 3
Chair – Professor Stephen Emmott, Microsoft Research, UK

09.00 Global variation in the structure and function of ecosystems
Dr Drew Purves, Microsoft Research, UK

09.30 Discussion

10.30 Coffee

11.00 Analytical mathematical methods in ecology
Dr Stephen Cornell, University of Leeds, UK

11.30 Discussion

12.30 Lunch

SESSION 4
Chair – Dr Mike Bithell, University of Cambridge, UK

13.30 An empirical approach to eco-evolutionary complexity: a long-term experiment in Trinidadian streams
Dr Andrés López-Sepulcre, École Normale Supérieure de Paris/CNRS, France

14.00 Discussion

15.00 Tea

15.30 Harvest-induced life-history evolution in exploited fish populations: empirical evidence and forecasting of evolutionary changes and their demographic consequences
Dr Bruno Ernande, French Research Institute for Exploration of the Sea, France

16.00 Discussion

16.45 Overview and future directions

17.30 Close

18.30 Dinner
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Synopsis
Rigorous methods are required to enable robust predictions to be made about the future state of the biological world under conditions of environmental change. The development of robust process-based approaches to modelling ecological systems, to provide these predictions, will be a challenging task. A well-defined research agenda is required so that new approaches can be brought to bear, with some urgency, onto questions of societal need. Input is required from diverse communities to better understand the nature of the challenges and the types of questions both for which society needs answers and for which data exists to provide these answers.

Day 1 – Wednesday 20 April 2011

09.00  Welcome by Professor Matthew Evans, Organiser

SESSION 1
Chair – Professor Georgina Mace, Imperial College London, UK

09.05  The need for ecological predictions to inform policy decisions
Professor Robert Watson, DEFRA, UK

Biodiversity, ecosystems and their services are constantly changing due to demographic, economic, socio-political, technological and behavioural pressures, which influence the demand for goods and services and the management of natural resources. These pressures manifest themselves through changes in land-use, exploitation of natural resources, invasive species, air and water pollution and climate change. During the 21st Century significant changes in ecosystems services are projected, with potentially adverse effects on human well-being and economic prosperity. We need to use a range of techniques, including the use of plausible futures, to project changes in ecosystem state and ecosystem services, implications for human well-being, and the economy, and to assess whether some of stocks exhibit thresholds below which they rapidly deplete or collapse. Combining projections of changes in the flow of ecosystem services with valuation techniques will allow for informed decision making over a range of spatial and temporal scales. It is critical we quantify the benefits we derive from the full range of ecosystem services (those that have market and non-market values) because non-market values are rarely taken into account in economic decision-making, resulting in less efficient resource allocation. Policy decisions for now and the future must consider ecological predictions so that we can build on our successes in a sustainable way.

09.35  Discussion

10.30  Coffee
11.00  Predicting the consequences of policy and technology change
Mr Paul Leonard, BASF SE, Belgium

European Legislation sets out to secure high standards of human and environmental protection. The extent and sophistication of studies required to register a new plant protection product requires investment of 200€ million and often more, over a period of 7 to 10 years. The magnitude and complexity of these dossiers also places a proportionally heavy burden on regulatory authorities. When revising the Directive 91/414/EEC, the European Commission set out to increase efficiency by replacing scientific risk assessment with hazard-based regulatory exclusion criteria.

This fundamental shift, now enshrined in Regulation 1107/2009, may also result in unforeseen and unintended consequences for pest control, the environment and innovation. Examples include:

- Mandated use of non-chemical alternatives instead of chemical pesticides may result in replacement of technologies, where risks are known and mitigated, with practices and technologies where risks are unknown and unmitigated.
- The EU Commission’s proposed ban of biocides classified as persistent, bioaccumulative and toxic, could have resulted in removal of anticoagulant rodenticides from the market, without availability of suitable alternatives.
- With 65% of pesticides already removed from the European market, selection pressure placed on remaining actives has intensified to the point where emergency registrations are increasingly required.
- Investment in innovations which trigger regulatory hazard-based exclusion criteria will be terminated, even if safe use could be demonstrated.

This shift to more precautionary policy could increase the challenge of sustainable production of healthy and affordable food, at a time of rising food prices and escalating global demand.

11.30  Discussion

12.30  Lunch

SESSION 2
Chair – Dr Justin Travis, University of Aberdeen, UK

13.30  Conservation management for an uncertain future
Dr Mike Morecroft, Natural England, UK

Traditionally conservation has sought to restore degraded ecosystems to their former state and learned lessons from practical experience. Climate change and a cocktail of other anthropogenic pressures mean that the past is an unreliable basis for identifying future objectives and mechanisms to achieve them.

Good management in a time of change depends on a good understanding of ecological processes and modelling has a critical role to play in this. Models can also help us to explore future scenarios beyond past or present experience. Caution should however be exercised in interpreting model outputs and a robust appreciation of uncertainty should be encouraged as
part of a risk management approach. Comparison of model projections with empirical data also needs to be developed further.

If academic ecologists are to make a meaningful contribution to the development of conservation they need to understand the questions that practical conservationists ask and the way they work. The level of ecological understanding in the conservation community is high, but there are significant blocks to knowledge transfer between policy makers, practitioners and researchers. Academic publishing needs to be part of the solution but is, all too often, part of the problem.

14.00 Discussion

15.00 Tea

15.30 Can recurrent patterns of plant specialisation help summarizing ecosystem properties?
Professor Sandra Díaz, National University of Córdoba, Argentina

Are there recurrent functional trait syndromes underpinning the remarkable variety of living organisms? Can these be linked to the structure and dynamics of ecosystems? Do such links help understanding and predicting the responses of ecosystems - and the societal benefits derived from them - to different environmental drivers? I will address these questions by first presenting an overview of the field of plant functional traits. There is now convincing evidence of the existence of recurrent functional trait syndromes among plants, and new international databases offer the promise to put this to the test at the global scale. I will then link plant functional traits with new conceptual and methodological tools for the study of functional diversity. These tools allow empirical testing of the importance of functional trait composition and variety in determining ecosystem properties and the benefits that people derive from them in different contexts. Finally, I will discuss the potentials and limitations of using these links in predictive ecology.

16.00 Discussion

17.00 End of day 1

18.30 Dinner
Day 2 – Thursday 21 April 2011

SESSION 3
Chair – Professor Stephen Emmott, Microsoft Research, UK

09.00 Global variation in the structure and function of ecosystems
Dr Drew Purves, Microsoft Research, UK

This talk will give an overview of how and why the CEES group at Microsoft Research is trying to build a dynamic model of the world’s ecosystems. If successful this (first, draft) process-based model will accurately capture known patterns of variation in key ecosystem properties (eg how carbon storage, body size spectra of herbivores, carnivores and omnivores, vary across the globe), help to understand the underlying reasons for these patterns, and make useful predictions for how ecosystems might respond to anthropogenic perturbations. In our opinion, several relatively recent developments make it worth at least trying to build this kind of model, including what might be termed the emerging new synthesis in ecology (focussing primarily on the traits of individuals, rather than taxonomic identities), successful models developed for particular processes or parts of ecosystems (eg biogeochemical models, and size-structured models from fisheries and forestry), Bayesian statistics, increasing data availability, and fast computation. Trying to build a model of this kind would perhaps be a rather thankless task, if not for the fact that it necessarily touches on so many interesting topics in ecology, biogeochemistry, stoichiometry, physiology, biomechanics, ethology, and other, traditionally somewhat isolated, subdisciplines.

09.30 Discussion

10.30 Coffee

11.00 Analytical mathematical methods in ecology
Dr Stephen Cornell, University of Leeds, UK

Mathematical models have played a distinguished role in the genesis of classical ecological concepts. Unfortunately, exactly solvable models are typically too simple to be a faithful representation of any real ecological system. Modern computing power makes it straightforward to simulate models containing many biological processes, which can be realistic enough to be useful in many practical situations. However, it is not yet feasible to simulate every individual in an ecosystem in complete biological detail. I shall discuss the way in which mathematical approaches can play a complementary or synergistic role to computational models in ecology. Mathematical approaches can lead to deeper generic insights than computational studies, but can also help make predictions in specific situations. Mathematical techniques can sometimes deal economically with scenarios where simulation models struggle, such as very large numbers of individuals that interact over large spatial scales. Mathematical approaches such as perturbation methods can extend the results of exactly solvable models to much more realistic situations, and can quantify the importance of processes that might have been omitted from a model for computational expediency. They can also reduce the computational burden of simulation models by facilitating the development of efficient sub-models to replace explicit biological processes.

11.30 Discussion
12.30 Lunch

SESSION 4
Chair – Dr Mike Bithell, University of Cambridge, UK

13.30 An empirical approach to eco-evolutionary complexity: a long-term experiment in Trinidadian streams
Dr Andrés López-Sepulcre, École Normale Superiéure de Paris/CNRS, France

Eco-evolutionary feedbacks occur when evolving phenotypes affect the environment in ways that change selection pressures in return. They have attracted a large body of theory showing that ecological and evolutionary predictions can change drastically if their interdependence is ignored. In contrast, there exists little empirical work quantifying these feedbacks in real systems. As our first attempts move from the laboratory to nature, the structural complexity of the environment and the evolutionary process reveal themselves: environments are networks of ecological interactions selecting for ensembles of interdependent traits. Unravelling this web of interactions in nature represents a daunting yet necessary challenge. I will present an experimental system built around a replicated introduction of predation-adapted Trinidadian guppies into predator-free streams. Introduction has triggered rapid evolution of guppy life-histories and morphology, as well as ecosystem change. The study combines intensive individual-based data and the monitoring of environmental variables at all levels of organization. It also allows for regular mesocosm and common garden experiments on a subsample of the population to evaluate the nature of evolutionary change and ecosystem effects in controlled experiments. I will discuss progress and the development of appropriate tools to analyze such eco-evolutionary complexity.

14.00 Discussion

15.00 Tea

15.30 Harvest-induced life-history evolution in exploited fish populations: empirical evidence and forecasting of evolutionary changes and their demographic consequences
Dr Bruno Ernande, French Research Institute for Exploration of the Sea, France

Recent developments have highlighted that, in addition to its direct demographic consequences, fishing may induce evolution of life history traits in exploited stocks. These evolutionary changes come as an adaptive response of fish to changes in their mortality regime imposed by exploitation, a phenomenon to be expected given the strength of fishing pressure and the significant intra-population genetic variability of most life history traits. Exploitation is very often size-selective and life history traits related to size like age and size at maturation, somatic growth and reproductive effort are therefore especially prone to fisheries-induced evolution. Evolutionary changes in these traits lead to indirect demographic consequences of fishing that may mitigate or worsen their direct counterpart. After presenting briefly empirical evidence for fisheries-induced evolutionary changes in the maturation schedule of exploited fish populations, this talk will focus on three modelling studies that aim at predicting fisheries-induced evolutionary changes, their expected demographic consequences and possible mitigation measures: (i) a model of phenotypic life history evolution in exploited population will provide support to the hypothesis of fishing as a selective agent responsible for evolutionary changes and highlight their detrimental demographic consequences; (ii) a quantitative genetic model coupled with dynamic
programming will be used to predict rates of evolutionary changes in Northeast Arctic cod and analyze potential mitigation measures based on gear selectivity; and (iii) an individual-based model will allow to explore and predict the effect of fishing on neutral and adaptive genetic variability. Relying on different modelling approaches, deterministic vs. stochastic models, cohort-based vs. individual-based, phenotypic vs. genetic evolution, these three studies will also be used to highlight the disadvantages and benefits of various modelling frameworks.

16.00 Discussion

16.45 Overview and future directions

17.30 Close
Biographies

Professor Tim Benton, University of Leeds, UK (Organiser)
Professor Benton’s core research interests are in understanding how ecological systems respond to environmental change. Much of his work has revolved around in-depth understanding of how variation in the environment propagates through changes in individuals life-histories into changes in population and evolutionary dynamics. This has involved various types of modelling inspired by (and fitted to) empirical data generated by an empirical model system: a soil mite cultured in the laboratory. Ideas generated from this understanding have increasingly been transported to other systems, and most notably, Professor Benton has been involved in much research on understanding how the agricultural landscapes impact upon biodiversity and ecosystem services. The increasing pressure on food production systems, and therefore ecology, has driven a major interest in global food security and predicting how we can both produce food and conserve ecosystem services is a very active area for him. Professor Benton is currently Pro-Dean for Research in Biological Sciences at the University of Leeds and also the lead of the Africa College Partnership whose work is to aid the development of sustainable agriculture in sub-Saharan Africa.

Dr Mike Bithell, University of Cambridge, UK (Chair)
After a PhD in astronomy at the University of Cambridge, Dr Bithell worked on dynamics of the ozone hole and on exchange of ozone between stratosphere and troposphere at the Rutherford Appleton laboratory, before moving to the School of Geography at the University of Oxford to work on climate change and its human impacts. At present Dr Bithell is Assistant Director of Research in computing at the Department of Geography, University of Cambridge. Current research is based on computational techniques for the representation and analysis of systems consisting of interacting discrete components, including individual-based ecological and agent-based social systems models. The aim is to work toward understanding the interaction of environmental processes with human systems, and the adaptation of social dynamics to environmental change.

Dr Stephen Cornell, University of Leeds, UK (Speaker)
Stephen Cornell is a mathematical ecologist at the University of Leeds, who was once a statistical physicist but moved into population biology in 1998. He is interested in the way that demographic processes and interactions facilitate coexistence or invasions, and hence generate ecological patterns of abundance. He is particularly interested in the ability of mathematical, rather than computational, models to improve understanding of these processes and the phenomena that arise from them. He has applied such methods to understanding a wide variety of problems, including: the effect of landscape structure and dynamics on metapopulations; the tradeoff between food production and wildlife conservation; patterns of biodiversity in spatial ecology; intracellular dynamics of bacterial pathogens; the probability that sexually-reproducing parasites will cause an epidemic; and the genetics of drug resistance.
Professor Sandra Diaz, National University of Córdoba, Argentina (Speaker)
Sandra Diaz is Professor of Community and Ecosystems Ecology at Córdoba National University and Senior Principal Researcher of the National Research Council of Argentina. She is interested in plant functional traits, their interactions with global change drivers and their effects on ecosystem properties. She has had a strong influence in the development and practical implementation of the concept of functional diversity and how it affects ecosystem properties and the benefits that people derive from them. She was elected Foreign Associate Member of the USA National Academy of Sciences in 2009, and Member of the Academies of Sciences of the Developing World (TWAS) and of Argentina in 2010. She was awarded the Argentine Botanical Society Prize (1998), the J S Guggenheim Fellowship (2002), the Cozzarelli Prize of the USA National Academy of Sciences (2008), and the Sustainability Science Award of the Ecological Society of America (2009). She participated in the Millennium Ecosystem Assessment and the IPCC. She is a member of the Science Committee of the international programme on biodiversity science DIVERSITAS, and the founder and director of the international initiative Núcleo DiverSus on Diversity and Sustainability.

Professor Stephen Emmott, Microsoft Research, UK (Chair)
Stephen Emmott is Head of Computational Science at Microsoft Research, Professor of Computational Science at the University of Oxford and Visiting Professor of Intelligent Systems at University College London. He began his research in Neuroscience and biological computation with Roger Watt at Stirling University, and as a Post-Doctoral Fellow at Bell Laboratories in the USA. At the age of 36 he went on to establish and lead as Chief Scientist, NCR’s Advanced Research Lab. In 2004 Stephen joined Microsoft where he established and leads its scientific research into novel computational methods to tackle fundamental problems in science. In parallel, he established Microsoft’s European PhD Scholarship programme and Post-Doctoral Fellowship programme to support the education and development of scientists. In 2004 Stephen was appointed to the UK Government’s 10 Year Science & Innovation Strategy Committee, and in 2005 was appointed as scientific advisor to the Chancellor of the Exchequer. In 2009 he was appointed by the UK Science Minister as a Trustee of The National Endowment for Science, Technology and the Arts.

Dr Bruno Ernande, French Research Institute for Exploration of the Sea, France (Speaker)
Bruno Ernande is scientific coordinator of the Channel and North Sea Fisheries Department from the French Research Institute for Exploration of the Sea (IFREMER, Boulogne-sur-Mer, France) and research affiliate in the Evolution and Ecology Program at the International Institute for Applied Systems Analysis (IIASA, Laxenburg, Austria). He holds an MSc in Ecology (1997) from the Ecole Normale Supérieure and the University Pierre et Marie-Curie (Paris, France) and a PhD in Evolutionary Ecology (2001) from the University of La Rochelle (France) for his work on the genetics and the evolution of phenotypic plasticity. He was appointed as lecturer and teaching assistant at the University of La Rochelle from 1998 to 2001 and then as post-doctoral fellow in the Evolution and Ecology Program at IIASA. He joined IFREMER as research scientist in 2004.

Dr Ernande’s research interests are in marine ecology, fish and molluscs’ evolutionary ecology and life history, fisheries-induced evolution, fish habitats, marine food webs, predator-prey interactions, aquaculture and fisheries. His work combines both empirical and modelling studies in the fields of population and quantitative genetics, bioenergetics, life history theory, population dynamics and evolutionary dynamics. He serves as French representative in the ICES (International Council for the Exploration of the Sea) Working Group on the Application of Genetics in Fisheries and Mariculture (WGAGFM) and the ICES Working Group on Fisheries-Induced evolution (WGEVO) and is an editorial board member of the journal OIKOS.
**Professor Matthew Evans, University of Exeter, UK (Organiser)**
Matthew Evans is Professor of Behavioural Ecology at the University of Exeter’s Cornwall Campus. Research interests are now in mainly in conservation and in particular in understanding how we can predict the impact of environmental change on the natural world. This represents a considerable shift from an early interest in mate choice and sexual selection, which included the first theoretical and empirical examinations of the aerodynamics of birds’ tails and the first experimental investigations of the effects of endocrine hormones on the immune system and on signalling traits. Matthew was a founder member of the School of Biosciences on Exeter’s Cornwall Campus and the Director of the Centre of Ecology and Conservation until 2007, and was Provost of the Campus until 2009.

**Mr Paul Leonard, BASF SE, Belgium (Speaker)**
After graduating in Zoology from the University of Bristol, Paul Leonard moved to London University's Imperial College of Science and Technology, where he was awarded an MSc in Applied Entomology. In 2004 he was awarded an MBA by the Open University Business School.

In 1994, Paul was hired by Dow Chemical Company, where he worked as a research entomologist for ten years. He Chaired the Insecticide Resistance Action Committee (IRAC), from 1993 to 1996.

In 1994, he moved to American Cyanamid in Belgium, as European Insecticide Technical Manager. In 1999, he was appointed Director Regulatory Affairs for the European Middle East and African Region.

In 2000, American Cyanamid was purchased by BASF, after which he set up a new "Alliance Management" regulatory function.

In 2008, Paul transferred to BASF’s Communications and Government Relations Team, to represent the company’s Agricultural Products Division in Brussels. In same year, he was also elected to the board of directors of Rothamsted Research.

In 2009 he was elected to the Board of Directors of the British Chamber of Commerce in Belgium, where he also chairs the Food Security Safety and Sustainability Task Force.

**Dr Andrés López-Sepulcre, École Normale Superiéure de Paris/CNRS, France (Speaker)**
Dr López-Sepulcre dedicates his research to the investigation of eco-evolutionary feedbacks. He makes particular emphasis in the integration of theoretical models, short-term experiments and the analysis of long-term data. After a BSc at the Universities of Barcelona and Glasgow, he obtained his PhD in 2007 at the Universities of Jyväskylä and Helsinki. He investigated the links between demography and the evolution of behaviour, using adaptive dynamics models and the Seychelles Magpie Robin as a case study. A postdoc at the University of California, Riverside extended his view of eco-evolutionary feedbacks the explicit consideration of multivariate life histories evolving in complex ecosystems. For that, he and his colleagues developed a research program in Trinidadian streams, taking advantage of the rapid evolution of guppy life-histories and their effects on their stream ecosystem. Such integrative project, which integrates demography, evolutionary biology and ecosystem science, is ongoing and represents a high proportion of his research efforts. He is currently a CNRS researcher at the École Normale Superiéure in Paris and a visiting scholar at the University of Arizona.
Professor Georgina Mace, Imperial College London, UK (Chair)
Georgina Mace is Professor of Conservation Science at Imperial College London. Her research interests are in measuring the trends and consequences of biodiversity loss and the assessment of species extinctions. She led the process to develop, test and document criteria for listing species on IUCN’s Red List of threatened species, and subsequently worked on the biodiversity elements of the Millennium Ecosystem Assessment and on the technical development of measures for the CBD 2010 biodiversity target. From 2000 to 2006 she was Director of Science at the Zoological Society of London and Head of the Institute of Zoology. In 2006 she moved to Imperial College London as Director of the NERC Centre for Population Biology. She was awarded a CBE in 2007, elected FRS in 2002, and was the 2007 winner of the international Cosmos prize. She has been Vice President of the British Ecological Society (2001-2004), President of the Society for Conservation Biology (2007-2009) and Vice Chair of the international programme on biodiversity science DIVERSITAS (2007-2010).

Dr Mike Morecroft, Natural England, UK (Speaker)
Mike Morecroft is Head of Climate Change at Natural England, the government conservation agency for England. His job is to develop the evidence base for climate change adaptation and mitigation and apply it to practical nature conservation. Mike is an ecologist and has published widely on climate change and related issues, including on forest carbon cycle processes and the monitoring of long-term change in ecosystems. Before joining Natural England in 2009, he led a research group at the Centre for Ecology and Hydrology at Wallingford, having worked with CEH and its predecessor, the Institute of Terrestrial Ecology, since 1992. He is a Senior Visiting Research Associate at Oxford University and a trustee of the Ecological Continuity Trust.

Professor Ken Norris, University of Reading, UK (Organiser)
Ken Norris is Professor of Agro-ecology and Director of the Centre for Agri-Environmental Research (CAER) at the University of Reading. He works on biodiversity and ecosystem services in a changing environment, particularly in relation to changes in land-use and management. His work focuses on developing novel approaches to assessing the biodiversity impacts of environmental change, assessing the functional role of biodiversity in agro-ecosystems and linking these functions to the values and benefits people experience. He also leads NERC’s Biodiversity Theme.

Dr Drew Purves, Microsoft Research, UK (Speaker)
Drew Purves is the head of the Computational Ecology and Environmental Science Group (CEES) at Microsoft Research, Cambridge, UK. Before taking up this position Drew studied ecology at Cambridge University, did a PhD in ecological modelling at the University of York (UK, working under Professor Richard Law), and spent nearly 6 years as a postdoc in the EEB Department at Princeton University (working under Professor Stephen Pacala). Drew’s research, which mainly focuses on the dynamics of populations and communities of plants, especially forests, has led to over 20 publications in peer-reviewed journals including Science, PNAS, Proc Roy Soc B, Global Change Biology, Ecology, Ecological Monographs and Ecology Letters. Drew co-supervises several PhD students at European universities and since 2008 has been an affiliate lecturer at Cambridge University.
Dr Justin Travis, University of Aberdeen, UK (Chair)

Justin Travis is a theoretical biologist at the University of Aberdeen. Most of his research uses individual-based models to study the population and evolutionary dynamics of spatially structured populations. During a PhD at Imperial College and in a postdoc at Lund, his work focused on understanding the evolution of dispersal. He then moved to Scotland and worked within the Centre for Research in Ecological and Environmental Modelling at St Andrews and subsequently at the Centre for Ecology and Hydrology at Banchory before moving to Aberdeen in 2006. More recent and current work includes developing models of invasions that incorporate increased biological and environmental detail such as genetics and habitat variability, understanding the dynamics of populations living at biogeographic range margins and developing theory on the evolutionary ecology of longevity. He is also increasingly interested in exploring the potential benefits to be gained from combining the use of mathematical and simulation approaches rather than viewing them as alternative, or competing, methodologies.

Professor Robert Watson, DEFRA, UK (Speaker)

Professor Watson’s career has evolved from research scientist at the Jet Propulsion Laboratory: California Institute of Technology, to a US Federal Government programs manager/director at the National Aeronautics and Space Administration (NASA), to a scientific/policy advisor in the US Office of Science and Technology Policy (OSTP), White House, to a scientific advisor, manager and chief scientist at the World Bank, to a Chair of Environmental Sciences at the University of East Anglia, the Director for Strategic Direction for the Tyndall centre, and Chief Scientific Advisor to the UK Department for Environment, Food and Rural Affairs. In parallel to his formal positions he has chaired, co-chaired or directed international scientific, technical and economic assessments of stratospheric ozone depletion, biodiversity/ecosystems (the GBA and MA), climate change (IPCC) and agricultural S&T (IAASTD). Professor Watson’s areas of expertise include managing and coordinating national and international environmental programmes, research programmes and assessments; establishing science and environmental policies - specifically advising governments and civil society on the policy implications of scientific information and policy options for action; and communicating scientific, technical and economic information to policymakers. During the last twenty years he has received numerous national and international awards recognising his contributions to science and the science-policy interface, including in 2003 - Honorary “Companion of the Order of Saint Michael and Saint George“ from the United Kingdom.